CASE NUMBER:

99-299

INDEX FOR CASE: 99-299
KENTUCKY-AMERICAN WATER COMPANY
Construct
ADDITIONAL RESIDUALS PROCESSING FACILITIES

IN THE MATTER OF THE APPLICATION OF KENTUCKY-AMERICAN WATER COMPANY FOR A CERTIFICATE OF CONVNIENCE AND NECESSITY AUTHORIZING THE CONSTRUCTION OF ADDITIONAL RESIDUALS PROCESSING FACILITIES AT THE KENTUCKY RIVER STATION

SEQ NBR	ENTRY DATE	REMARKS
0001	07/09/99	Application.
0002	07/14/99	Acknowledgement letter.
0003	07/27/99	Def. letter, info due 8/11
M0001	08/12/99	LINDSEY INGRAM KY AMERICAN WATER-AMENDED APPLICATION
0004	09/15/99	FINAL ORDER GRANTING CONSTRUCTION

COMMONWEALTH OF KENTUCKY
PUBLIC SERVICE COMMISSION
730 SCHENKEL LANE
POST OFFICE BOX 615
FRANKFORT, KY. 40602
(502) 564-3940

CERTIFICATE OF SERVICE

RE: Case No. 99-299
KENTUCKY-AMERICAN WATER COMPANY

I, Stephanie Bell, Secretary of the Public Service Commission, hereby certify that the enclosed attested copy of the Commission's Order in the above case was served upon the following by U.S. Mail on September 15, 1999.

Parties of Record:

Honorable Herbert A. Miller
Kentucky-American Water Company
2300 Richmond Road
Lexington, KY. 40502

Honorable Lindsey Ingram,
Attorney at Law
Stoll, Keenon & Park, LLP
201 East Main Street
Suite 1000
Lexington, KY. 40507 1380

Stephanie D. Bell

Secretary of the Commission

SB/sa
Enclosure

COMMONWEALTH OF KENTUCKY

BEFORE THE PUBLIC SERVICE COMMISSION

In the Matter of:

THE APPLICATION OF KENTUCKY-AMERICAN WATER COMPANY FOR A CERTIFICATE OF CONVENIENCE AND NECESSITY AUTHORIZING THE CONSTRUCTION OF ADDITIONAL RESIDUALS PROCESSING FACILITIES AT THE KENTUCKY RIVER STATION	))))))	CASE NO. 99-299

O R D E R

By application filed August 12, 1999, Kentucky-American Water Company ("Kentucky-American") is seeking authorization to construct a $4,102,967 waterworks improvement project. Project funding includes $4,102,967 in Kentucky-American funds and short-term notes. The proposed project includes the construction of a new mechanical dewatering building containing two 2.8 meter belt filter presses, a polymer system, gravity thickeners, wash water waste and solids feed pumps, and related appurtenances. The existing four sludge lagoons are no longer sufficient to properly handle the quantity of residuals generated due to the inadequate storage time for drying. Plans and specification for the proposed improvement prepared by Montgomery Watson Americas, Inc. of Cleveland, Ohio, have been approved by the Division of Water of the Natural Resources and Environmental Protection Cabinet.

Having reviewed the application and being otherwise sufficiently advised, the Commission finds that:

1. The proposed construction consists of the construction of a new mechanical dewatering building containing two 2.8 meter belt filter presses, a polymer system, gravity thickeners, wash water waste and solids feed pumps, and related appurtenances. The total construction cost for this project is approximately $4,102,967.

2. The Division of Waste Management, Department for Environmental Protection, Natural Resources and Environmental Protection Cabinet of the Commonwealth of Kentucky has required that the concentration of solids in the residuals be increased to at least 20 percent before beneficial reuse. Adequate space is not available to expand the existing lagoon system to accomplish this requirement. Under the circumstances, the proposed construction is a reasonable alternative to increase the concentration of solids in the residuals to the at least 20 percent level.

3. Kentucky-American should obtain approval from the Commission prior to performing any additional construction not expressly authorized by this Order.

4. Any deviation from the construction approved should be undertaken only with the prior approval of the Commission.

5. Kentucky-American should furnish documentation of the total costs of this project including the cost of construction and all other capitalized costs (engineering, legal, administrative, etc.) within 60 days of the date that construction is substantially completed. Construction costs should be classified into appropriate plant accounts in accordance with the Uniform System of Accounts for Water Utilities prescribed by the Commission.

6. Kentucky-American should require construction to be inspected under the general supervision of a professional engineer with the Kentucky registration in civil or mechanical engineering, to ensure that the construction work is done in accordance with the contract drawing and specifications and in conformance with the best practices of the construction trades involved in the project.

7. Kentucky-American should file a copy of the "as-built" drawings and a certified statement that the construction has been satisfactorily completed in accordance with the contract plans and specifications with 60 days of the substantial completion of the construction certificated herein.

8. Kentucky-American proposes to finance the proposed waterworks project with $4,102,967 in Kentucky-American funds and short-term notes.

IT IS THEREFORE ORDERED that:

1. Kentucky-American is granted a Certificate of Public Convenience and Necessity for the proposed construction project.

2. Kentucky-American shall comply with the requirements contained in Findings 3 through 7 as if the same were individually so ordered.

Done at Frankfort, Kentucky, this 15th day of September, 1999.

By the Commission

ATTEST:

Executive Director

STOLL, KEENON & PARK, LLP

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SUITE 1000
LEXINGTON, KENTUCKY 40507-1380

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August 12, 1999

Ms. Stephanie Bell
Public Service Commission
730 Schenkel Lane
Frankfort, Kentucky 40601

Via Hand Delivery

RE: Case No. 99-299

Dear Stephanie:

I deliver herewith for filing the Amended Application of Kentucky-American Water Company in Case No. 99-299.

This Amended Application is in response to your letter of July 27, 1999, and it has attached, as Exhibit D, the approval of the Division of Water of the sanitary features of the project.

The Amended Application also has attached a reduced copy of page 1 of the plans showing compliance with KRS 322.340. I also deliver herewith one set of the plans with every page conforming to the requirements of KRS 322.340.

As I requested in my letter to Helen Helton dated July 9, 1999, would you please attempt to secure an expedited review of this Application and its amendment.

Very truly yours,

STOLL, KEENON & PARK, LLP

By Lindsey
Lindsey Ingram, Jr.

/sl
Encs.

312\C:\Work\LWI\KAWC\Residuals\686bell.ltr

COMMONWEALTH OF KENTUCKY
BEFORE THE PUBLIC SERVICE COMMISSION

IN THE MATTER OF:

APPLICATION OF KENTUCKY-AMERICAN WATER COMPANY FOR A CERTIFICATE OF CONVENIENCE AND NECESSITY AUTHORIZING THE CONSTRUCTION OF ADDITIONAL RESIDUAL PROCESSING FACILITIES AT THE KENTUCKY RIVER STATION	))))))	CASE NO. 99-299

AMENDED APPLICATION

Comes Kentucky-Water Company, by counsel, and for its Amended Application to the Public Service Commission for a Certificate of Convenience and Necessity authorizing the construction of additional residual processing facilities at the Kentucky River Station states as follows:

13. That by letter dated August 5, 1999, the Division of Water, Drinking Water Branch, Department for Environmental Protection, Natural Resources and Environmental Protection Cabinet of the Commonwealth of Kentucky, approved the plans and specifications for the additional residual processing facilities to be constructed by Kentucky-American Water Company at its Kentucky River Treatment Plant. A copy of the approval dated August 5, 1999, is attached hereto and marked Exhibit D.

14. That on June 18, 1999, Richard G. Atoulikian, a registered professional engineer in the Commonwealth of Kentucky, certified the plans for the additional residual processing facilities of Kentucky-American Water Company to be constructed at the Kentucky River Station by affixing

his signature and seal thereon. A reduced, photostatic copy of the first page of the plans for the additional residual processing facilities so stamped, dated and signed is attached hereto and marked Exhibit E.

15. That it amends so much of numerical paragraph 9 in its original Application that estimated the cost of construction of the additional residual processing facilities to be $4,900,000. Based upon bids received by Kentucky-American Water Company it estimates that the cost of construction of the additional residual processing facilities will be $4,102,967.

WHEREFORE, Kentucky-American Water Company prays that this be accepted as its Amended Application, that it be authorized pursuant to KRS 278.020(1) and 807 KAR 5:001, Section 9 (2), to construct the residual processing facilities as delineated in the exhibits attached to the original Application hereto.

HERBERT A. MILLER, JR., ESQ.
Kentucky-American Water Company
2300 Richmond Road
Lexington, Kentucky 40502

and

STOLL, KEENON & PARK, LLP
201 East Main Street, Suite 1000
Lexington, Kentucky 40507-1380
Telephone: (606) 231-3000

BY: _____
Lindsey Ingram, Jr.

312\C:\Work\LWI\KAWC\Residuals\686amended.app

JAMES E. BICKFORD
SECRETARY

PAUL E. PATTON
GOVERNOR

COMMONWEALTH OF KENTUCKY
NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION CABINET
DEPARTMENT FOR ENVIRONMENTAL PROTECTION
FRANKFORT OFFICE PARK
14 REILLY RD
FRANKFORT KY 40601

August 5, 1999

Kentucky-American Water Company
ATTN: John A. Hill, Jr, PE
2300 Richmond Road
Lexington, Kentucky 40502

RE: DW #0340250-99-070
Water Plant Improvements
KY River Station Add'l
Residual Processing Fac.
KY-American Water Co.

Dear Sirs:

This is to advise that plans and specifications covering the above referenced subject are APPROVED with respect to sanitary features of design as of this date. This approval is in accordance with the standard specifications as covered in our letter to the Kentucky-American Water Company dated January 27, 1999.

This approval has been issued under the provisions of KRS Chapter 224 and regulations promulgated pursuant thereto. Issuance of this approval does not relieve the applicant from the responsibility of obtaining any other approvals, permits or licenses required by this Cabinet and other state, federal and local agencies.

Unless construction of this project is begun within one year from the date of approval, the approval shall expire. If you have any questions concerning this project, please contact Jim Hamon, PE at 502/564-2225, extension 637.

Sincerely,

Vicki L. Ray

Vicki L. Ray, Branch Manager
Drinking Water Branch
Division of Water

VLR:JEH:lm

Enclosures

EXHIBIT D

C: Montgomery Watson
Lexington-Fayette County Health Department
Public Service Commission
Frankfort Regional Office
Drinking Water Files

KENTUCKY-AMERICAN WATER COMPANY
LEXINGTON, KENTUCKY

KENTUCKY RIVER STATION
ADDITIONAL RESIDUAL PROCESSING FACILITIES

JUNE 1999

DRAWING FILE NO. 380-575

LIST OF DRAWINGS

GENERAL

-001 TITLE SHEET/LIST OF DRAWINGS
-002 GENERAL SYMBOLS AND NOTES
-003 GENERAL ABBREVIATIONS
-004 PIPING SCHEDULE
-005 PROCESS AND EQUIPMENT ABBREVIATIONS

SITE

-006 EXISTING PARTIAL SITE PLAN
-007 PARTIAL SITE PLAN
-008 MISCELLANEOUS DETAILS
-009 MISCELLANEOUS DETAILS

DEMOLITION

-010 WASHWATER WASTE HOLDING TANKS (1 OF 2)
-011 WASHWATER WASTE HOLDING TANKS (2 OF 2)

STRUCTURAL

-012 GENERAL NOTES AND ABBREVIATIONS
-013 GRAVITY THICKENERS
-014 DEWATERING BUILDING FOUNDATION
-015 DEWATERING BULDING FLOOR PLAN AND DETAILS
-016 DEWATERING BUILDING ROOF PLAN
-017 DEWATERING BUILDING SECTIONS
-018 DEWATERING BUILDING PLANS AND SECTIONS
-019 LAGOON SUPERNATANT VAULT
-020 MISCELLANEOUS DETAILS
-021 MISCELLANEOUS DETAILS
-022 MISCELLANEOUS DETAILS
-023 MISCELLANEOUS DETAILS

ARCHITECTURAL

-024 DEWATERING BUILDING FLOOR PLAN
-025 DEWATERING BUILDING ROOF PLAN
-026 DEWATERING BUILDING ELEVATIONS
-027 DEWATERING BUILDING ELEVATIONS
-028 DEWATERING BUILDING WALL SECTIONS
-029 SCHEDULES AND DETAILS

MECHANICAL

-030 EQUIPMENT AND VALVE SCHEDULE
-031 OVERALL RESIDUAL SOLIDS SYSTEM
-032 TYPICAL VALVE HOUSE DRAIN LINE
-033 TYPICAL VALVE HOUSE FLUSHING LINE
-034 DEMOLITION/NEW SLUDGE WELL PLAN AND SECTION
-035 GRAVITY THICKENERS (1 OF 2)
-036 GRAVITY THICKENERS (2 OF 2)
-037 DEWATERING BUILDING PLAN AT EL. 888.50
-038 DEWATERING BUILDING PLAN AT EL. 907.83
-039 DEWATERING BUILDING SECTIONS
-040 DEWATERING BUILDING DETAILS
-041 LAGOON IMPROVEMENTS
-042 LAGOON SUPERNATANT VAULT No. 2
-043 MISCELLANEOUS DETAILS
-044 MISCELLANEOUS DETAILS

HVAC/PLUMBING

-045 DEWATERING BUILDING PLAN AND ABBREVIATIONS
-046 DEWATERING BUILDING SECTIONS AND DETAILS

INSTRUMENTATION

-047 LEGENDS, SYMBOLS AND ABBREVIATIONS
-048 VALVE HOUSE 1 OF 5 P&ID
-049 VALVE HOUSE 2 OF 5 P&ID
-050 VALVE HOUSE 3 OF 5 P&ID
-051 VALVE HOUSE 4 OF 5 P&ID
-052 VALVE HOUSE 5 OF 5 P&ID
-053 SLUDGE WELL P&ID
-054 LAGOON SYSTEM P&ID
-055 GRAVITY THICKENER NO. 1 P&ID
-056 GRAVITY THICKENER NO. 2 P&ID
-057 THICKENED SLUDGE FEED SYSTEM P&ID
-058 BELT FILTER PRESS SYSTEM P&ID
-059 LAGOON SUPERNATANT VAULT P&ID
-060 BFP POLYMER FEED SYSTEM P&ID
-061 GT AND WWW POLYMER FEED SYSTEM P&ID
-062 GRAVITY THICKENER PBS P&ID
-063 WASHWATER WASTE PBS P&ID
-064 RTU DEWATERING BLDG. (NEW) - (1 OF 2)
-065 RTU DEWATERING BLDG. (NEW) - (2 OF 2)
-066 RTU B DPC 3330 (EXIST) - (1 OF 4)
-067 RTU B DPC 3330 (EXIST) - (2 OF 4)
-068 RTU B RIO 3331 (EXIST) - (3 OF 4)
-069 RTU B RIO 3331 (EXIST) - (4 OF 4)
-070 RTU VALVE HOUSE NO. 1 (EXIST)
-071 RTU VALVE HOUSE NO. 2 (EXIST)
-072 RTU VALVE HOUSE NO. 3 (EXIST)
-073 RTU VALVE HOUSE NO. 4 (EXIST)
-074 RTU VALVE HOUSE NO. 5 (EXIST)

ELECTRICAL

-075 GENERAL SYMBOLS AND NOTES I
-076 GENERAL SYMBOLS AND NOTES II
-077 STANDARD DETAILS
-078 EXISTING PARTIAL ONE-LINES
-079 REVISED PARTIAL ONE-LINES
-080 ONE-LINE - UNIT SUBSTATION
-081 MCC-1 ONE-LINE, LAYOUT AND SCHEDULE
-082 MCC-2 ONE-LINE, LAYOUT AND SCHEDULE
-083 LIGHTING & POWER PANEL SCHEDULES I
-084 ELEMENTARY SCHEMATICS I
-085 ELEMENTARY SCHEMATICS II
-086 ELEMENTARY SCHEMATICS III
-087 ELEMENTARY SCHEMATICS IV
-088 ELEMENTARY SCHEMATICS V
-089 SITE PLAN AND DUCT SECTIONS
-090 DEWATERING BUILDING PLAN AT EL. 907.83
-091 DEWATERING BUILDING PLAN AT EL. 888.50
-092 DEWATERING BUILDING LIGHTING PLAN
-093 GRAVITY THICKENERS PLAN
-094 VAULT PLANS
-095 CONDUIT DEVELOPMENT I
-096 CONDUIT DEVELOPMENT II
-097 CONDUIT DEVELOPMENT III
-098 CONDUIT DEVELOPMENT IV
-099 CONDUIT SCHEDULE I
-100 CONDUIT SCHEDULE II
-101 CONDUIT SCHEDULE III
-102 CONDUIT SCHEDULE IV
-103 CONDUIT SCHEDULE V

MONTGOMERY WATSON
CLEVELAND, OHIO

STATE OF KENTUCKY
RICHARD G. ATOULIKIAN
19947
REGISTERED
PROFESSIONAL ENGINEER

Richard C. Atoulikian
RICHARD G. ATOULIKIAN
REGISTERED PROFESSIONAL ENGINEER IN STATE OF KENTUCKY, LICENSE NO. 19947

EXHIBIT E

COMMONWEALTH OF KENTUCKY
PUBLIC SERVICE COMMISSION
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Paul E. Patton
Governor

Ronald B. McCloud, Secretary
Public Protection and
Regulation Cabinet

Helen Helton
Executive Director
Public Service Commission

July 27, 1999

Honorable Herbert A. Miller
Kentucky-American Water Company
2300 Richmond Road
Lexington, KY 40502

Honorable Lindsey Ingram
Attorney at Law
Stoll, Keenon & Park, LLP
201 East Main Street
Suite 1000
Lexington, KY 40507-1380

Re: Case No. 99-299
Filing Deficiencies

Gentlemen:

The Commission staff has conducted an initial review of your filing in the above case. This filing is rejected pursuant to 807 KAR 5:001, Section 2, as it is deficient in certain filing requirements. The items listed below are either required to be filed with the application or must be referenced if they are already on file in another case or will be filed at a later date.

Filing deficiencies pursuant to 807 KAR 5:001:

1) Section 9(2)(b): Copies of franchises or permits, if any, from the proper public authority for the proposed new construction or extension, if not previously filed with the commission.

2) KRS 322.340: At least on copy of preliminary and final engineering report is signed, sealed, and dated by registered professional engineer.

The statutory time period in which the Commission must process this case will not commence until the above-mentioned information is filed with the Commission. You are requested to file 10 copies of this information within 15 days of the date of this letter. If you need further information, please contact James Rice of my staff at (502) 564-3940, ext. 411.

Sincerely,

Stephanie Bell

Stephanie Bell
Secretary of the Commission

sa

COMMONWEALTH OF KENTUCKY
PUBLIC SERVICE COMMISSION
730 SCHENKEL LANE
POST OFFICE BOX 615
FRANKFORT, KY. 40602
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July 14, 1999

Honorable Herbert A. Miller
Kentucky-American Water Company
2300 Richmond Road
Lexington, KY. 40502

Honorable Lindsey Ingram
Attorney at Law
Stoll, Keenon & Park, LLP
201 East Main Street
Suite 1000
Lexington, KY. 40507 1380

RE: Case No. 99-299
KENTUCKY-AMERICAN WATER COMPANY
(Construct) ADDITIONAL RESIDUALS PROCESSING FACILITIES

This letter is to acknowledge receipt of initial application in the above case. The application was date-stamped received July 9, 1999 and has been assigned Case No. 99-299. In all future correspondence or filings in connection with this case, please reference the above case number.

If you need further assistance, please contact my staff at 502/564-3940.

Sincerely,

Stephanie Bell
Secretary of the Commission

SB/jc

STOLL, KEENON & PARK, LLP

ROBERT F. HOULIHAN
LESLIE W. MORRIS II
LINDSEY W. INGRAM, JR.
WILLIAM L. MONTAGUE
JOHN STANLEY HOFFMAN**
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WALLACE MUIR (1878 - 1947)
RICHARD C. STOLL (1878 - 1949)
WILLIAM H. TOWNSEND (1890 - 1964)
RODMAN W. KEENON (1882 - 1966)
JAMES PARK (1892 - 1970)
JOHN L. DAVIS (1913 - 1970)
GLADNEY HARVILLE (1921 - 1978)
GAYLE A. MOHNEY (1906 - 1980)
C. WILLIAM SWINFORD (1921 - 1986)

RECEIVED
JUL - 9 1999
PUBLIC SERVICE COMMISSION

July 9, 1999

Via Hand Delivery

Helen C. Helton, Esq.
Public Service Commission
730 Schenkel Lane
Frankfort, Kentucky 40601

CASE 99-299

RE: Kentucky-American Water Company - Application for a Certificate of Convenience and Necessity Authorizing the Construction of Additional Residuals Processing Facilities at the Kentucky River Treatment Plant

Dear Helen:

The original and eight (8) copies of the above indicated Application of Kentucky-American Water Company are delivered herewith for filing.

Because of the voluminous nature of the exhibits only the original and three copies have exhibits attached to them.

Kentucky-American Water Company will receive bids on this project on July 20. As soon as the successful bidder is selected I will amend the Application to provide the cost of construction of the facilities. We also expect to receive approval from the Division of Water about the same time.

I am filing the Application at this time with the hope that staff review can be instituted before the final cost is known. Kentucky-American needs an expedited review of this Application in order

that as much outside construction as possible can be accomplished prior to winter weather. We would appreciate whatever assistance can be given to expedite the review.

Very truly yours,

STOLL, KEENON & PARK, LLP

By Lindsey
Lindsey Ingram, Jr.

/sl
Encs.
312\C:\Work\LWI\KAWC\GENERAL\685helton.ltr

COMMONWEALTH OF KENTUCKY
BEFORE THE PUBLIC SERVICE COMMISSION

IN THE MATTER OF:

APPLICATION OF KENTUCKY-AMERICAN WATER COMPANY FOR A CERTIFICATE OF CONVENIENCE AND NECESSITY AUTHORIZING THE CONSTRUCTION OF ADDITIONAL RESIDUALS PROCESSING FACILITIES AT THE KENTUCKY RIVER STATION	))))))	CASE NO.: 99-299

Comes Kentucky-Water Company, by counsel, and for its Application to the Public Service Commission for a Certificate of Convenience and Necessity authorizing the construction of additional residuals processing facilities at the Kentucky River Station states as follows:

1. Kentucky-American Water Company ("Kentucky-American") is a corporation organized and existing under the laws of the Commonwealth of Kentucky with its principal office and place of business at 2300 Richmond Road, Lexington, Fayette County, Kentucky. It is engaged in the distribution and sale of water in the City of Lexington, Kentucky, and other areas of Fayette County, Kentucky. It also provides direct potable water service to customers in Woodford, Scott, Harrison, Clark and Bourbon Counties along with service to a water district and a water company with mailing addresses in Jessamine County, Kentucky.

2. Kentucky-American is a corporation and a certified copy of its Articles of Incorporation, together with all amendments thereto, are incorporated herein by reference as authorized by 807 KAR 5:001, Section 8 (3), and were filed as filing Exhibit No. 4 in Case No. 95-

554, Notice of Adjustment of the Rates of Kentucky-American Water Company Effective On and After February 29, 1996.

3. Kentucky-American's production facilities consists of two treatment plants known as the Kentucky River Station and the Richmond Road Station. The Kentucky River Station is operated as a base load plant and is rated for production of 40,000,000 gallons of water per day. It is a conventional surface water treatment plant utilizing Aldrich purification units. Flocculation, sedimentation and filtration of water occurs in the purification units. The treatment residuals are collected in the sedimentation compartments of the purification units and are withdrawn by gravity into holding tanks where they are pumped into four sludge lagoons for settling and decanting. The quantity of residuals generated is dependent on the quality of raw water and the volume of water processed. The lagoons are no longer sufficient to properly handle the quantity of residuals generated because there is inadequate storage time for drying. The residuals have been retained onsite for possible future beneficial reuse applications.

4. The retention of the residuals onsite for possible future beneficial reuse application has been without approval of the Division of Waste Management, Department for Environmental Protection, Natural Resources and Environmental Protection Cabinet of the Commonwealth of Kentucky. The Division of Waste Management has required that the concentration of solids in the residuals be increased to at least 20% before beneficial reuse. The existing lagoon system would need to be expanded to approximately eight (8) times the current volume in order to provide adequate drying time to achieve a 20% solids concentration required by the Division of Waste Management to continue onsite disposal. Adequate space is not available for this expansion.

5. On February 25, 1997, Kentucky-American applied to the Division of Waste Management for a beneficial reuse permit by rule of the residuals generated at the Kentucky River Station. A copy of that application is attached hereto and marked Exhibit A.

6. By letter dated July 29, 1997, the Division of Waste Management granted Kentucky-American's request and authorized the beneficial reuse of the residuals produced at the Kentucky River Treatment Station subject to 12 conditions. A copy of the approval dated July 29, 1997, as modified by letters dated March 13, 1998 and August 28, 1998, is attached hereto and marked Exhibit B.

7. Attached hereto and marked Exhibit C, collectively, are copies of the bidding requirements, contract forms, conditions of the contract and technical specifications (two volumes), a design memorandum (one volume, revision No. 3) and a set of the drawings for the facilities dated June, 1999. This exhibit includes a full description of the location of the facilities to be constructed and a description of the manner in which they will be constructed. A new mechanical dewatering building will be constructed to contain two 2.8 meter belt filter presses, a polymer system, gravity thickeners, wash water waste, and solids feed pumps. Each belt filter press will be capable of operating at a solids loading rate of 4,000 pounds per hour. Maximum solids production of 76,400 pounds per day can be processed by each belt filter press operating approximately 10 hours per day. The existing wash water waste holding tanks will be converted to flow-through gravity thickeners because it is necessary to pre-thicken the residuals which accumulate in the purification units before mechanically dewatering. This modification requires the removal of the supernatant pumps and the addition of mechanical solid collectors and effluent weir troughs. The existing solids handling pumps will be modified and used to pump the settled solids

to the dewatering building. Supernatant will flow by gravity to the existing lagoons. This pumping will require modifications to the existing supernatant recycle pumping system. Lagoon decant valves will have to be installed along with automatic dechlorination and continuous on-line monitoring of the effluent discharge to the Kentucky River. The discharge piping from the lagoons to the lagoon supernatant return vault will have to be modified to accept the additional flows by increasing its size to 12 inches, construction of a second lagoon supernatant return vault and a parallel vault discharge pipe.

8. There are no known public utilities, corporations or persons with whom the construction of these residual processing facilities is likely to compete.

9. Construction of these facilities is expected to begin in 1999 and will take at least two years. Kentucky-American estimates that the cost of construction of these facilities will be $4,900,000. Bids are to be received by Kentucky-American Water Company on July 20, 1999.

10. Kentucky-American has delivered an application to the Division of Water seeking its approval for the construction of the additional residuals processing facilities. Kentucky-American anticipates that it will receive that approval around July 20, 1999.

11. Kentucky-American intends to finance the construction of the residuals processing facilities by a combination of short-term debt and retained earnings. The short-term bank indebtedness of Kentucky-American will be converted to permanent financing at the appropriate time in the future.

12. Kentucky-American does not believe that the cost of operation of its residuals processing facilities at the Kentucky River Treatment Plant will change materially as a result of this construction.

WHEREFORE, Kentucky-American Water Company prays that this be accepted as its application, that it be authorized pursuant to KRS 278.020(1) and 807 KAR 5:001, Section 9 (2), to construct the residuals processing facilities as delineated in the exhibits attached hereto.

HERBERT A. MILLER, JR., ESQ.
Kentucky-American Water Company
2300 Richmond Road
Lexington, Kentucky 40502

and

STOLL, KEENON & PARK, LLP
201 East Main Street, Suite 1000
Lexington, Kentucky 40507-1380
Telephone: (606) 231-3000

BY: Lindsey Ingram
Lindsey Ingram, Jr.

312\C:\Work\LWI\KAWC\GENERAL\684application.krs

Application for Registered Permit-by-Rule Beneficial Re-use

Kentucky River Station
Kentucky-American Water Company

February 1997

Prepared by:

Quest Engineers, Inc.
881 Corporate Drive
Lexington, Kentucky 40503
(606) 223-3755

and

FMSM Engineers, Inc.
1409 North Forbes Road
Lexington, Kentucky 40511
(606) 233-0574

Natural Resources and Environmental Protection Cabinet

DEPARTMENT FOR ENVIRONMENTAL PROTECTION
DIVISION OF WASTE MANAGEMENT
18 REILLY ROAD
FRANKFORT, KENTUCKY 40601
TELEPHONE NUMBER (502)564-6716

REGISTERED PERMIT-BY-RULE BENEFICIAL RE-USE DEP 7059F (3/92)

GENERAL INSTRUCTIONS

1. ***APPLICABILITY*** *- This registration form must be completed and submitted to the Cabinet by persons who propose to beneficially re-use special waste.*

2. ***ASSISTANCE*** *- Questions regarding this form may be directed in writing to the Division of Waste Management, Solid Waste Branch at the address listed above, or by calling (502)564-6716.*

3. ***SUBMISSION*** *- Please type or print legibly. Complete all sections of this registration, however, if an item is not applicable to your facility write "N/A" in the space provided. Submit the original and three (3) copies of the completed registration form to the Division of Waste Management at the address noted above.*

4. ***LAWS AND REGULATIONS*** *- Registrants are expected to understand and comply with all laws and regulations applicable to beneficial re-use of special waste.*

DEP 7059F (3/92)

REGISTERED PERMIT-BY-RULE
BENEFICIAL RE-USE

REGISTRATION NUMBER:_____ (FOR AGENCY USE ONLY)

1. FACILITY REGISTRATION

A. Name of Facility **Kentucky River Station**

B. Address **Kentucky-American Water Company**
2300 Richmond Road
City **Lexington** State **KY** Zip Code **40502**

C. Phone Number (**606**) **269** - **2386**

D. Contact Person at Facility **Julie W. Simpson, Water Quality Superintendent**

E. Provide the following information concerning the person preparing this registration if different from contact person named above:

Name **Joseph C. Lewis, P.E.**
Address **Quest Engineers, Inc.**
881 Corporate Drive
City **Lexington** State **KY** Zip Code **40503**
Phone Number (**606**) **223** - **3755**

F. Designate the individual to whom correspondence concerning this registration should be addressed:

Name **Linda C. Bridwell, P.E., Engineering Manager with copy to Julie W. Simpson, Water Quality Superintendent**

Address **Kentucky-American Water Company**
2300 Richmond Road
City **Lexington** State **KY** Zip Code **40502**

2. List the source(s) of the special waste to be beneficially re-used. If more space is necessary, use additional sheets and label as Attachment 1.

See Attachment 1

3. Provide, as Attachment 2, a description of the type and anticipated volume of special waste received.

4. Provide, as Attachment 3, the actual laboratory TCLP analyses for each type of special waste to be beneficially re-used.

NOTE: If there is any change in the technique, procedure or source of material in the production of special waste, the registrant shall re-test the waste and submit new laboratory TCLP analyses for each type of special waste.

5. Provide, as Attachment 4, a description of how the special waste is to be beneficially re-used.

6. Provide, as Attachment 5, a description of how the environmental performance standards of 401 KAR 30:031 will be achieved in re-using the special waste.

7. Submit, on a quarterly basis, the information requested in Attachment 6.

Registered Permit-by-Rule
Beneficial Re-use

Kentucky River Station (KRS)
Kentucky-American Water Company (KAWC)

Attachment 1 - Source of Special Waste

Residual solids from the sedimentation process in connection with the KAWC 40 million gallon per day water treatment plant are pumped into one of four lagoons. As the solids settle, water is decanted from the lagoons and discharged to the Kentucky River in conformance with the KPDES permit. When the lagoon is filled, dried solids are removed from the lagoon and placed in the area designated for residual solids as shown on the site plan included in Appendix A.

Registered Permit-by-Rule
Beneficial Re-use

Kentucky River Station (KRS)
Kentucky-American Water Company (KAWC)

Attachment 2 - Special Waste Description/Volume

Type of Waste

Residual solids from the KRS are classified as an elastic silt. A summary of the soil tests on a bag sample of the material is included at the end of this attachment.

Projected Water Production and Removal Quantities

The anticipated volume of residual solids for the KRS will be based on the projected production of water. Water production projections were calculated using system delivery data from 1991 to 1994 and water production projections supplied by KAWC. Based on these projections, the water production was calculated and is presented below.

Summary of Water Production Projections

Year	*Average Day Production (million gallons per day)*
2000	34.05
2005	35.17
2010	36.30
2015	38.07

Using the projected water production presented above, the quantities of residual solids from the KRS were estimated based on the current solids production rates. Currently, there is no available solids quantities information for the KRS, therefore, the projected residual solids quantities at the KRS were estimated using the lagoon volumes as designed with 1-foot freeboard and the water production data from above. It was assumed that the lagoons will be filled to capacity once per year, and the residual solids in the lagoons will be at 8% solids. The lagoon capacities as designed are 5.4 million gallons. Based on annual water production in 1995 at the KRS of 32.3 million gallons per day, the 1995 estimated residual solids production rate is 306 dry pounds per million gallons (lb/MG) of water production. Using a production rate of 306 lb/MG, the water production projections, and assuming a 20% dry solids concentration for residual solids management, the residual solids production projections were calculated and are presented as follows:

Summary of Residual Solids Quantities

Item	1995	2000	2005	2010	2015
Water production projections (million gallons per day)	32.30	34.05	35.17	36.30	38.07
Residuals quantity projections (wet tons per year)	9,005	9,508	9,821	10,136	10,631
Residuals quantity projections (dry tons per year)	1,801	1,902	1,964	2,027	2,126

Fuller Mossbarger Scott & May ENGINEERS

SUMMARY OF SOIL TESTS

County Fayette **Project No.** 96232

Name of Project Kentucky American Water Co. Residual Study

Laboratory No.: 2 **Date Received:** 10-29-96

Identification: Ky. River Station **Date Reported:** 11-11-96

Source of Material: Bag Sample **Submitted By:** TK/DW

TEST RESULTS

Particle Size Analysis

Size	Total % Passing
3" (75 mm)	
2" (50 mm)	
1½" (38.1 mm)	
1" (25.0 mm)	
3/4" (19.0 mm)	100
3/8" (9.5 mm)	99
No. 4 (4.75 mm)	97
No. 10 (2.00 mm)	96
No. 40 (.425mm)	94
No. 200 (.075 mm)	86
.005 mm	47
.001mm	

Material	Passing Size	Retaining Size	% Total Sample	% Soil Mortar
Gravel	3" (75 mm)	No. 4 (4.75 mm)	3	--
Coarse Sand	No. 4 (4.75 mm)	No. 10 (2.00 mm)	1	--
Medium Sand	No. 10 (2.00 mm)	No. 40 (.425 mm)	2	2
Fine Sand	No. 40 (.425 mm)	No. 200 (.075 mm)	8	8
Silt	No. 200 (.075 mm)	.005 mm	39	41
Clay	.005 mm	.000 mm	47	49

Physical Tests

Natural Moisture (%)	
Liquid Limit	85
Plastic Limit	56
Plasticity Index	29
Activity Index	1.26
Specific Gravity	2.74
Maximum Density (pcf) (kg/m^3)	71.2
Optimum Moisture (%)	43.6
California Bearing Ratio (%)	
CLASSIFICATION:	
Unified	MH
Textural	Elastic Silt
AASHTO	A-7-5(35)

Remarks: Total Organic Content
ASTM D-2974 Method C - 12.8%

Material is a by-product from a ferric-based water treatment process.

Fuller Mossbarger Scott & May ENGINEERS

MOISTURE-DENSITY DATA SHEET

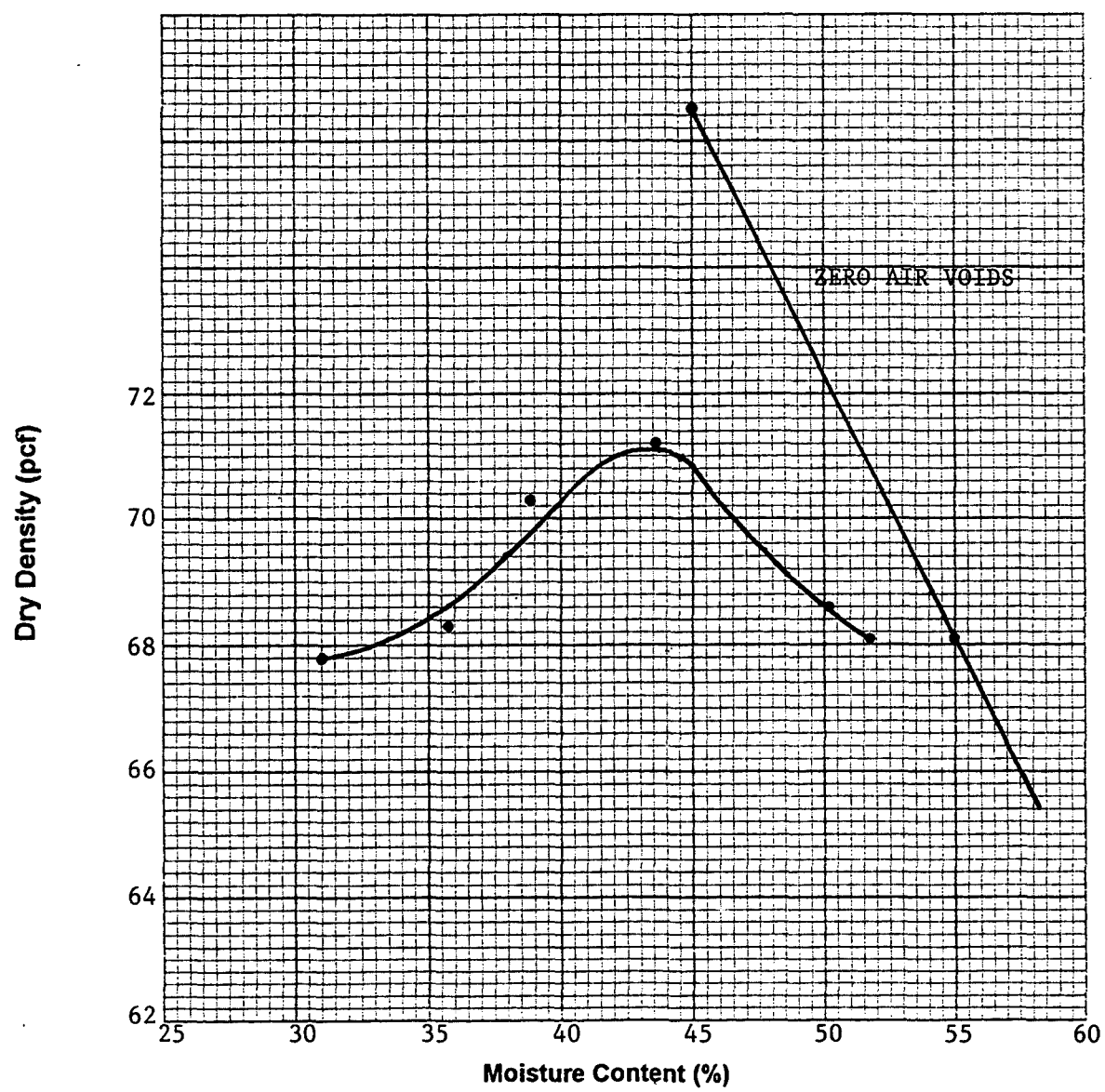
Project KAWC Residual Study Date 10/31/96 Project No. 96232

Sample No. #2 Operator AK Plotted By TK

Sample Description Brown lean clay

Test Method ASTM D698 A Hole No. Depth

Mold Weight 4340 grams			Moisture Determination				
Wet Weight Plus Mold grams	Wet Weight Minus Mold grams	Can No.	Wet Soil and Can Weight grams	Dry Soil and Can Weight grams	Can Weight grams	Water Content %	Dry Density pcf
5681	1341	P-302	530.95	424.08	76.86	30.8	67.8
5742	1402	P-317	523.28	405.21	75.37	35.8	68.3
5817	1477	P-378	538.98	409.21	75.83	38.9	70.3
5885	1545	P-394	504.07	374.29	76.65	43.6	71.2
5897	1557	P-336	472.28	339.64	75.20	50.2	68.6
5901	1561	P-375	540.40	382.51	76.88	51.7	68.1



Maximum Density 71.2 pcf

Optimum Moisture 43.6 %

FULLER, MOSSBARGER, SCOTT AND MAY ENGINEERS, INC.

Registered Permit-by-Rule
Beneficial Re-use

Kentucky River Station (KRS)
Kentucky-American Water Company (KAWC)

Attachment 3 - Laboratory TCLP Analyses

The results of the TCLP analysis reported in October 1996 on residual material from the KRS water treatment process are included in this attachment.

Commonwealth Technology, Inc.

Account Code: CKENB

CTI Lab No.: 96115852

Attn: Ms. Julie Simpson
To: Kentucky-American Water Company
2300 Richmond Road
Lexington, KY 40502

Report Date: 10/22/96
PO#: N/A

RECEIVED

JAN 09 1997

FULLER, MUSSBARGER, SCOTT AND MAY
ENGINEERS, INC.

Sample ID: Kentucky River Station
Source of Sample:
Sample Matrix: Solid Sludge
COC ID No.: COC102792

Date of Collection: 9/23/96
Collection Time: 12:15 PM
Collected By: Client
Date Received: 9/24/96

Report Submitted By:

Report of Analytical Results

Analytical Tests	Results	Units	Detection Limits	Sample Type	Method Reference	Analysis Date	By
RADIOLOGICALS							
Gross Alpha	See Att	pCi/L	N/A	Grab	SM7110	10/11/96	SUB
Radium 226	See Att	pCi/L	N/A	Grab	SM7500-Ra	10/11/96	SUB
Uranium	See Att	pCi/g dry	N/A	Grab	EPA9080	10/11/96	SUB
HAZARDOUS WASTE CHARACTERISTICS							
TCLP-PESTICIDE: Endrin	< 0.250	ug/L	0.25	Grab	SW8081	10/1/96	XAG
TCLP-PESTICIDE: Lindane	< 0.25	ug/L	0.25	Grab	SW8081	10/1/96	XAG
TCLP-PESTICIDE: Methoxychlor	< 0.25	ug/L	0.25	Grab	SW8081	10/1/96	XAG
TCLP-PESTICIDE: Toxaphene	< 0.50	ug/L	0.5	Grab	SW8081	10/1/96	XAG
TCLP-PESTICIDE: Chlordane	< 0.50	ug/L	0.5	Grab	SW8081	10/1/96	XAG
TCLP-PESTICIDE: Heptachlor	< 0.250	ug/L	0.25	Grab	SW8081	10/1/96	XAG
TCLP-PESTICIDE: Heptachlor Epoxide	< 0.250	ug/L	0.25	Grab	SW8081	10/1/96	XAG
TCLP-HERBICIDE: 2,4-D	< 0.001	mg/L	0.001	Grab	SW8151	10/2/96	JLL
TCLP-HERBICIDE: 2,4,5-TP Silvex	< 0.001	mg/L	0.001	Grab	SW8151	10/2/96	JLL
TCLP-VOL: Benzene	< 0.025	mg/L	0.025	Grab	SW5030A/8260A	9/26/96	DHM
TCLP-VOL: Carbon Tetrachloride	< 0.025	mg/L	0.025	Grab	SW5030A/8260A	9/26/96	DHM
TCLP-VOL: Chlorobenzene	< 0.025	mg/L	0.025	Grab	SW5030A/8260A	9/26/96	DHM
TCLP-VOL: Chloroform	< 0.025	mg/L	0.025	Grab	SW5030A/8260A	9/26/96	DHM

8354 CTI-Formal Report

2520 Regency Road
Lexington, KY 40503-2921

Office: 606-276-3506
Fax: 606-278-5665

Commonwealth Technology, Inc.

Account Code: CKENB **CTI Lab No.:** 96115852

TCLP-VOL: 1,4-Dichlorobenzene	< 0.025	mg/L	0.025	Grab	SW5030A/8260A	9/26/96	DHM
TCLP-VOL: 1,2-Dichloroethane	< 0.025	mg/L	0.025	Grab	SW5030A/8260A	9/26/96	DHM
TCLP-VOL: 1,1-Dichloroethene	< 0.025	mg/L	0.025	Grab	SW5030A/8260A	9/26/96	DHM
TCLP-VOL: Methyl Ethyl Ketone	< 0.05	mg/L	0.05	Grab	SW5030A/8260A	9/26/96	DHM
TCLP-VOL: Tetrachloroethene	< 0.025	mg/L	0.025	Grab	SW5030A/8260A	9/26/96	DHM
TCLP-VOL: Trichloroethene	< 0.025	mg/L	0.025	Grab	SW5030A/8260A	9/26/96	DHM
TCLP-VOL: Vinyl Chloride	< 0.025	mg/L	0.025	Grab	SW5030A/8260A	9/26/96	DHM
TCLP-SEMIVOL: o-Cresol	< 0.05	mg/L	0.05	Grab	SW8270	10/1/96	XAG
TCLP-SEMIVOL: m and p-Cresol	< 0.10	mg/L	0.1	Grab	SW8270	10/1/96	XAG
TCLP-SEMIVOL: 2,4-Dinitrotoluene	< 0.05	mg/L	0.05	Grab	SW8270	10/1/96	XAG
TCLP-SEMIVOL: Hexachlorobenzene	< 0.05	mg/L	0.05	Grab	SW8270	10/1/96	XAG
TCLP-SEMIVOL: Hexachlorobutadiene	< 0.05	mg/L	0.05	Grab	SW8270	10/1/96	XAG
TCLP-SEMIVOL: Hexachloroethane	< 0.05	mg/L	0.05	Grab	SW8270	10/1/96	XAG
TCLP-SEMIVOL: Nitrobenzene	< 0.05	mg/L	0.05	Grab	SW8270	10/1/96	XAG
TCLP-SEMIVOL: Pentachlorophenol	< 0.05	mg/L	0.05	Grab	SW8270	10/1/96	XAG
TCLP-SEMIVOL: Pyridine	< 0.2	mg/L	0.2	Grab	SW8270	10/1/96	XAG
TCLP-SEMIVOL: 2,4,5-Trichlorophenol	< 0.05	mg/L	0.05	Grab	SW8270	10/1/96	XAG
TCLP-SEMIVOL: 2,4,6-Trichlorophenol	< 0.05	mg/L	0.05	Grab	SW8270	10/1/96	XAG
TCLP-METAL: Silver (ICP)	< 0.01	mg/L	0.01	Grab	SW6010	9/27/96	MEC
TCLP-METAL: Arsenic (ICP)	< 0.05	mg/L	0.05	Grab	SW6010	9/27/96	MEC
TCLP-METAL: Barium (ICP)	0.76	mg/L	0.01	Grab	SW6010	9/27/96	MEC
TCLP-METAL: Cadmium (ICP)	< 0.005	mg/L	0.005	Grab	SW6010	9/27/96	MEC
TCLP-METAL: Chromium (ICP)	< 0.01	mg/L	0.01	Grab	SW6010	9/27/96	MEC
TCLP-METAL: Mercury (Cold Vapor)	< 0.001	mg/L	0.001	Grab	SW7470	9/27/96	GLM
TCLP-METAL: Lead (ICP)	< 0.05	mg/L	0.05	Grab	SW6010	9/27/96	MEC
TCLP-EXTRACTION: Non-Volatiles	N/A	N/A	N/A	Grab	SW1311	9/26/96	DCC
TCLP-EXTRACTION: Volatiles	N/A	N/A	N/A	Grab	SW1311	9/26/96	DCC
TCLP-METAL: Selenium (ICP)	< 0.05	mg/L	0.05	Grab	SW6010	9/27/96	MEC

8354 CTI-Formal Report

2520 Regency Road
Lexington, KY 40503-2921

Office: 606-276-3506
Fax: 606-278-5665

Registered Permit-by-Rule
Beneficial Re-use

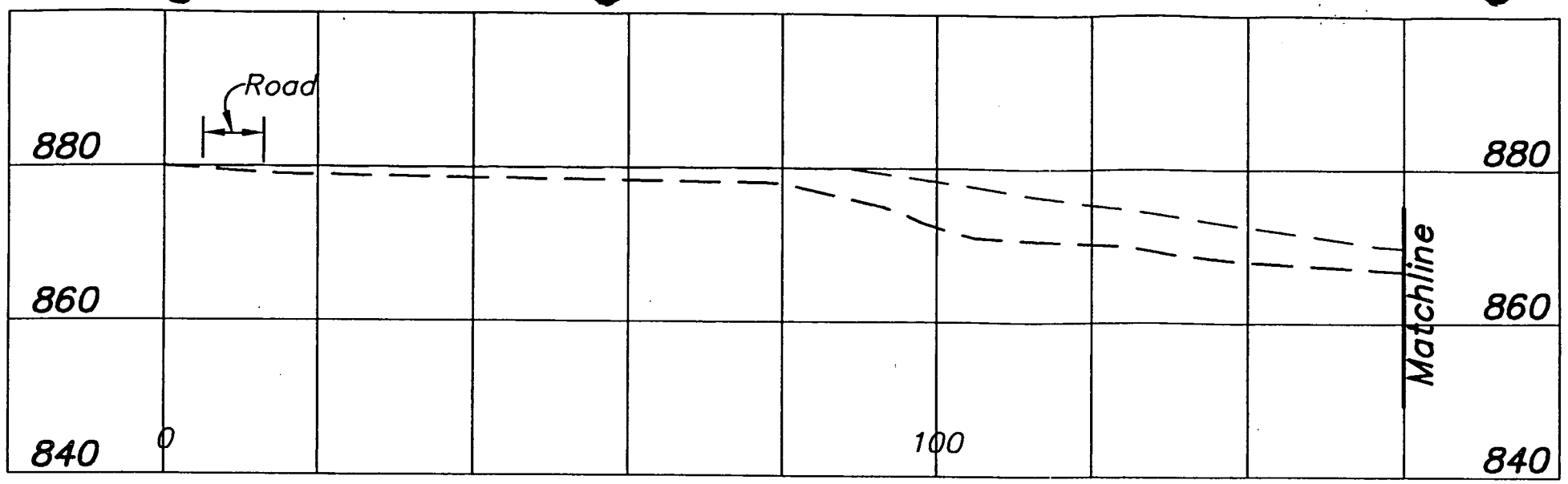
Kentucky River Station (KRS)
Kentucky-American Water Company (KAWC)

Attachment 4 - Beneficial Re-use Description

The residual solids generated by the KRS water treatment process will be used as structural fill to create and expand an area for the following activities:

- Material and equipment storage
- Parking
- Storage/staging area during improvements construction and maintenance associated with the existing treatment facility

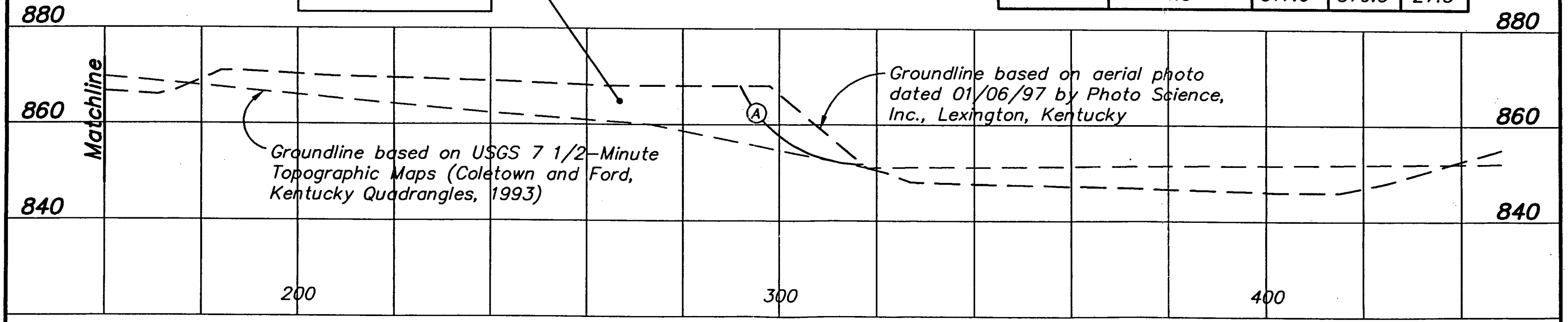
A slope stability analysis of the existing site has been performed and is included in this attachment. The location of the specific sections analyzed are shown on the site plan included in Appendix A. The factors of safety computed in this analysis indicate stability is not a problem.



Ferric Sludge
Shear Strength Parameters

c = 150 p.s.f.
Φ = 18°
γ = 90 p.c.f.

SUMMARY OF SLOPE STABILITY ANALYSES				
Failure Surface	Factor of Safety	X	Y	R
A	1.3	317.0	879.3	27.5



SECTION A-A'
SCALE: 1"=20'

NOTE:
Shear strength parameters assumed based on treating residual material as a soil placed at 90 percent Standard Proctor Maximum Dry Density and Optimum Moisture Content.

STATE OF KENTUCKY
DONALD W. ARMOUR, JR.
15496
REGISTERED PROFESSIONAL ENGINEER
2/1/97

96232/STABXAA.DWG

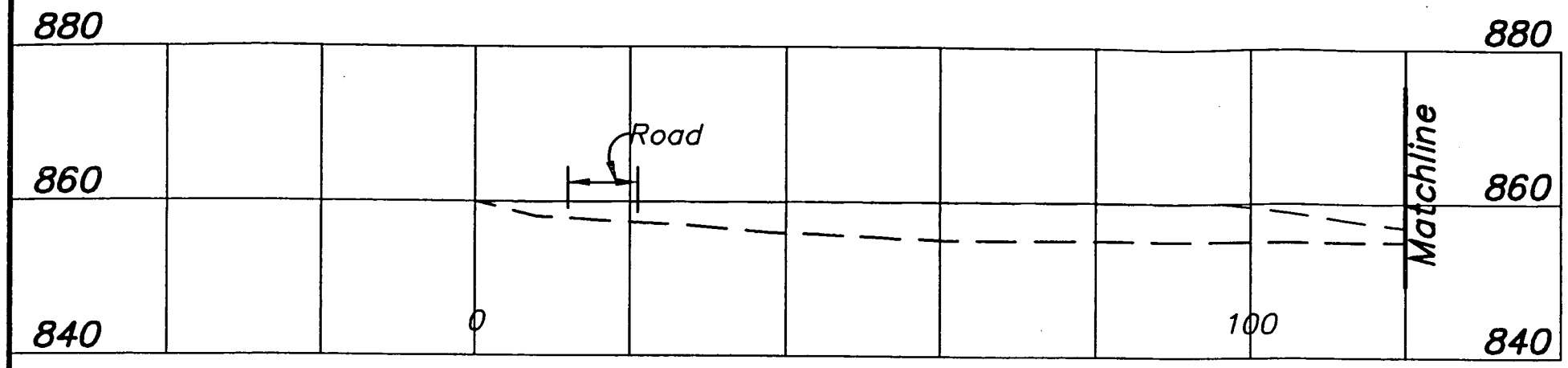
STABILITY ANALYSIS - SECTION A-A'

KENTUCKY RIVER STATION
KENTUCKY AMERICAN WATER COMPANY
FAYETTE COUNTY, KENTUCKY

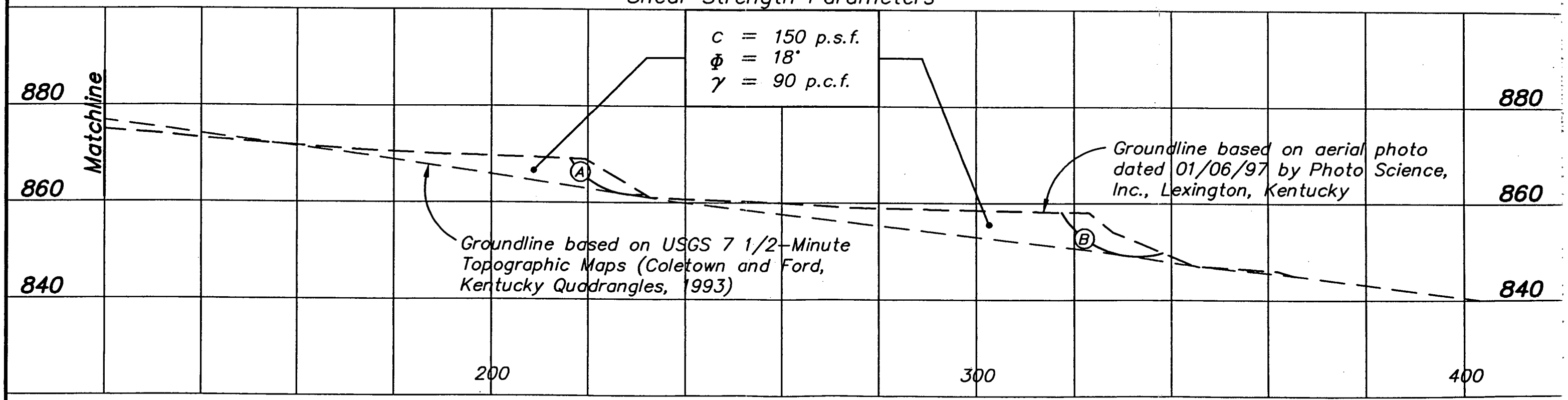
EMSM ENGINEERS
LEXINGTON LOUISVILLE CINCINNATI

FULLER MOSSBARGER SCOTT AND MAY ENGINEERS, INC.
1400 N. Forbes Rd.
Lexington, Kentucky
40511-2059
606-233-4571

DRAWN BY CMQ	DATE FEB., 1997	REVISED	SHEET
CHECKED BY BLB	PROJECT NO. 96232	1. 3.	1 OF 2
CHECKED BY DWA	SCALE AS SHOWN	2. 4.	



SUMMARY OF SLOPE STABILITY ANALYSES				
Failure Surface	Factor of Safety	X	Y	R
A	2.6	229.6	877.0	15.4
B	2.4	333.0	866.8	17.8



SECTION B-B'

SCALE: 1"=20'

NOTE:

Shear strength parameters assumed based on treating residual material as a soil placed at 90 percent Standard Proctor Maximum Dry Density and Optimum Moisture Content.

STABILITY ANALYSIS - SECTION B-B'

KENTUCKY RIVER STATION
KENTUCKY AMERICAN WATER COMPANY
FAYETTE COUNTY, KENTUCKY

STATE OF KENTUCKY
DONALD W. ARMOUR JR.
15495
REGISTERED PROFESSIONAL ENGINEER

FMSM ENGINEERS
LEXINGTON LOUISVILLE CINCINNATI

FULLER, MOSSBARGER, SCOTT AND MAY ENGINEERS, INC.
1409 N. Forbes Rd.
Lexington, Kentucky
40511-2059
606-233-4574

DRAWN BY CMQ	DATE FEB., 1997	REVISED	SHEET
CHECKED BY BLB	PROJECT NO. 96232	1. 3.	2 OF 2
CHECKED BY DWA	SCALE AS SHOWN	2. 4.	

96232/STABXSB.DWG

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UNIVERSITY OF KENTUCKY, LEXINGTON, KY 40506

LE NAME -96232A.DAT

INPUT FROM FILE (NINPUT)?(ENTER 1 WHEN INPUT FROM FILE & 0 WHEN NOT) 1

TITLE -96232 - KAWC FILTRATION PLANT STABILITY SECTION A-A

NO. OF STATIC AND SEISMIC CASES- 1

ASE NO. 1 SEISMIC COEFFICIENT= 0

NO. OF BOUNDARY LINES= 2

NO. OF POINTS ON BOUNDARY LINE 1 = 6
1 X COORD.= 240 Y COORD.= 862.3
2 X COORD.= 273 Y COORD.= 860
3 X COORD.= 318 Y COORD.= 851
4 X COORD.= 322 Y COORD.= 850
5 X COORD.= 327 Y COORD.= 848
6 X COORD.= 384 Y COORD.= 847

NO. OF POINTS ON BOUNDARY LINE 2 = 7
1 X COORD.= 240 Y COORD.= 869
2 X COORD.= 265 Y COORD.= 868
3 X COORD.= 298 Y COORD.= 868
X COORD.= 318 Y COORD.= 851
5 X COORD.= 322 Y COORD.= 850
6 X COORD.= 327 Y COORD.= 848
7 X COORD.= 384 Y COORD.= 847

INE NO. AND SLOPE OF EACH SEGMENT ARE:
1 -0.070 -0.200 -0.250 -0.400 -0.018
2 -0.040 +0.000 -0.850 -0.250 -0.400 -0.018

MIN. DEPTH OF TALLEST SLICE= 1
NO. OF RADIUS CONTROL ZONES= 1

ADIUS DECREMENT FOR ZONE 1 = 0
NO. OF CIRCLES FOR ZONE 1 = 5
ID NO. FOR FIRST CIRCLE FOR ZONE 1 = 1
O. OF BOTTOM LINES FOR ZONE 1 = 1

FOR ZONE 1 LINE SEQUENCE 1
INE NO.= 1 BEG. NO.= 1 END NO.= 6

SOIL NO.	COHESION	FRIC. ANGLE	UNIT WEIGHT
1	150	18	90

USE PHREATIC SURFACE
UNIT WEIGHT OF WATER= 62.4
SE GRID
. OF SLICES= 10 NO. OF ADD. RADII= 5

O. OF POINTS ON WATER TABLE= 6
1 X COORD.= 240 Y COORD.= 862.3

2 X COORD.= 273 Y COORD.= 860
3 X COORD.= 318 Y COORD.= 851
4 X COORD.= 322 Y COORD.= 850
5 X COORD.= 327 Y COORD.= 848
X COORD.= 384 Y COORD.= 847

NO. OF SOILS WITH DIFFERENT WATER TABLE= 0
NO. OF SOILS WITH DIFFERENT PORE PRESSURE RATIO= 0

INPUT COORD. OF GRID POINTS 1,2,AND 3

POINT 1 X COORD.= 322 Y COORD.= 893
POINT 2 X COORD.= 322 Y COORD.= 868
POINT 3 X COORD.= 302 Y COORD.= 868

X INCREMENT= 5 Y INCREMENT= 5
NO. OF DIVISIONS BETWEEN POINTS 1 AND 2= 5
NO. OF DIVISIONS BETWEEN POINTS 2 AND 3= 4
ONLY F. S. AT EACH CENTER WILL BE PRINTED
SLICES WILL BE SUBDIVIDED

AUTOMATIC SEARCH WILL FOLLOW AFTER GRID

WARNING IN THE FOLLOWING TABLE INDICATES HOW MANY TIMES THE MAXIMUM RADIUS IS LIMITED BY THE END POINTS OF GROUND LINES

CENTER X COORDINATE	CENTER Y COORDINATE	NO. OF CIRCLE TOTAL	CRITIC.	RADIUS	LOWEST F.S.	WARNING
322	893	5	1	41.969	1.342	0
322	888	5	1	37.066	1.325	0
322	883	5	1	32.163	1.348	0
322	878	5	1	27.260	1.484	0
322	873	4	1	22.357	1.856	0
322	868	4	1	17.464	2.603	0
317	893	5	1	40.988	1.424	0
317	888	5	1	36.085	1.370	0
317	883	5	1	31.182	1.328	0
317	878	5	1	26.280	1.314	0
317	873	5	1	21.377	1.378	0
317	868	5	1	16.474	1.608	0
312	893	5	1	40.008	1.603	0
312	888	5	1	35.105	1.530	0
312	883	5	1	30.202	1.461	0

312	878	5	1	25.299	1.403	0
312	873	5	1	20.396	1.372	0
12	868	5	1	15.493	1.418	0
307	893	5	1	39.027	1.897	0
307	888	5	1	34.124	1.813	0
307	883	5	1	29.221	1.733	0
307	878	5	1	24.318	1.660	0
307	873	5	1	19.416	1.606	0
307	868	5	1	14.513	1.596	0
302	893	5	1	38.047	2.374	0
302	888	5	1	33.144	2.292	0
302	883	5	1	28.241	2.217	0
302	878	5	1	23.338	2.156	0
302	873	5	1	18.435	2.132	0
302	868	5	1	13.532	2.197	0

T POINT (317 878)RADIUS 26.280

THE MINIMUM FACTOR OF SAFETY IS 1.314

WARNING IN THE FOLLOWING TABLE INDICATES HOW MANY TIMES THE MAXIMUM RADIUS IS LIMITED BY THE END POINTS OF GROUND LINES

CENTER X COORDINATE	CENTER Y COORDINATE	NO. OF CIRCLE TOTAL	CRITIC.	RADIUS	LOWEST F.S.	WARNING
317	878	5	1	26.280	1.314	0
322	878	5	1	27.260	1.484	0
312	878	5	1	25.299	1.403	0
317	883	5	1	31.182	1.328	0
317	873	5	1	21.377	1.378	0
318.25	878	5	1	26.525	1.322	0
15.75	878	5	1	26.034	1.320	0
317	879.25	5	1	27.505	1.313	0

317	880.5	5	1	28.731	1.316	0
318.25	879.25	5	1	27.750	1.314	0
315.75	879.25	5	1	27.260	1.324	0

AT POINT (317 879.25)RADIUS 27.505

THE MINIMUM FACTOR OF SAFETY IS 1.313

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 E NAME -96232B1.DAT

NPUT FROM FILE (NINPUT)?(ENTER 1 WHEN INPUT FROM FILE & 0 WHEN NOT) 1

ITLE -96232 - KAWC FILTRATION PLANT STABILITY SECTION B-B CIRCLE 1 (A)

NO. OF STATIC AND SEISMIC CASES- 1

ASE NO. 1    SEISMIC COEFFICIENT= 0

O. OF BOUNDARY LINES= 2

NO. OF POINTS ON BOUNDARY LINE 1 = 6
 1  X COORD.= 156          Y COORD.= 872
 2  X COORD.= 172          Y COORD.= 870
 3  X COORD.= 239          Y COORD.= 860
 4  X COORD.= 325          Y COORD.= 850
 5  X COORD.= 345          Y COORD.= 847
 6  X COORD.= 403          Y COORD.= 840

NO. OF POINTS ON BOUNDARY LINE 2 = 11
 1  X COORD.= 156          Y COORD.= 872
 2  X COORD.= 170          Y COORD.= 871
 3  X COORD.= 189          Y COORD.= 870
    X COORD.= 219.5        Y COORD.= 869
 5  X COORD.= 233          Y COORD.= 861
 6  X COORD.= 259          Y COORD.= 860
 7  X COORD.= 274          Y COORD.= 859
 8  X COORD.= 323          Y COORD.= 858
 9  X COORD.= 328          Y COORD.= 854
 10 X COORD.= 345          Y COORD.= 847
 11 X COORD.= 403          Y COORD.= 840

LINE NO. AND SLOPE OF EACH SEGMENT ARE:
 1        -0.125     -0.149     -0.116     -0.150     -0.121
 2        -0.071     -0.053     -0.033     -0.593     -0.038     -0.067
          -0.020     -0.800     -0.412     -0.121

IN. DEPTH OF TALLEST SLICE= 1
O. OF RADIUS CONTROL ZONES= 1

ADIUS DECREMENT FOR ZONE 1 = 0
O. OF CIRCLES FOR ZONE 1 = 5
ID NO. FOR FIRST CIRCLE FOR ZONE 1 = 1
NO. OF BOTTOM LINES FOR ZONE 1 = 1

OR ZONE 1    LINE SEQUENCE 1
LINE NO.= 1  BEG. NO.= 1  END NO.= 6

OIL NO.      COHESION      FRIC. ANGLE   UNIT WEIGHT
               150            18            90

SE PHREATIC SURFACE
NIT WEIGHT OF WATER= 62.4
```

USE GRID
NO. OF SLICES= 10 NO. OF ADD. RADII= 5

NO. OF POINTS ON WATER TABLE= 6
X COORD.= 156 Y COORD.= 872
2 X COORD.= 172 Y COORD.= 870
3 X COORD.= 239 Y COORD.= 860
4 X COORD.= 325 Y COORD.= 850
5 X COORD.= 345 Y COORD.= 847
6 X COORD.= 403 Y COORD.= 840

NO. OF SOILS WITH DIFFERENT WATER TABLE= 0
NO. OF SOILS WITH DIFFERENT PORE PRESSURE RATIO= 0

INPUT COORD. OF GRID POINTS 1,2,AND 3

POINT 1 X COORD.= 234 Y COORD.= 884.5
POINT 2 X COORD.= 234 Y COORD.= 872
POINT 3 X COORD.= 224 Y COORD.= 872

X INCREMENT= 2.5 Y INCREMENT= 2.5
NO. OF DIVISIONS BETWEEN POINTS 1 AND 2= 5
NO. OF DIVISIONS BETWEEN POINTS 2 AND 3= 4
ONLY F. S. AT EACH CENTER WILL BE PRINTED
SLICES WILL BE SUBDIVIDED

AUTOMATIC SEARCH WILL FOLLOW AFTER GRID

ARNING IN THE FOLLOWING TABLE INDICATES HOW MANY TIMES THE
MAXIMUM RADIUS IS LIMITED BY THE END POINTS OF GROUND LINES

CENTER X COORDINATE	CENTER Y COORDINATE	NO. OF CIRCLE TOTAL	CRITIC.	RADIUS	LOWEST F.S.	WARNING
234	884.5	4	1	23.494	2.702	0
234	882	4	1	21.021	2.826	0
234	879.5	3	1	18.548	3.264	0
234	877	3	1	16.076	3.888	0
234	874.5	3	1	13.603	4.725	0
234	872	2	1	11.130	6.059	0
231.5	884.5	4	1	23.124	2.593	0
231.5	882	4	1	20.652	2.582	0
231.5	879.5	4	1	18.179	2.609	0
231.5	877	4	1	15.707	2.702	0
231.5	874.5	4	1	13.234	3.017	0
231.5	872	3	1	10.761	3.424	0
229	884.5	5	1	22.755	2.683	0

229	882	4	1	20.283	2.622	0
229	879.5	4	1	17.810	2.575	0
229	877	4	1	15.338	2.557	0
229	874.5	4	1	12.865	2.599	0
229	872	4	1	10.392	2.804	0
226.5	884.5	5	1	22.386	2.930	0
226.5	882	5	1	19.914	2.845	0
226.5	879.5	5	1	17.441	2.767	0
226.5	877	5	1	14.969	2.702	0
226.5	874.5	4	1	12.496	2.662	0
226.5	872	4	1	10.023	2.675	0
224	884.5	5	1	22.017	3.352	0
224	882	5	1	19.545	3.259	0
224	879.5	5	1	17.072	3.171	0
224	877	5	1	14.599	3.092	0
224	874.5	5	1	12.127	3.023	0
224	872	5	1	9.654	3.025	0

AT POINT (229 877)RADIUS 15.338

E MINIMUM FACTOR OF SAFETY IS 2.557

RNING IN THE FOLLOWING TABLE INDICATES HOW MANY TIMES THE
XIMUM RADIUS IS LIMITED BY THE END POINTS OF GROUND LINES

ENTER X ORDINATE	CENTER Y COORDINATE	NO. OF CIRCLE TOTAL	CRITIC.	RADIUS	LOWEST F.S.	WARNING
229	877	4	1	15.338	2.557	0
231.5	877	4	1	15.707	2.702	0
226.5	877	5	1	14.969	2.702	0
229	879.5	4	1	17.810	2.575	0
229	874.5	4	1	12.865	2.599	0
229.625	877	4	1	15.430	2.554	0

230.25	877	4	1	15.522	2.587	0
229.625	877.625	4	1	16.048	2.556	0
229.625	876.375	4	1	14.812	2.571	0

AT POINT (229.625 877)RADIUS 15.430

THE MINIMUM FACTOR OF SAFETY IS 2.554

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LE NAME -96232B2.DAT

INPUT FROM FILE (NINPUT)?(ENTER 1 WHEN INPUT FROM FILE & 0 WHEN NOT) 1

TITLE -96232 - KAWC FILTRATION PLANT STABILITY SECTION B-B CIRCLE 2 (B)

NO. OF STATIC AND SEISMIC CASES- 1

CASE NO. 1 SEISMIC COEFFICIENT= 0

NO. OF BOUNDARY LINES= 2

NO. OF POINTS ON BOUNDARY LINE 1 = 6
1 X COORD.= 156 Y COORD.= 872
2 X COORD.= 172 Y COORD.= 870
3 X COORD.= 239 Y COORD.= 860
4 X COORD.= 325 Y COORD.= 850
5 X COORD.= 345 Y COORD.= 847
6 X COORD.= 403 Y COORD.= 840

NO. OF POINTS ON BOUNDARY LINE 2 = 11
1 X COORD.= 156 Y COORD.= 872
2 X COORD.= 170 Y COORD.= 871
3 X COORD.= 189 Y COORD.= 870
X COORD.= 219.5 Y COORD.= 869
X COORD.= 233 Y COORD.= 861
6 X COORD.= 259 Y COORD.= 860
7 X COORD.= 274 Y COORD.= 859
8 X COORD.= 323 Y COORD.= 858
9 X COORD.= 328 Y COORD.= 854
10 X COORD.= 345 Y COORD.= 847
11 X COORD.= 403 Y COORD.= 840

LINE NO. AND SLOPE OF EACH SEGMENT ARE:
1 -0.125 -0.149 -0.116 -0.150 -0.121
2 -0.071 -0.053 -0.033 -0.593 -0.038 -0.067
-0.020 -0.800 -0.412 -0.121

MIN. DEPTH OF TALLEST SLICE= 1
NO. OF RADIUS CONTROL ZONES= 1

RADIUS DECREMENT FOR ZONE 1 = 0
NO. OF CIRCLES FOR ZONE 1 = 5
ID NO. FOR FIRST CIRCLE FOR ZONE 1 = 1
NO. OF BOTTOM LINES FOR ZONE 1 = 1

FOR ZONE 1 LINE SEQUENCE 1
LINE NO.= 1 BEG. NO.= 1 END NO.= 6

SOIL NO. COHESION FRIC. ANGLE UNIT WEIGHT
150 18 90

USE PHREATIC SURFACE
UNIT WEIGHT OF WATER= 62.4

USE GRID
NO. OF SLICES= 10 NO. OF ADD. RADII= 5

NO. OF POINTS ON WATER TABLE= 6
X COORD.= 156 Y COORD.= 872
2 X COORD.= 172 Y COORD.= 870
3 X COORD.= 239 Y COORD.= 860
4 X COORD.= 325 Y COORD.= 850
5 X COORD.= 345 Y COORD.= 847
6 X COORD.= 403 Y COORD.= 840

NO. OF SOILS WITH DIFFERENT WATER TABLE= 0
NO. OF SOILS WITH DIFFERENT PORE PRESSURE RATIO= 0

INPUT COORD. OF GRID POINTS 1,2,AND 3

POINT 1 X COORD.= 348 Y COORD.= 883
POINT 2 X COORD.= 348 Y COORD.= 858
POINT 3 X COORD.= 328 Y COORD.= 858

X INCREMENT= 5 Y INCREMENT= 5
NO. OF DIVISIONS BETWEEN POINTS 1 AND 2= 5
NO. OF DIVISIONS BETWEEN POINTS 2 AND 3= 4
ONLY F. S. AT EACH CENTER WILL BE PRINTED
SLICES WILL BE SUBDIVIDED

AUTOMATIC SEARCH WILL FOLLOW AFTER GRID

ANING IN THE FOLLOWING TABLE INDICATES HOW MANY TIMES THE
AXIMUM RADIUS IS LIMITED BY THE END POINTS OF GROUND LINES

CENTER X COORDINATE	CENTER Y COORDINATE	NO. OF CIRCLE TOTAL	NO. OF CIRCLE CRITIC.	RADIUS	LOWEST F.S.	WARNING
348	883	3	1	36.047	4.468	0
348	878	2	1	31.102	6.038	0
348	873	2	1	26.157	7.734	0
348	868	1	1	21.208	1000000.000	0
348	863	1	1	16.244	1000000.000	0
348	858	1	1	11.280	1000000.000	0
343	883	4	1	35.305	2.712	0
343	878	4	1	30.360	2.964	0
343	873	3	1	25.416	3.756	0
343	868	3	1	20.471	4.727	0
343	863	2	1	15.526	5.597	0
343	858	2	1	10.582	6.981	0
338	883	5	1	34.563	2.514	0

338	878	5	1	29.619	2.482	0
338	873	4	1	24.674	2.510	0
338	868	4	1	19.729	2.748	0
338	863	4	1	14.785	3.635	0
338	858	4	1	9.840	4.399	0
333	883	5	1	33.822	2.699	0
333	878	5	1	28.877	2.581	0
333	873	5	1	23.932	2.487	0
333	868	5	1	18.988	2.425	0
333	863	4	1	14.043	2.493	0
333	858	4	1	9.098	3.197	0
328	883	5	1	33.126	3.196	0
328	878	5	1	28.159	3.052	0
328	873	5	1	23.195	2.909	0
328	868	5	1	18.246	2.772	0
328	863	5	1	13.301	2.676	0
328	858	5	1	8.357	2.766	0

AT POINT (333 868)RADIUS 18.988

HE MINIMUM FACTOR OF SAFETY IS 2.425

ARNING IN THE FOLLOWING TABLE INDICATES HOW MANY TIMES THE
AXIMUM RADIUS IS LIMITED BY THE END POINTS OF GROUND LINES

ENTER X OORDINATE	CENTER Y COORDINATE	NO. OF CIRCLE TOTAL	CRITIC.	RADIUS	LOWEST F.S.	WARNING
333	868	5	1	18.988	2.425	0
338	868	4	1	19.729	2.748	0
328	868	5	1	18.246	2.772	0
333	873	5	1	23.932	2.487	0
333	863	4	1	14.043	2.493	0
334.25	868	5	1	19.173	2.426	0

331.75	868	5	1	18.802	2.460	0
333	869.25	5	1	20.224	2.433	0
333	866.75	5	1	17.751	2.424	0
333	865.5	5	1	16.515	2.431	0
334.25	866.75	5	1	17.937	2.438	0
331.75	866.75	5	1	17.566	2.446	0

AT POINT (333 866.75)RADIUS 17.751

THE MINIMUM FACTOR OF SAFETY IS 2.424

Registered Permit-by-Rule
Beneficial Re-use

Kentucky River Station (KRS)
Kentucky-American Water Company (KAWC)

Attachment 5 - Environmental Performance Standards

Floodplains (401 KAR 30:031, Section 2)

Based on current floodplain mapping published by the Federal Emergency Management Agency (Flood Insurance Rate Map, Lexington, Fayette Urban County Government, Community Panel Number 210067-0090 C, September 3, 1993), the structural fill will not restrict the flow of the 100-year flood and is not within a floodplain. Since the fill will not be in the floodplain, the temporary water storage capacity of the floodplain will also not be reduced and washout of material will not occur.

Endangered Species (401 KAR 30:031, Section 3)

A letter dated January 14, 1997 from the Kentucky Nature Preserves Commission indicates that there are no threatened, or endangered species in the area of the structural fill. The letter is included in this attachment.

Surface Water (401 KAR 30:031, Section 4)

Sufficient sediment control will be established using the best management practices outlined in "Best Management Practices for Construction Activities" prepared by the Kentucky Divisions of Conservation and Water, Natural Resource and Environmental Protection Cabinet, Commonwealth of Kentucky.

Soils present beneath the structural fill are classified as upland soils based on the Fayette County, Kentucky Soil Survey published by the US Department of Agriculture, Soil Conservation Service. Therefore, a discharge of dredged material, or fill into water regulated by Section 404 of the Clean Water Act is not anticipated.

Groundwater (401 KAR 30:031, Section 5)

Based on the data provided in Attachment 3, the TCLP concentration for all regulated chemicals under 401 KAR 30:031 Section 5 (1), is below the MCL, or below detection limits. Based on the data provided in Attachment 3, the material will not exceed the environmental performance standards listed in 401 KAR 30:031 Section 5(1).

Application to Land Use for the Production of Food Chain Crops (401 KAR 30:031 Section 6)

The residuals will not be applied to the land for the production of food crops. Therefore, this section is not applicable.

Polychlorinated Biphenyls (401 KAR 30:031 Section 7)

Based on historical testing completed by KAWC, the concentration of PCBs is less than 1 mg/kg (dry weight basis). The November 1989 report is included in this attachment.

Disease (401 KAR 30:031 Section 8)

Due to the non-organic nature of the fill material, disease vectors are not expected to be a concern. In addition, septic tank cleanings and sewage sludge are not part of the materials to be used in the structural fill.

Air (401 KAR 30:031 Section 9)

Open burning will not be conducted on the structural fill and the structural fill will be operated so that the requirements of KRS Chapter 224, or 401 KAR Chapters 50 to 63 will not be violated.

Safety (401 KAR 30:031 Section 10)

The residual materials are not known to generate explosive gases and are not known to be flammable. In addition, the structural fill is on KAWC property with access restricted by a chain link fence.

Public Nuisance (401 KAR 30:031 Section 11)

The residual material to be used in the structural fill are soil-like and will not pose a public nuisance through blowing litter, debris, or other waste material.

Wetlands (401 KAR 30:031 Section 12)

The soils beneath the structural fill are classified as upland soils by the Soil Conservation Service; therefore, the area to be filled does not classify as jurisdictional wetlands.

Karst (401 KAR 30:031 Section 13)

Based on geologic quadrangle mapping (Geologic Map of the Coletown Quadrangle, East-Central Kentucky, USGS, 1967 and Geologic Map of the Ford Quadrangle, Central Kentucky, USGS, 1968), there are no known features of Karst terrain at the structural fill site.

Radioactivity

Although radioactivity is not a direct requirement of the Kentucky Environmental Performance Standards, recent EPA guidance on water treatment residuals has raised environmental health and safety questions within the cabinet on the use of water treatment residuals as a structural fill. To investigate these concerns, KAWC subjected the residuals to radioactivity testing. The results were then forwarded to the Kentucky Cabinet for Health Services, Department for Public Health. Dr. John Volpe, Supervisor of the Radiation Control Program reviewed the results and evaluated the risk associated with the use of the residuals as structural fill. A copy of his response is included in this attachment and indicates that significant health and safety risks should not be posed by the structural fill.

ROBERT MCCANCE, JR.
DIRECTOR

PAUL E. PATTON
GOVERNOR

COMMONWEALTH OF KENTUCKY
KENTUCKY STATE NATURE PRESERVES COMMISSION
801 SCHENKEL LANE
FRANKFORT, KENTUCKY 40601-1403
(502) 573-2886 VOICE
(502) 573-2355 FAX

January 14, 1997

Don Armour
FMSM Engineers, Inc.
1409 North Forbes Road
Lexington, KY 40511-2050

Data Request 97-72

Dear Mr. Armour:

This letter is in response to your data request of January 7, 1997 for the Structural Fill - Kentucky River project. We have reviewed our Natural Heritage Program Database to determine if any of the endangered, threatened, or special concern plants and animals or exemplary natural communities monitored by the Kentucky State Nature Preserves Commission occur in the specified area on the Coletown and Ford quadrangles. Based on our most current information, we have determined that no occurrences of the plants or animals and no occurrences of the exemplary natural communities that are monitored by KSNPC are reported as occurring in the specified area.

It is important to note that your project area comes in close proximity to Floracliff State Nature Preserve. This nature preserve harbors a population of the state threatened plant *Malvastrum hispidum*, Hispid false mallow. Any questions concerning the preserve should be directed to Joyce Bender, Stewardship Coordinator. A map of Floracliff State Nature Preserve is enclosed.

Please note that the quantity and quality of data collected by the Kentucky Natural Heritage Program are dependent on the research and observations of many individuals and organizations. In most cases, this information is not the result of comprehensive or site-specific field surveys; many natural areas in Kentucky have never been thoroughly surveyed, and new plants and animals are still being discovered. For these reasons, the Kentucky Natural Heritage Program cannot provide a definitive statement on the presence, absence, or condition of biological elements in any part of Kentucky. Heritage reports summarize the existing information known to the Kentucky Natural Heritage Program at the time of the request regarding the biological elements or locations in question. They should never be regarded as final statements on the elements or areas being considered, nor should they be substituted for on-site surveys required for environmental assessments. We

would greatly appreciate receiving any pertinent information obtained as a result of on-site surveys.

If you have any questions or I can be of further assistance, please do not hesitate to contact me.

Sincerely,

Martina Hines

Martina Hines
Data Manager

MH/MGR

Enclosures: Endangered, Threatened, and Special Concern Plants and Animals of Kentucky
Plants and Animals Presumed Extinct or Extirpated from Kentucky
Monitored Natural Communities of Kentucky
Map of Floracliff State Nature Preserve

Edward G. Foree, Ph.D., P.E.

John S. Tapp, Ph.D., P.E., L.S.

COMMONWEALTH TECHNOLOGY, INC.

Environmental and Natural Resources Consulting and Analytical Services

DATE: 11/08/89

CTI LAB NO: L8912241
P. O. NO: N/A

To: Kentucky-American Water Company
2300 Richmond Road
Lexington KY 40502

Attn: Ms. Jan Routt

REPORT ON TESTING OF SAMPLES

SAMPLE ID: Water Treatment Sludge STORAGE AREA COMPOSITE
SOURCE OF SAMPLE: KY River Station
SAMPLE TYPE: Composite
DATE OF COLLECTION: 10/10/89
COLLECTION TIME: 9:30A
COLLECTED BY: Client
DATE RECEIVED: 10/11/89

NOTE: 835 gr. d.w./L wet volume; 0.614 gr. d.w./gr. wet weight

PARAMETER		RESULTS	UNITS	DET'T LIMIT
Corrosivity		6	S U	N/A
Density		1.36	g/cc	0.01
EP Toxicity: Arsenic	<	0.01	mg/L	0.01
EP Toxicity: Barium	<	0.5	mg/L	0.5
EP Toxicity: Cadmium	<	0.01	mg/L	0.01
EP Toxicity: Chromium	<	0.05	mg/L	0.05
EP Toxicity: Lead	<	0.05	mg/L	0.05
EP Toxicity: Mercury	<	0.001	mg/L	0.001
EP Toxicity: Selenium	<	0.01	mg/L	0.01
EP Toxicity: Silver	<	0.03	mg/L	0.03
Ignitability		NEG		N/A
Nitrogen, Ammonia		0.0008	%	N/A
Nitrogen, Nitrate		0.0028	%	N/A
Nitrogen, Total Kjeldahl		0.96	%	N/A
Paint Filter		0	%Free Liqu	N/A
PCB's	<	1	mg/Kg d w	1
Phosphorus, Total		0.09	%	N/A
Reactivity-Forms Toxic Gas/Vapor w/Water		NEG		N/A
Reactivity-Reacts Violently with Water		NEG		N/A
Solids, Total		61.4	%	N/A
Solids, Total Volatile		12.5	%	N/A

Edward G. Foree, Ph.D., P.E.

John S. Tapp, Ph.D., P.E., L.S.

COMMONWEALTH TECHNOLOGY, INC.

Environmental and Natural Resources Consulting and Analytical Services

Page 2
L8912241
KRS SLUDGE STORAGE AREA 10/10/89
COMPOSITE

PARAMETER	RESULTS	UNITS	DET'T LIMIT
Total Cadmium	1.3	mg/Kg TS	0.01
Total Chromium	27.7	mg/Kg TS	0.05
Total Copper	44.3	mg/Kg TS	0.02
Total Lead	39.6	mg/Kg TS	0.05
Total Nickel	51.1	mg/Kg TS	0.05
Total Potassium	0.26	%	N/A
Total Zinc	162	mg/Kg TS	0.05

Route 3, Box 10
Grayson, KY 41143-9501
(606) 474-7891

2520 Regency Road
Lexington, KY 40503-2961
(606) 276-3506

101 Jasper Street
Somerset, KY 42501-1201
(606) 679-3530

TELEDYNE ISOTOPES
MIDWEST LABORATORY

dba TELEDYNE BROWN ENGINEERING
ENVIRONMENTAL SERVICES
700 Landwehr Road • Northbrook, IL 60062-2310
Phone (847) 564-0700 • Fax (847) 564-4517

Ms. Marcia Wooton
Commonwealth Technology, Inc.
2520 Regency Rd.
Lexington, Kentucky 40503-2961

LABORATORY REPORT NO.: 8100-3866
DATE: 10-11-96
SAMPLES RECEIVED: 09-26-96
TYPE OF REPORT: COMPLETE
PURCHASE ORDER NO.: S-1254

Dear Ms. Wooton:

Below are the results of the analyses for gross alpha, gross beta, radium-226 and isotopic uranium in two (2) sludge samples collected September 24, 1996.

Lab Code	Kentucky River SPSG-6502	Richmond Road SPSG-6503
Sample Description	5852	5853
Isotope (DW Limits (MCL))	Concentration (pCi/g dry)	
Gross α } 15 pCi/L	29.8±6.0	30.6±5.7
Gross β }	49.7±4.2	42.6±3.7
* Ra-226 (5 pCi/L (excluding U))	2.1±0.3	1.7±0.4
U-233/234	2.8±0.3	4.6±0.6
U-235	<0.1	0.2±0.1
U-238	2.4±0.3	3.6±0.5

The error given is the probable counting error at the 95% confidence level. Less than (<) values are based on a 3 sigma counting error for background sample.

* Not so by (proposed)

Sincerely,

Tony Coorlim
Special Projects

TC:lsd

APPROVED BY L. G. Huebner
L. G. Huebner
Manager

SAMPLES RETAINED THIRTY DAYS AFTER ANALYSIS

ABINET FOR HEALTH SERVICES
COMMONWEALTH OF KENTUCKY
FRANKFORT 40621-0001

RTMENT FOR PUBLIC HEALTH

December 20, 1996

DEC 4 19

Mr. D.W. Armour, Jr., P.E.
Fuller, Mossbarger, Scott and May
Engineers, Inc.
1409 North Forbes Road
Lexington, KY 40511-2050

Dear Mr. Armour:

The Kentucky Radiation Control Program has evaluated radiological risk associated with the use of water treatment residuals as structural fill. The analysis was performed with the data provided in your letter of October 31, 1996 and from information provided during our telephone conversations.

Three (3) pathways were evaluated as potential avenues of dose/risk. These include external exposure, inhalation, and soil ingestion. The predominant pathway was external exposure and minor dose from inhalation and soil. Analysis of dose/risk from radon was not conducted.

Based on the analysis, the Radiation Control Program considers the dose/risk to be consistent with proposed standards for release of contaminated facilities for unrestricted use. However, it must be understood this statement is based on the activities in soil provided in your letter of October 31, 1996. If activities of radionuclides are greater than indicated in your October 31, 1996 letter, the dose/risk would need to be recalculated for determining impact on worker and public health and safety. Since it was indicated the location would only be used for a lay-down area and no facilities would be constructed, the risk from radon was not considered. If facilities or houses are to be constructed, a detailed analysis of the impacts of radon would become necessary.

If you have questions regarding our evaluation, feel free to contact me at (502) 564-3700 or via e-mail at jvolpe1@mail.state.ky.us.

Sincerely,

John A. Volpe, Ph.D., Supervisor
Radiation Control Program

Attachment 6 - Quarterly Reporting Form

The following form will be completed and submitted to the Division of Waste Management on a quarterly basis to report the additional residual solids placed in the area designated for residual solids as shown on the site plan included in Appendix A.

Quarterly Report

Registered Permit-by-Rule
Beneficial Re-use

Kentucky River Station
Kentucky-American Water Company
2300 Richmond Road
Lexington, Kentucky 40502
(606) 269-2386

Registration Number:_____

Reporting Period:_____ to _____ , _____

Residual Solids Placed:

_____ tons

_____ cubic yards

Reported by: _____
(Name)

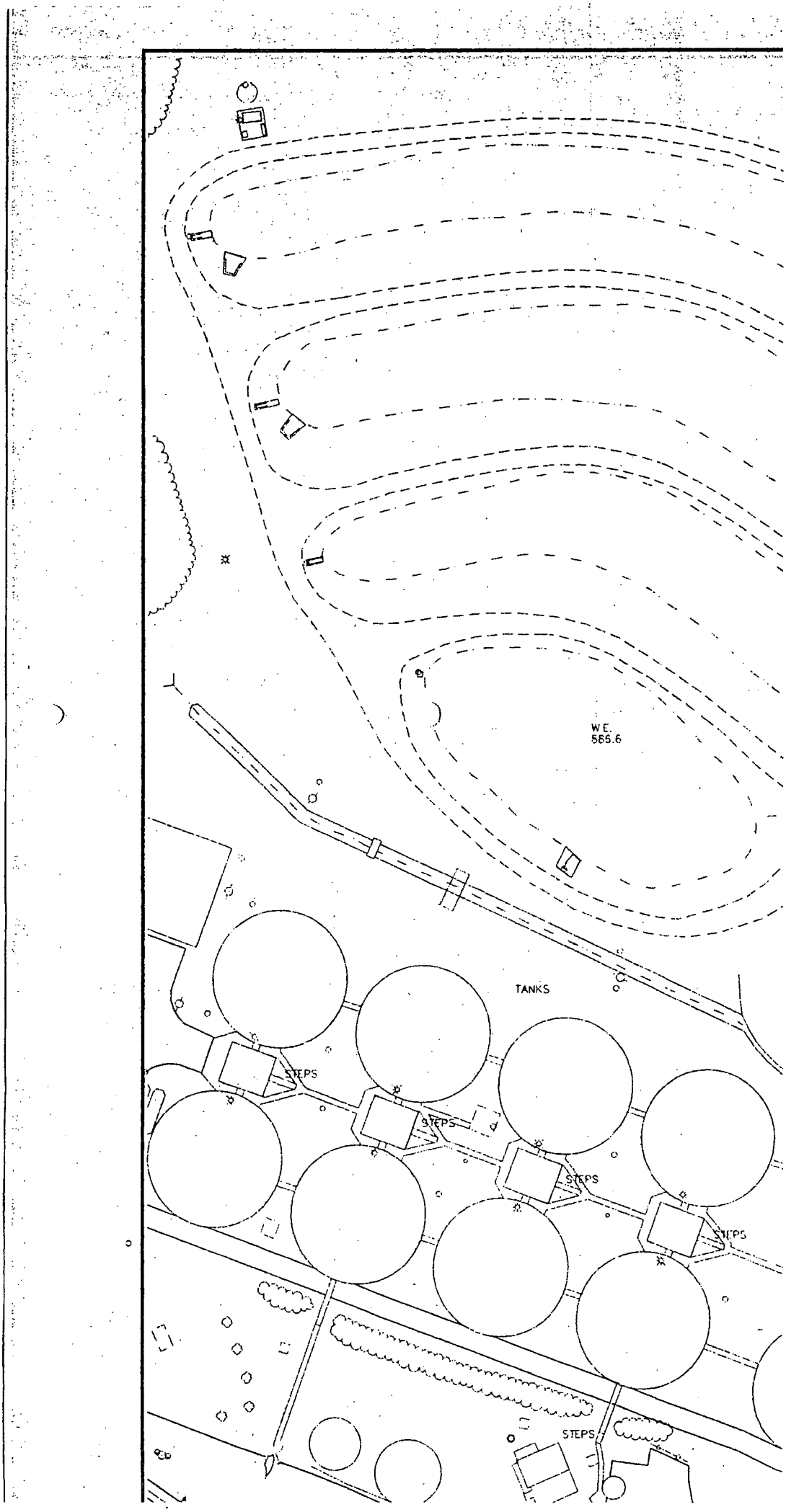
_____
(Title)

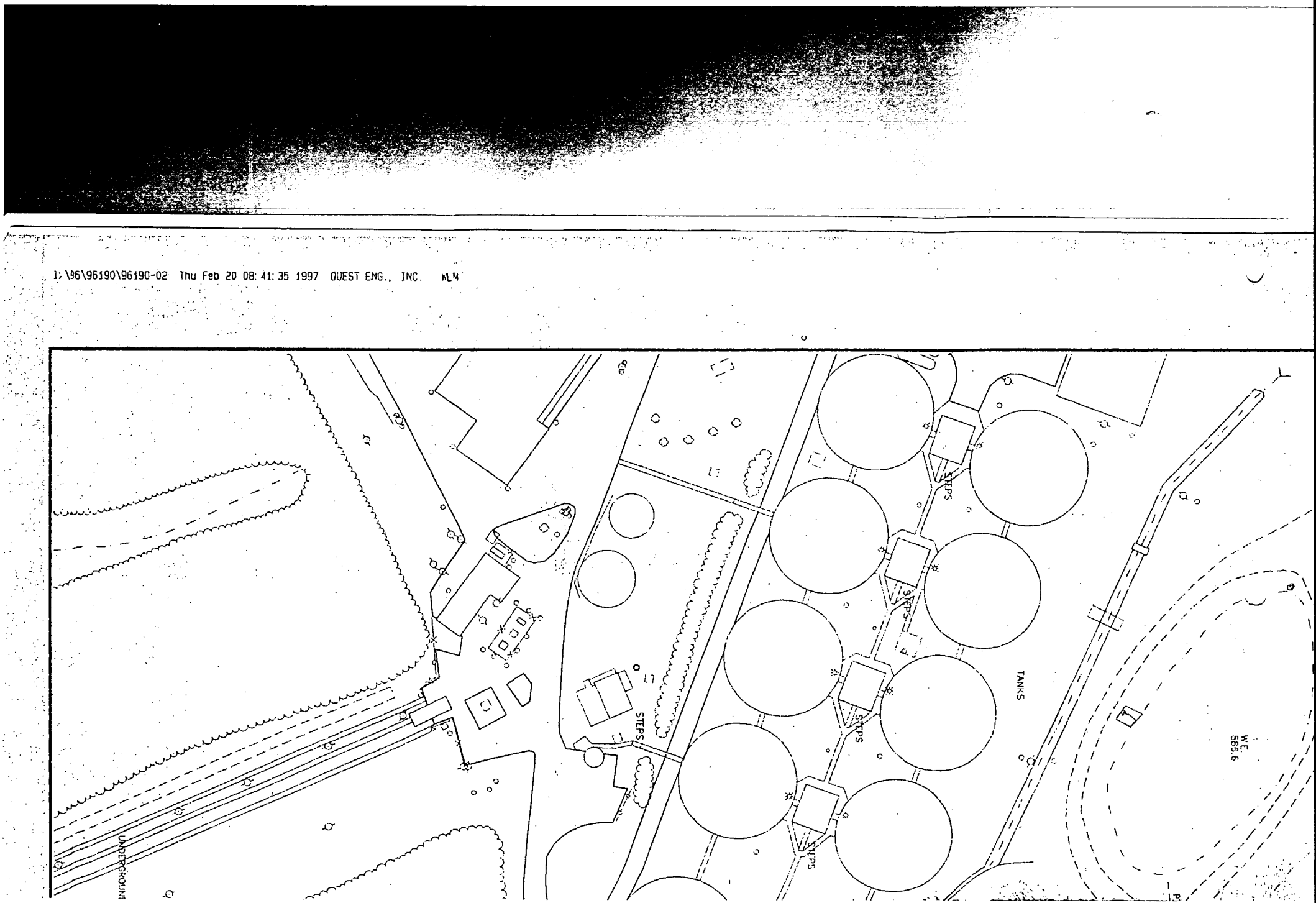
_____
(Date)

Registered Permit-by-Rule
Beneficial Re-use

Kentucky River Station (KRS)
Kentucky-American Water Company (KAWC)

Appendix A - Site Plan


W.E.
566.6
TANKS
STEPS
STEPS
STEPS
STEPS
STEPS


1:\96\96190\96190-02 Thu Feb 20 08:41:35 1997 QUEST ENG., INC. WLM
STEPS
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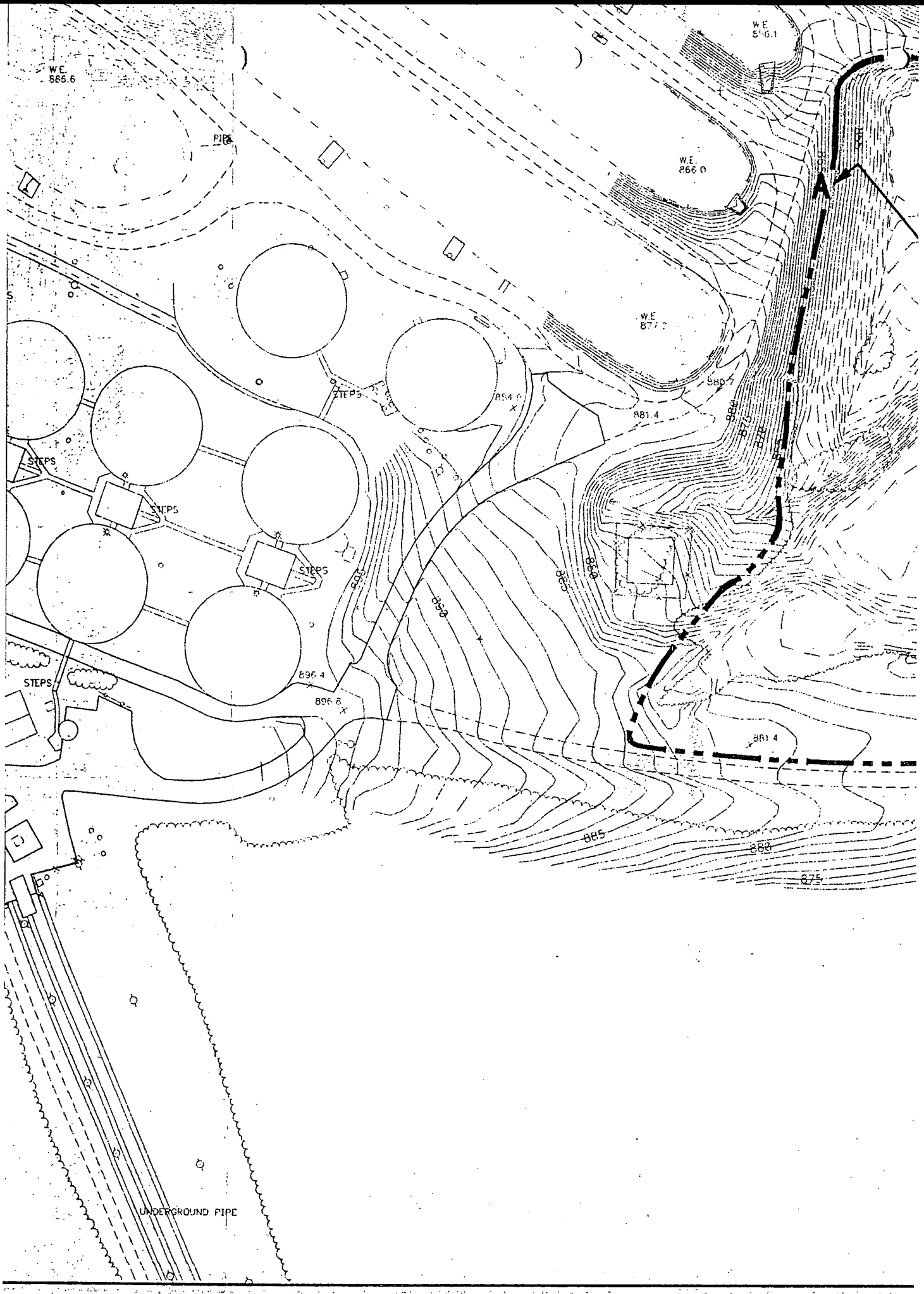
STEPS
TANKS
W.E. 565.6
UNDERGROUND


W.E.
566.6
PIPE
W.E.
866.0
STEPS
STEPS
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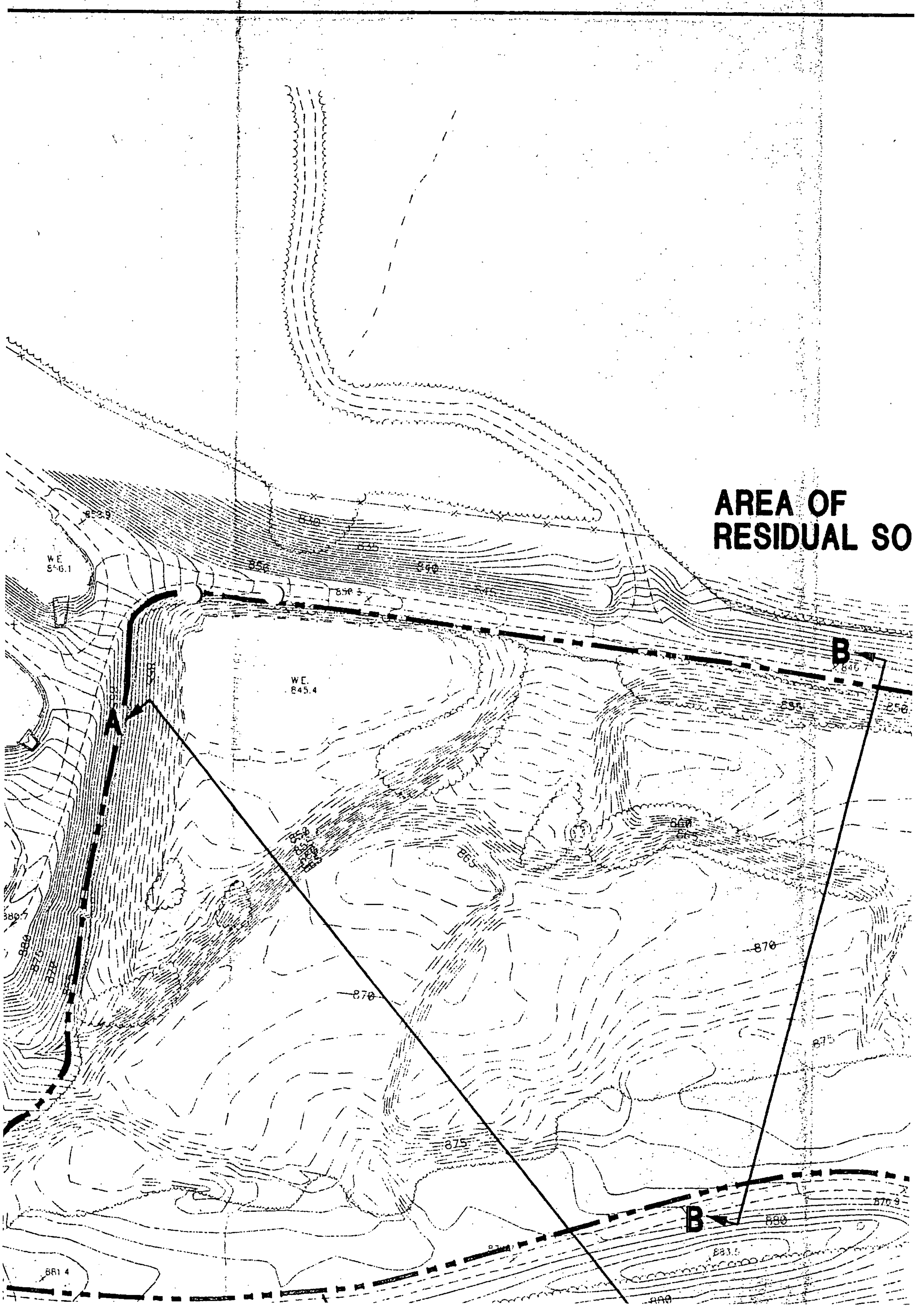
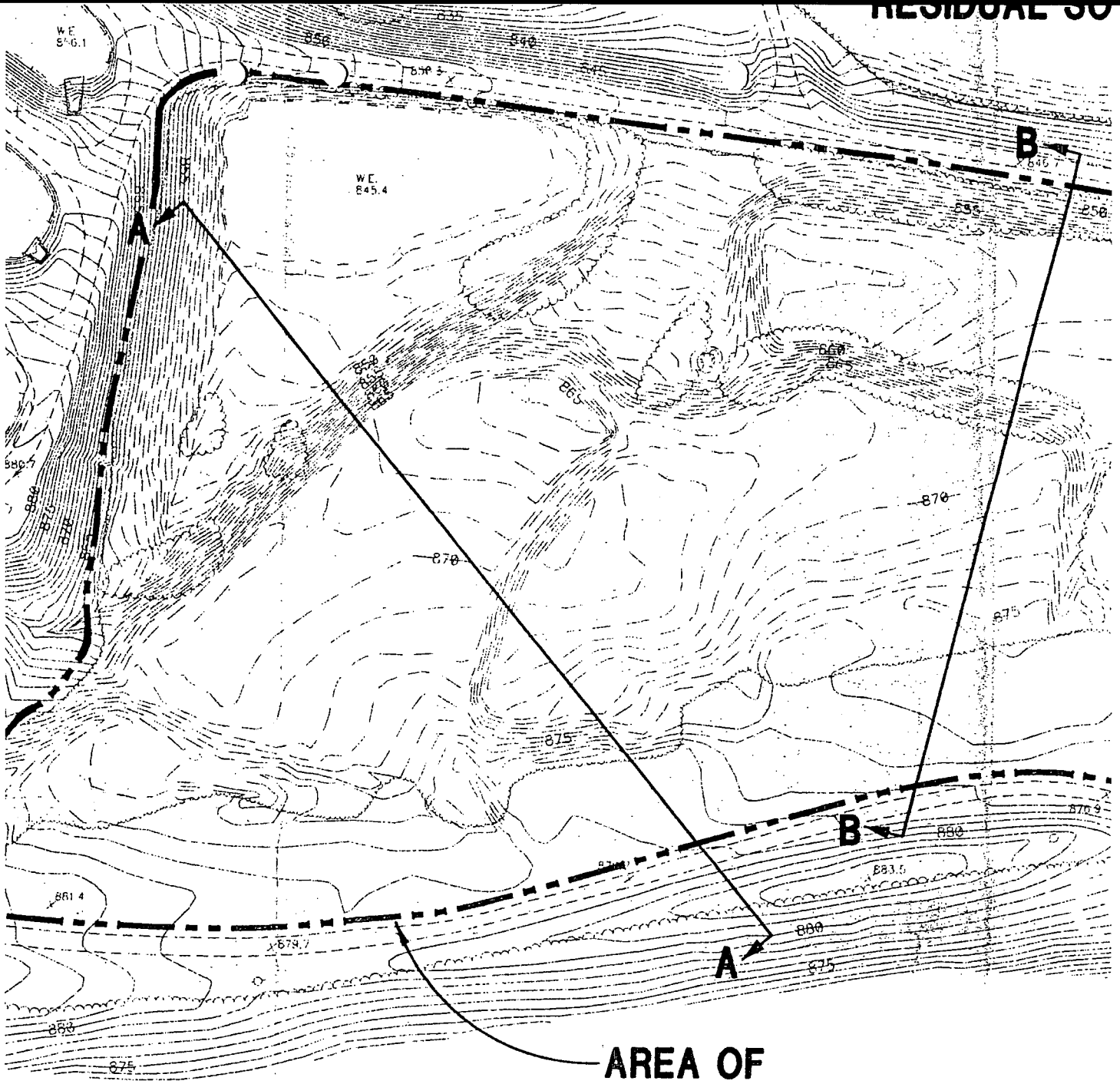
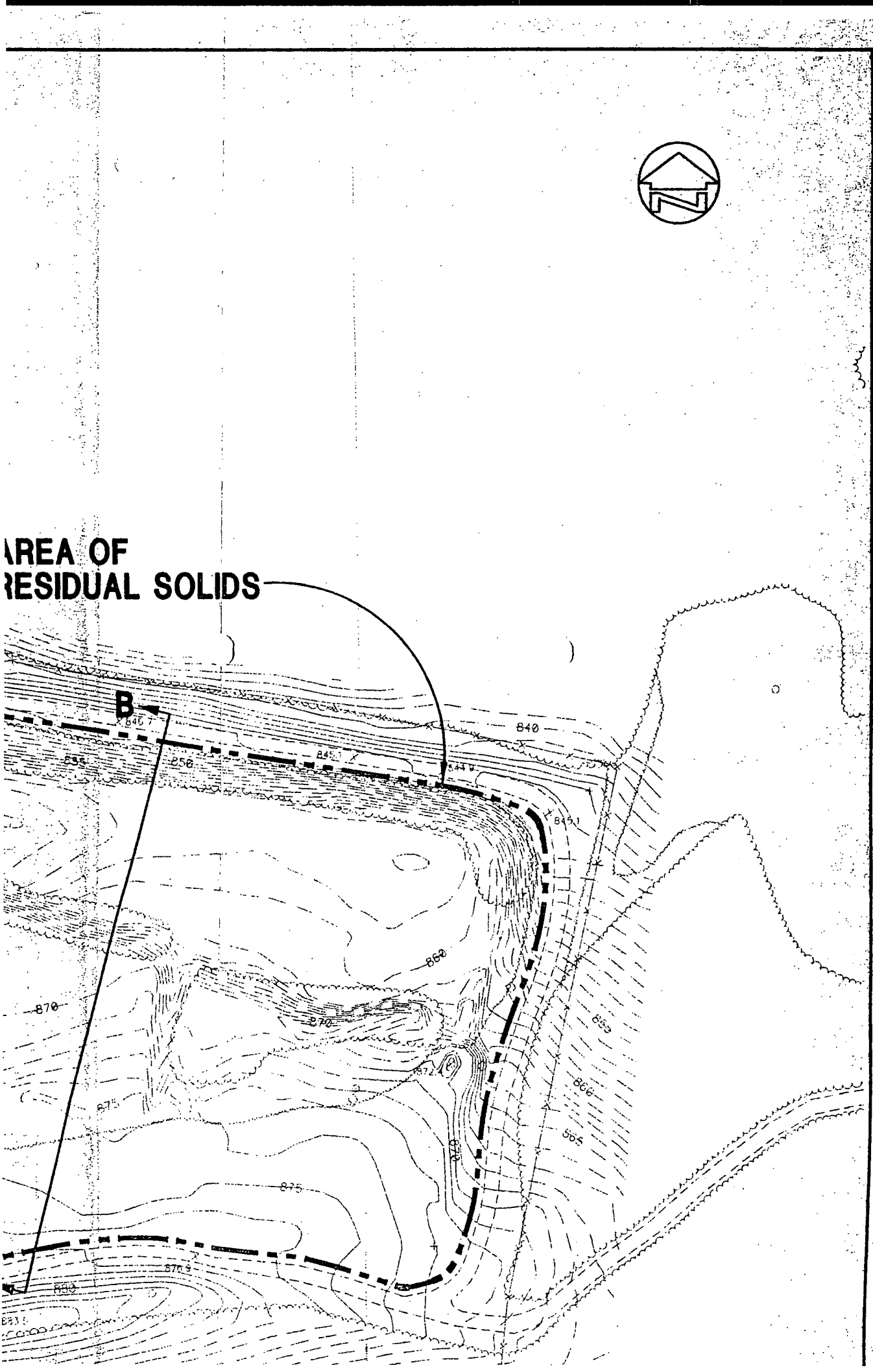
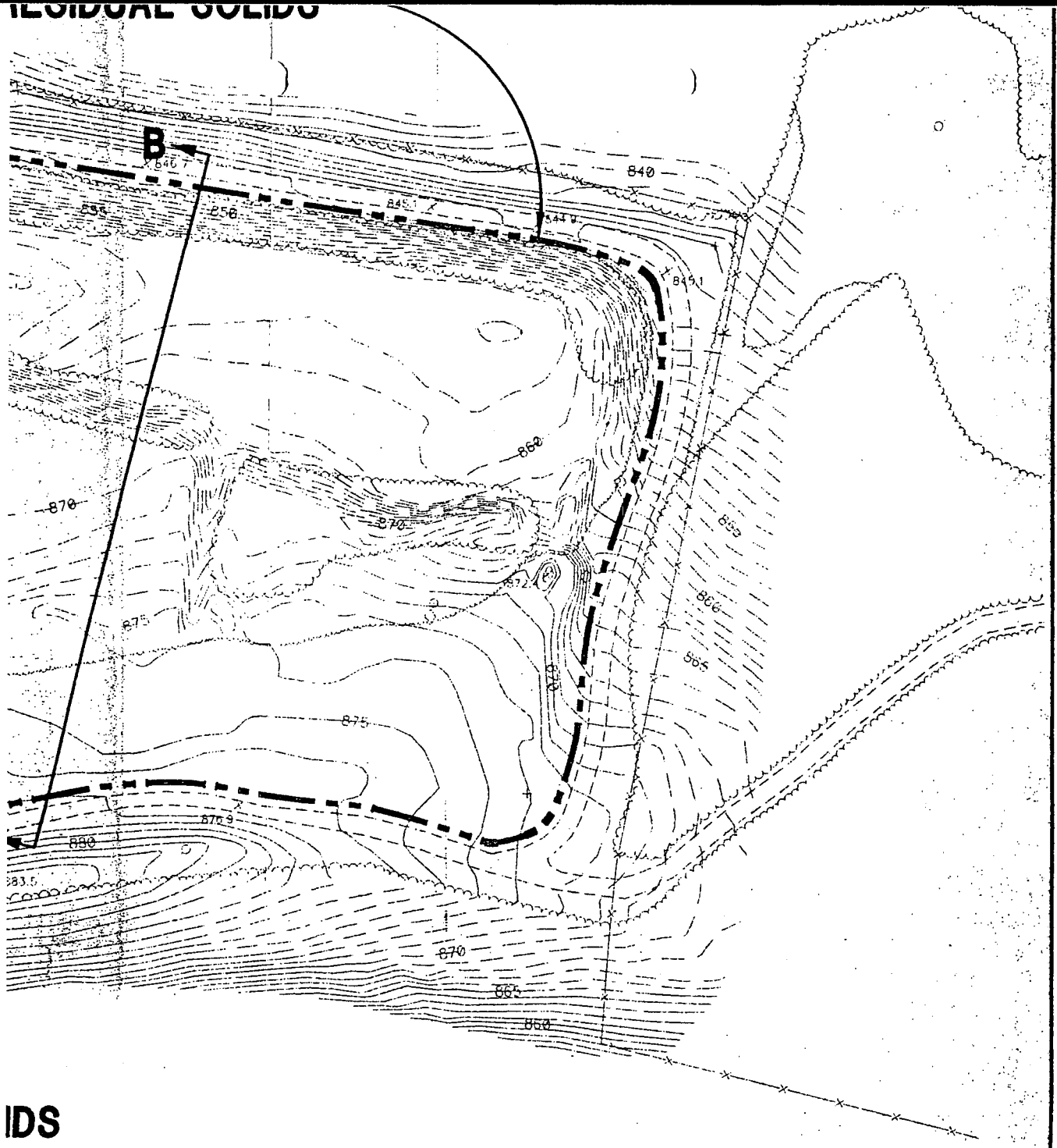
STEPS
STEPS
881.4
881.4
896.4
896.8
UNDERGROUND PIPE


AREA OF
RESIDUAL SO
A
B
B
W.E.
845.4
W.E.
846.1
870
870
875
875
880
883.5
876.9
846.7
861.4
865
840
835
830
853.9



CONTOURS AND MAPPING PROVIDED
PHOTO SCIENCE, INC.
LEXINGTON, KENTUCKY
JANUARY 1997


AREA OF
RESIDUAL SOLIDS
B
840
850
860
870
875



IDS

ONTOURS AND MAPPING PROVIDED BY
HOTO SCIENCE, INC.
XINGTON, KENTUCKY
NUARY 1997

REVISIONS

KENTUCKY RIVER STATION
AREA OF RESIDUAL SOLIDS

KENTUCKY–AMERICAN WATER COMPANY
LEXINGTON, KENTUCKY

PROJ. NO.	96190
DATE:	FEB. 1997
DESIGNED:	JCL
DRAWN:	WLM
CHECKED:	JCL
Q/C:	
SCALE:	1"=50'

Quest Engineers, Inc.
Lexington • Louisville

DRAWING NO. 1 OF 1

JAMES E. BICKFORD
SECRETARY

PAUL E. PATTON
GOVERNOR

COMMONWEALTH OF KENTUCKY
NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION CABINET
DEPARTMENT FOR ENVIRONMENTAL PROTECTION
DIVISION OF WASTE MANAGEMENT
14 REILLY RD
FRANKFORT KY 40601-1190

JUL 29 1997

Ms. Linda C. Bridwell
Engineering Manager
Kentucky-American Water Company
2300 Richmond Road
Lexington, KY 40502

RE: Beneficial Re-use Registered Permit-by-Rule Applications Approval
Richmond Road Station and Kentucky River Station Sites
Applications Number: 034-00042 RS2RG1 and 034-00050 RS1RG1
Permit Numbers: 034-00042 and 034-00050

Dear Ms. Bridwell:

The Division of Waste Management has completed the technical review of the above referenced applications and found them acceptable. The applications state that Kentucky-American Water intends to build material and equipment storage areas with the residual solids generated by the Richmond Road and Kentucky River Stations water treatment processes. These proposals are granted with the following conditions:

1. The beneficial re-use will follow the plans as stated in the applications dated February 19, 1997, and received by the Division on February 25, 1997.

2. The facilities shall operate in accordance with 401 KAR 45:070.

3. The facilities shall follow the Environmental Performance Standards set out in 401 KAR 30:031.

4. Residual solids must be placed as structural fill within (30) thirty days of being produced. No long term storage of the solids will be allowed.

5. Twice yearly analyses shall be conducted on the material disposed of at each site. Testing shall consist of the radiologicals, hazardous wastes, and PCB's.

6. Personnel handling radioactive wastes shall have their radiation exposure monitored.

7. Total radiation exposure to personnel with access to the sites shall not exceed 25 mrem/year and should remain as low as reasonably achievable.

8. The disposal areas shall be fenced off to prevent unauthorized site access.

9. A cap shall be placed on the disposal sites. The cap shall consist of ten feet of earth or non-radioactive material and be placed before any of the planned activities begin.

10. No buildings or closed structures shall be built upon the disposal sites without first performing a risk analysis on workers health based upon the contaminants levels of the materials disposed of.

11. Wastes containing Uranium in excess of 0.05% by weight would necessitate KAWC having to obtain a license from the U.S. Nuclear Regulatory Commission, unless conditions defined in 10 CFR 40 are met which exempt or preclude licensure.

12. You shall implement and maintain procedures necessary to ensure that the waste is treated and disposed of in compliance with all other state and federal regulations.

Please be aware that this acceptance does not supersede any local or county land use ordinances. If you have any questions concerning your permit, please contact me at (502) 564-2225, extension 239, or Mark Crim at extension 271.

Sincerely,

George F. Gilbert, Jr., P.E.

George F. Gilbert, Jr., P.E.
Manager, Solid Waste Branch

GFG/JRR/me

c: Frankfort Regional Office
Mark Crim
Ms. Julie W. Simpson, Water Quality Supervisor
Kentucky-American Water Company, 2300 Richmond Road, Lexington, KY 40502

JAMES E. BICKFORD
SECRETARY

PAUL E. PATTON
GOVERNOR

File - IN Sludge. Dept

COMMONWEALTH OF KENTUCKY
NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION CABINET
DEPARTMENT FOR ENVIRONMENTAL PROTECTION
FRANKFORT OFFICE PARK
14 REILLY RD
FRANKFORT KY 40601

March 13, 1998

Ms. Linda C. Bridwell
Engineering Manager
Kentucky-American Water Company
2300 Richmond Road
Lexington, KY 40502

RE: Beneficial Re-use Registered Permit-by-rule Permit Change
Richmond Road Station and Kentucky River Station Sites
Permit Numbers: 034-00042 and 034-00050

Dear Ms. Bridwell:

The Division of Waste Management has reviewed your request to modify the above referenced permits on the basis of the background radiation results dated February 6, 1998. The Division accepts the request for removal of Condition 9. A cap will not be required on the disposal site.

Also, Condition 6 will be modified as follows:

6) Personnel handling radioactive wastes shall have their radiation exposure monitored for a one (1) year time period beginning from April 1, 1998. Parameters for monitoring shall be verified with the Radiation Control Department of the Cabinet for Health Services. After one (1) year of monitoring, the Division of Waste Management will review the data to determine if continuous monitoring will be necessary.

Condition 7 will remain in effect until the study in Condition 6 is completed. The Division will review the necessity for further adjustments to the permit at that time.

received
3/20/98

Please be aware that local and county land use ordinances are not superseded by this permit. If you have any questions concerning these modifications to your permit, please contact me at (502) 564-2225, ext. 239, or Mark Crim at ext. 271.

Sincerely,

George F. Gilbert, Jr., P.E.

George F. Gilbert, Jr., P.E.
Manager, Solid Waste Branch
Division of Waste Management

GFG:JRR:akw

c: Frankfort Regional Office
Mark Crim
Ms. Julie W. Simpson, Water Quality Supervisor
Kentucky-American Water Company, 2300 Richmond Road, Lexington, KY 40502
Mr. John Hill
Fuller, Mossbarger, Scott, and May, 1409 North Forbes Rd., Lexington, KY 40511
Mr. John Volpe, Cabinet for Health Services

JAMES E. BICKFORD
SECRETARY

PAUL E. PATTON
GOVERNOR

COMMONWEALTH OF KENTUCKY
NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION CABINET
DEPARTMENT FOR ENVIRONMENTAL PROTECTION
FRANKFORT OFFICE PARK
14 REILLY RD
FRANKFORT KY 40601

August 28, 1998

Ms. Linda C. Bridwell
Engineering Manager
Kentucky-American Water Company
2300 Richmond Road
Lexington, KY 40502

RE: Beneficial Re-use Registered Permit-by-rule Permit Change
Richmond Road Station and Kentucky River Station Sites
Permit Numbers: 034-00042 and 034-00050
Fayette County

Dear Ms. Bridwell:

The Division of Waste Management has reviewed your request to modify the above referenced permits on the basis of the background radiation results dated February 6, 1998. The Division accepts the request to delete the capping and monitoring requirements. A cap will not be required on the disposal site and personnel monitoring for radiation will not be required.

Please be aware that local and county land use ordinances are not superseded by this permit. If you have any questions concerning these modifications to your permit, please contact me at (502) 564-2225, ext. 239 or Mark Crim at ext. 271.

Sincerely,

George F. Gilbert, Jr., P.E.

George F. Gilbert, Jr.
Manager, Solid Waste Branch
Division of Waste Management

GFG:JRR:akw

c: Frankfort Regional Office
Mark Crim
Julie W. Simpson, Water Quality Supervisor
Kentucky-American Water Company, 2300 Richmond Road, Lexington, KY 40502
Fuller, Mossbarger, Scott, and May, 1409 North Forbes Rd., Lexington, KY 40511
John Volpe, Cabinet for Health Services

Kentucky-American Water Company

Lexington, Kentucky

KENTUCKY RIVER STATION ADDITIONAL RESIDUALS PROCESSING FACILITIES

Contract Documents
Bidding Requirements, Contract Forms, Conditions of the Contract, and Technical Specifications

VOLUME 1 OF 2

Prepared by:

American Water Works Service Company, Inc.
System Engineering
1025 Laurel Oak Road
Voorhees, NJ 08043

Montgomery Watson Americas, Inc.
Consulting Engineers
2000 Bond Court Building
1300 East Ninth Street
Cleveland, OH 44114

June 1999

KENTUCKY AMERICAN WATER COMPANY

KENTUCKY RIVER STATION
ADDITIONAL RESIDUALS PROCESSING FACILITIES

TABLE OF CONTENTS

INVITATION TO BID

FOR CONSTRUCTION OF

Kentucky American Water Company
Kentucky River Station
Additional Residuals Processing Facilities

Sealed Bids for furnishing all plant, labor, equipment, materials and performing all Work to construct the **Kentucky River Station Additional Residuals Processing Facilities**, will be received and opened at the office of the **Kentucky American Water Company, 2300 Richmond Road, Lexington, KY 40502** at 2:00 p.m., local time, **July 20, 1999**.

Two (2) sets of Bidding Documents, including the Instructions to Bidders, Bid Form, Bid Bond Forms and Contract Documents, will be provided at no charge to the CONTRACTORS who are invited to bid the project. Additional copies can be obtained from **Montgomery Watson, Inc.** at the following address: **2000 Bond Court Building, 1300 East Ninth Street, Cleveland, Ohio 44114, telephone (216) 621-2407** for a fixed charge of **$300** per set.

Requests for complete sets shall be forwarded to the above address and shall be accompanied by a check in the proper amount. Checks shall be made payable to **Montgomery Watson, Inc.**. Checks shall be non-refundable and no refunds will be made for return of complete or partial Contract Documents.

Subcontractors, manufacturers and material suppliers should obtain information and review the Bidding Documents by contacting potential Bidders. Documents will also be available for review at the **Kentucky American Water Company, 2300 Richmond Road, Lexington, KY 40502** or the office of the **Montgomery Watson, Inc.**

Each proposal shall be accompanied by a Bid Bond in an amount not less than ten (10%) percent of the bid total, payable to the OWNER, all in accordance with the provisions contained in the Bidding Documents.

OWNER reserves its rights to waive any informality or deficiency in any Bid, to accept any Bid, to negotiate modifications of any Bid with any Bidder and accept any modified Bid, to reject any Bid, to reject all Bids, and to rebid the Project, all at the OWNER's sole discretion.

INSTRUCTIONS TO BIDDERS

1. Defined Terms

Terms used in these Instructions to Bidders which are defined in the General Conditions of the Contract Documents have the meanings assigned to them in the General Conditions. The term "Bidder" means one who submits a Bid directly to OWNER, as distinct from a subbidder, who submits a Bid to a Bidder. The term "Successful Bidder" means the lowest, qualified, responsible and responsive Bidder to whom OWNER (on the basis of OWNER's evaluation as hereinafter provided) makes an award. The term "Bidding Documents" includes the Invitation to Bid, Instructions to Bidders, the Bid Form, and the proposed Contract Documents (including all Addenda issued prior to receipt of Bids).

2. Copies of Bidding Documents

2.1 Complete sets of the Bidding Documents in the number and for the amount, if any, stated in the Invitation to Bid may be obtained from the party listed on the Invitation to Bid. No refunds will be made for the return of complete or partial copies of the Bidding Documents.

2.2 Complete sets of Bidding Documents must be used in preparing Bids; neither OWNER nor ENGINEER assume any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.

2.3 OWNER and ENGINEER in making copies of Bidding Documents available on the above terms do so only for the purpose of obtaining Bids on the Work and do not confer a license or grant for any other use.

3. Qualifications of Bidders

Bidders must be prequalified. Each Bid must contain evidence of Bidder's qualification to do business in the state where the project is located or covenant to obtain such qualification prior to award of the contract.

4. Examination of Contract Documents and Site

4.1 It is the responsibility of each Bidder before submitting a Bid, to (a) examine the Contract Documents thoroughly, (b) visit the site to become familiar with local conditions that may affect cost, progress, performance or furnishing of the Work, (c) consider Laws and Regulations that may affect cost, progress, performance or furnishing of the Work, (d) study and carefully correlate Bidder's observations with the Contract Documents, and (e) notify ENGINEER of all conflicts, errors or discrepancies in the Contract Documents.

4.2 Reference is made to the Supplementary Conditions for identification of:

4.2.1 those reports of explorations and tests of subsurface conditions at the site which have been utilized by ENGINEER in preparation of the Contract Documents. Bidder may rely upon the accuracy of the technical data contained in such reports but not upon non-technical data, interpretations or opinions contained therein or for the completeness thereof for the purposes of bidding or construction.

4.2.2 those drawings of physical conditions in or relating to existing surface and subsurface conditions (except Underground Facilities) which are at or contiguous to the site which have been utilized by ENGINEER in preparation of the Contract Documents. Bidder may rely upon the accuracy of the technical data contained in such drawings but not upon non-technical data, interpretations or opinions contained therein or for the completeness thereof for the purpose of bidding or construction.

Copies of such reports and drawings will be made available by OWNER to any Bidder on request. Those reports and drawings are not part of the Contract Documents.

4.3 Information and data reflected in the Contract Documents with respect to Underground Facilities at or contiguous to the site is based upon information and data furnished to OWNER and ENGINEER by owners of such Underground Facilities or others, and OWNER does not assume responsibility for the accuracy or completeness thereof unless it is expressly provided otherwise in the Supplementary Conditions.

4.4 Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders on subsurface conditions, Underground Facilities and other physical conditions, and possible changes in the Contract Documents due to differing conditions appear in Paragraphs 4.2 and 4.3 of the General Conditions.

4.5 Before submitting a Bid, each Bidder will, at Bidder's own expense, make or obtain any additional examinations, investigations, explorations, tests and studies and obtain any additional information and data which pertain to the physical conditions (surface, subsurface and Underground Facilities) at or contiguous to the site or otherwise which may affect cost, progress, performance or furnishing of the Work and which Bidder deems necessary to determine its Bid for performing and furnishing the Work in accordance with the time, price and other terms and conditions of the Contract Documents.

4.6 On request in advance and after submittal of Bidder's evidence of insurance coverage meeting limits designated in the Supplementary Conditions, OWNER will provide each Bidder access to the site to conduct such explorations and tests as each Bidder deems necessary for submission of a Bid. Bidder shall fill all holes, clean up and restore the site to its former condition upon completion of such explorations.

4.7 The lands upon which the Work is to be performed, rights-of-way and easements for access thereto and other lands designated for use by CONTRACTOR in performing the Work are identified in the Contract Documents. All additional lands and access thereto required for

temporary construction facilities or storage of materials and equipment are to be provided by CONTRACTOR. Easements for permanent structures or permanent changes in existing structures are to be obtained and paid for by OWNER unless otherwise provided in the Contract Documents.

4.8 The submission of a Bid will constitute an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article 4, that without exception the Bid is premised upon performing and furnishing the Work required by the Contract Documents and such means, methods, techniques, sequences or procedures of construction as may be indicated in or required by the Contract Documents, and that the Contract Documents are sufficient in scope and detail to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

5. Interpretations and Addenda

5.1 All questions about the meaning or intent of the Contract Documents are to be directed to ENGINEER. Interpretations or clarifications considered necessary by ENGINEER in response to such questions will be issued by Addenda mailed or delivered to all parties recorded by ENGINEER as having received the Bidding Documents. Questions received less than ten days prior to the date for opening of Bids may not be answered. Only questions answered by formal written Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.

5.2 Addenda may also be issued to modify the Bidding Documents as deemed advisable by OWNER or ENGINEER.

6. Bid Security

6.1 Each Bid must be accompanied by Bid security made payable to OWNER in an amount of ten percent of the Bidder's maximum Bid price and in the form of a Bid Bond (on form attached), issued by a surety meeting the requirements of Paragraph 5.1 of the General Conditions.

6.2 The Bid security of the Successful Bidder will be retained until such Bidder has executed the Agreement and furnished the required contract security, whereupon the Bid security will be returned. If the Successful Bidder fails to execute and deliver the Agreement and furnish the required contract security within fifteen days after the Notice of Award, OWNER may annul the Notice of Award and the Bid security of that Bidder will be forfeited. The Bid security of other Bidders whom OWNER believes to have a reasonable chance of receiving the award may be retained by OWNER until the expiration of the period that bids are subject to acceptance, whereupon Bid security furnished by such Bidders will be returned. Bid security with Bids which are not competitive will be returned within Fourteen days after the Bid opening.

7. Contract Times

The times for Substantial Completion and final completion are to be set forth by Bidder in the Bid and will be included in the Agreement. The times will be taken into consideration by OWNER during the evaluation of Bids, and it will be necessary for the Successful Bidder to satisfy OWNER of Bidder's ability to achieve Substantial Completion and final completion within the times designated in the Bid. Substantial Completion is desired on or before **December 1, 2000.**

8. Liquidated Damages

Provisions for liquidated damages, if any, are set forth in the Agreement.

9. Substitute and "Or-Equal" Items

Substitute or "Or-Equal" items are subject to the requirements of Paragraph 6.7 of the General Conditions.

All Bids shall be based upon the specified products. However, Bidders are encouraged to quote on alternative products by listing them in the tabulation of "Alternative Equipment and/or Materials" of the Bid Form as required by Section 1100 of the General Requirements. No later substitutes will be considered by the OWNER.

The specified products have been used in preparing the Drawings and Specifications and thus establish minimum qualities which alternatives must meet to be considered acceptable. The burden of proof of equality rests with the Bidder and adequate supporting information must be provided. The OWNER reserves the right to accept or reject proposed alternatives.

The Bid sum for each proposed alternative shall include all money required to incorporate the alternative into the project. Later requests for additional monies for alternatives will not be considered.

10. Subcontractors, Suppliers and Others

10.1 If the Supplementary Conditions require the identity of certain Subcontractors, Suppliers and other persons and organizations (including those who are to furnish the principal items of material and equipment) to be submitted to OWNER in advance of the specified date prior to the Effective Date of the Agreement, the apparent Successful Bidder, and any other Bidder so requested, shall within seven days after the Bid opening submit to OWNER a list of all such Subcontractors, Suppliers and other persons and organizations proposed for those portions of the Work for which such identification is required. Such list shall be accompanied by an experience statement with pertinent organization information if requested by OWNER. If OWNER or ENGINEER after due investigation has reasonable objection to any proposed Subcontractor, Supplier, other person or organization, OWNER or ENGINEER may before the Notice of Award is given request the apparent Successful Bidder to submit an acceptable substitute without an increase in Bid price.

If apparent Successful Bidder declines to make any such substitution, OWNER may award the contract to the next responsive Bidder that proposes to use acceptable Subcontractors, Suppliers and other persons and organizations. The declining to make requested substitutions will not constitute grounds for sacrificing the Bid security of any Bidder. Any Subcontractor, Supplier, other person or organization listed and to whom OWNER or ENGINEER does not make written objection prior to the giving of the Notice of Award will be deemed acceptable to OWNER and ENGINEER subject to revocation of such acceptance after the Effective Date of the Agreement as provided in Paragraph 6.8.2 of the General Conditions.

10.2 No CONTRACTOR shall be required to employ any Subcontractor, Supplier, other person or organization against whom CONTRACTOR has reasonable objection.

10.3 Certain Subcontractor and suppliers are to be approved by the OWNER and ENGINEER. Bidder shall identify the following Subcontractor(s) within seven (7) days after the date of the bid opening:

a) Electrical Subcontractor

11. Bid Form

11.1 The Bid Form is included with the Bidding Documents; additional copies may be obtained from the party issuing the documents as listed on the Invitation to Bid.

11.2 All blanks on the Bid Form must be completed in ink or by typewriter.

11.3 Bids by corporations must be executed in the corporate name by the president or a vice-president (or other corporate officer accompanied by evidence of authority to sign) and the corporate seal must be affixed and attested by the secretary or an assistant secretary. The corporate address and state of incorporation must be shown below the signature.

11.4 Bids by partnerships must be executed in the partnership name and signed by a partner, whose title must appear under the signature and the official address of the partnership must be shown below the signature.

11.5 All names must be typed or printed below the signature.

11.6 The Bid shall contain an acknowledgment of receipt of all Addenda (the numbers of which must be filled in on the Bid Form).

11.7 The address and telephone number for communications regarding the Bid must be shown.

12. Submission of Bids

Bids shall be submitted at the time and place indicated in the Invitation to Bid and shall be enclosed in an opaque sealed envelope, marked with the Project title and name and address of the Bidder and accompanied by the Bid security and other required documents. If the Bid is sent through the mail or other delivery system the sealed envelope shall be enclosed in a separate envelope with the notation "BID ENCLOSED" on the face of it.

13. Modification and Withdrawal of Bids

Bids may be modified or withdrawn by an appropriate document duly executed (in the manner that a Bid must be executed) and delivered to the place where Bids are to be submitted at any time prior to the opening of Bids.

14. Opening of Bids

The opening of Bids will be **public. Only Bidders are invited to attend.**

15. Bids to Remain Subject to Acceptance

All Bids will remain subject to acceptance for **One Hundred Fifty (150)** days after the day of the Bid opening, but OWNER may, in its sole discretion, release any Bid and return the Bid security prior to the acceptance period. A Certificate of Convenience and Necessity is required from the Kentucky Public Service Commission before work can begin. This certificate can only be issued after bids have been received.

16. Award of Contract

16.1 OWNER reserves the right to reject any and all Bids, to waive any and all informalities and to negotiate contract terms with the Successful Bidder, and the right to disregard all nonconforming, nonresponsive, unbalanced or conditional Bids. Also, OWNER reserves the right to reject the Bid of any Bidder if OWNER believes that it would not be in the best interest of the Project to make an award to that Bidder, whether because the Bid is not responsive or the Bidder is unqualified or of doubtful financial ability or fails to meet any other pertinent standard or criteria established by OWNER. Discrepancies in the multiplication of units of Work and Unit Prices will be resolved in favor of the Unit Prices. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum.

16.2 In evaluating Bids, OWNER will consider the qualifications of the Bidders, whether or not the Bids comply with the prescribed requirements, and such alternates, Unit Prices and other data, as may be requested in the Bid Form or prior to the Notice of Award.

16.3 OWNER may consider the qualifications and experience of Subcontractors, Suppliers, and other persons and organizations proposed for those portions of the Work as to which the identity of Subcontractors, Suppliers, and other persons and organizations must be submitted as provided

in the Supplementary Conditions. OWNER also may consider the operating costs, maintenance requirements, performance data and guarantees of major items of materials and equipment proposed for incorporation in the Work when such data is required to be submitted prior to the Notice of Award.

16.4 OWNER may conduct such investigations as OWNER deems necessary to assist in the evaluation of any Bid and to establish the responsibility, qualifications and financial ability of Bidders, proposed Subcontractors, Suppliers and other persons and organizations to perform and furnish the Work in accordance with the Contract Documents to OWNER's satisfaction within the prescribed time.

16.5 If the contract is to be awarded, it will be awarded to the Bidder whose evaluation by OWNER indicates to OWNER that the award will be in the best interests of the Project.

16.6 If the contract is to be awarded, OWNER will give the Successful Bidder a Notice of Award within the period of time that bids are subject to acceptance.

17. Contract Security

Paragraph 5.1 of the General Conditions and the Supplementary Conditions set forth OWNER's requirements as to performance, payment or other Bonds. When the Successful Bidder delivers the executed Agreement to OWNER, it must be accompanied by the required Bonds.

18. Signing of Agreement

When OWNER gives a Notice of Award to the Successful Bidder, it will be accompanied by the required number of unsigned counterparts of the Agreement with all other written Contract Documents attached. Within fifteen days thereafter CONTRACTOR shall sign and deliver the required number of counterparts of the Agreement and attached documents to OWNER with the required Bonds. Within ten days thereafter OWNER shall deliver one fully signed counterpart to CONTRACTOR.

19. Prebid Conference

A prebid conference will be held at **1:00 p.m.** on the **30th day of June** at **Kentucky-American Water Company, Kentucky River Station, Lexington, KY 40502.** Representatives of OWNER and ENGINEER will be present to discuss the Project. Bidders are **required** to attend and participate in the conference. ENGINEER will transmit to all prospective Bidders of record such Addenda as ENGINEER considers necessary in response to questions arising at the conference.

20. Sales and Use Taxes

OWNER is exempt from **Kentucky** State Sales and Use Taxes on certain materials and equipment to be incorporated in the Work. Said taxes shall not be included in the Contract Price. Refer to Supplementary Conditions SC-6.15 for additional information.

21. Retainage

Provisions concerning retainage are set forth in the Agreement.

BID

PROJECT IDENTIFICATION: **Kentucky American Water Company**
Kentucky River Station
Additional Residuals Processing Facilities

THIS BID IS SUBMITTED TO: **Roy Mundy, President**
Kentucky American Water Company
2300 Richmond Road
Lexington, Kentucky, 40502

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1. The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an Agreement with OWNER in the form included in the Contract Documents to perform and furnish all Work as specified or indicated in the Contract Documents for the Contract Price and within the Contract Times indicated in this Bid and in accordance with the other terms and conditions of the Contract Documents.

2. Bidder accepts all of the terms and conditions of the Invitation to Bid and Instructions to Bidders, including without limitation those dealing with the disposition of Bid security. This Bid will remain subject to acceptance as stated in paragraph 15 of the Instructions To Bidders. Bidder will sign and submit the Agreement with the Bonds and other documents required by the Bidding Requirements within fifteen days after the date of OWNER's Notice of Award.

3. In submitting this Bid, Bidder represents, as more fully set forth in the Agreement:

(a) Bidder has examined copies of all the Bidding Documents and of the following Addenda (receipt of all which is hereby acknowledged):

Date	Number
_____	_____
_____	_____
_____	_____
_____	_____

(b) Bidder has familiarized itself with the nature and extent of the Contract Documents, Work, site, locality, and all local conditions and Laws and Regulations that in any manner may affect cost, progress, performance or furnishing of the Work.

(c) Bidder has studied carefully all reports and drawings of subsurface conditions and drawings of physical conditions which are identified in the Supplementary Conditions as provided in Paragraph 4.2 of the General Conditions, and accepts the determination set forth in Paragraph GC-4.2.2 of the General Conditions, as may be amended by the Supplemental Conditions, of the extent the technical data contained in such reports and drawings upon which Bidder is entitled to rely.

(d) Bidder has obtained and carefully studied (or assumes responsibility for obtaining and carefully studying) all such examinations, investigations, explorations, tests and studies (in addition to or to supplement those referred to in (c) above) which pertain to the subsurface or physical conditions at the site or otherwise which may affect the cost, progress, performance or furnishing of the Work as Bidder considers necessary for the performance or furnishing of the Work at the Contract Price, within the Contract Times and in accordance with the other terms and conditions of the Contract Documents, including specifically the provisions of Paragraph 4.2 of the General Conditions; and no additional examinations, investigations, explorations, tests, reports or similar information or data are or will be required by Bidder for such purposes.

(e) Bidder has reviewed and checked all information and data shown or indicated on the Contract Documents with respect to existing Underground Facilities at or contiguous to the site and assumes responsibility for the accurate location of said Underground Facilities. No additional examinations, investigations, explorations, tests, reports or similar information or data in respect of said Underground Facilities are or will be required by Bidder in order to perform and furnish the Work at the Contract Price, within the Contract Times and in accordance with the other terms and conditions of the Contract Documents, including specifically the provisions of Paragraph 4.3 of the General Conditions.

(f) Bidder has correlated the results of all such observations, examinations, investigations, explorations, tests, reports and studies with the terms and conditions of the Contract Documents.

(g) Bidder has given ENGINEER written notice of all conflicts, errors or discrepancies that it has discovered in the Contract Documents and the written resolution thereof by ENGINEER is acceptable to Bidder.

(h) This Bid is genuine and not made in the interest of or on behalf of any undisclosed person, firm or corporation and is not submitted in conformity with any agreement or rules of any group, association, organization or corporation; Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid; Bidder has not solicited or induced any person, firm or corporation to refrain from bidding; and Bidder has not sought by collusion to obtain for itself any advantage over any other Bidder or over OWNER.

4. Bidder will complete the Work for the price(s) shown.

Where materials are furnished by the OWNER, the prices provided herein are for installation only. Otherwise the prices include furnishing and installation of materials.

LUMP SUM CONTRACT PRICE EXCEPT DIVISION 17 - PCIS

_____

_____($_____).

All specific cash allowances are included in the price(s) set forth above.

BID FOR THE PROCESS CONTROL AND INSTRUMENTATION SYSTEM (PCIS):

NOTE: PCIS Subcontractors are required to submit a technical proposal to the ENGINEER at the time of bid. See Specification Section 17100 for proposal requirements.

A. I will provide the PCIS as specified in Specification Section 17100 (including subsections) using Bristol Babcock, Inc. of Watertown, CT, as the PCIS Subcontractor for the Lump Sum Bid Price of:

_____

_____($_____).

B. I will provide the PCIS as specified in Specification Section 17100 (including subsections) using Industrial Control Systems, Inc. of Sandston, VA, as the PCIS Subcontractor for the Lump Sum Bid Price of:

_____

_____($_____).

C. I will provide the PCIS as specified in Specification Section 17100 (including subsections) using Integrity Engineering, Inc. of Indianapolis, IN, as the PCIS Subcontractor for the Lump Sum Bid Price of:

_____

_____($_____).

COST OF DEMOLITION AND/OR REMOVAL

Contained in the lump sum bid is the sum of _____ dollars, ($_____) associated with cost of demolition of existing facilities and/or removal of existing material and/or equipment as required to complete the Work in accordance with the Contract Documents. This is the net cost to Bidder for such work taking into consideration estimated disposal costs or salvage values accruing to Bidder. This information is necessary for OWNER's financial accounting of project costs and will not be used in the selection of the successful Bidder.

SUPPLEMENTAL UNIT PRICES

When additional work is authorized, or work is deleted, by the OWNER, the following prices, when applicable, shall be used to determine the contract price adjustment. The items of Work and method of measurement to determine quantities shall be as described in Specification Section 1075 - Basis of Payment.

SUPPLEMENTAL UNIT PRICES

1.	30" Dia. Drilled Pier	$_____/VF
2.	36" Dia. Drilled Pier	$_____/VF

5. Bidder will provide alternative equipment and/or materials (if any) as listed below in lieu of the specified equipment and/or materials in accordance with the General Requirements in Specification Section 1100 - ALTERNATIVES.

OWNER may select items of any manufacturer or supplier listed in the following tabulation. Bidder will furnish and install such items selected for a Contract Price equal to the lump sum Contract Price, adjusted by the amount of deduction for the substituted item(s).

In the following tabulation, the name of the manufacturer or supplier entered on line (a) is the name of the manufacturer or supplier named in the Specifications for that item and the cost for providing that specified item is included in the lump sum Contract Price. If the name of the manufacturer or supplier is not shown on line (a), it is understood that the lump sum Contract Price includes the cost for providing the item furnished by the manufacturer or supplier first named in that portion of the Specification pertaining to the equipment and/or materials being substituted.

Names of alternative manufacturers and suppliers are shown on lines (b) and (c) with the respective prices to be deducted from the lump sum Contract Price should the OWNER elect to accept the alternative item.

ALTERNATIVE EQUIPMENT AND/OR MATERIALS

Spec. Section	Item and Manufacturer of Supplier	Deduct from Base Bid
_____	(a) _____	
	(b) _____	_____
	(c) _____	_____
_____	(a) _____	
	(b) _____	_____
	(c) _____	_____
_____	(a) _____	
	(b) _____	_____
	(c) _____	_____
_____	(a) _____	
	(b) _____	_____
	(c) _____	_____

6. Bidder agrees that the Work will be substantially complete within _____ calendar days after the date when the Contract Times commences to run as provided in Paragraph 2.3 of the General Conditions, and completed and ready for final payment within ____ calendar days after the date when the Contract Times commences to run.

Bidder accepts the provisions of the Agreement as to liquidated damages in the event of failure to complete the Work on time.

7. The following documents are attached to and made a condition of this Bid:

(a) Required Bid Security in the form of Bid Bond.

(b) Evidence of Bidder's qualification to do business in the State where the project is located.

(c) Bidder's contractor's license number if required to work in the State where the project is to be constructed.

(d) Information describing the proposed alternative equipment and/or materials.

8. The terms used in this Bid which are defined in the General Conditions of the Contract Documents have the meanings assigned to them in the General Conditions.

SUBMITTED on _____, 19____.

If Bidder is:

An Individual

By _____

(SEAL)

(Individual's Name)

doing business as _____

Business address: _____

Phone No.: _____

A Partnership

By _____ (SEAL)

(Firm Name)

_____

(general partner)

Business address: _____

Phone No.: _____

A Corporation

By _____

(Corporation name)

_____

(state of incorporation)

By _____

(name of person authorized to sign)

_____

(Title)

(Corporate Seal)

Attest _____

(Secretary)

Business address: _____

PhoneNo.: _____

A Joint Venture

By _____

(Name)

_____

(Address)

By _____

(Name)

_____

(Address)

(Each joint venture must sign. The manner of signing for each individual, partnership and corporation that is a party to the joint venture should be in the manner indicated above).

BID BOND

KNOW ALL MEN BY THESE PRESENTS, that we _____, as
(BIDDER)
Principal and _____ of
the City of _____, State of _____,
a corporation existing under the laws and the State of _____,
and authorized to transact business in _____,
as Surety, are held and firmly bound unto **Kentucky American Water Company, 2300 Richmond Road, Lexington, Kentucky, 40502**

hereinafter called the Obligee, in the sum of _____
Dollars ($_____), lawful money of the United States of America, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the Principal has submitted the accompanying Bid dated _____, 19___, for the **Kentucky River Station Additional Residuals Processing Facilities**.

NOW, THEREFORE, the condition of this Bond shall be such that if the Principal, upon due acceptance of said Bid and award of a Contract to him by the Obligee, bonds with good and sufficient surety as may be required by the Contract Documents, and furnishes the Obligee proper evidence of effectiveness of insurance coverage, respectively, within the time, in the forms and in the amounts, as appropriate, required by the Contract Documents, and enters into a Contract with the Obligee in accordance with the Contract Documents, then this Bond shall be void; otherwise, the Bond shall be and shall remain in full force and effect.

The Principal and the Surety hereby stipulate and agree that if the Principal fails to perform all conditions of this Bond, they will pay the sum of the Bond to the Obligee as fixed, liquidated damages.

The Surety, for value received, hereby stipulates and agrees that the obligations of said Surety and its Bond shall be in no way impaired or affected by any extension of time within which the Obligee may accept such Bid; and said Surety does hereby waive notice of any such extension. It is the intention of the parties to be legally bound by this instrument.

IN WITNESS WHEREOF, the above bounden parties have executed this instrument under their several seals this _____ day of _____, 19___, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned and representative, pursuant to authority of its governing.

ATTEST:

DATE _____, 19___

WITNESS:

_____
Name of Bidder, Corporation
Firm or Individual

_____

By _____

_____
(Title)

_____

_____
Business Address of Bidder

ATTEST:

_____
Secretary

_____

_____
Surety

_____
Attorney-In-Fact

NOTE: This agreement must be properly executed and must accompany the Bid Bond as proposal security.

AGREEMENT OF SURETY

KNOW ALL MEN BY THESE PRESENTS, that we _____ _____, as Surety, a corporation existing under the laws of the State of _____, and authorized to transact business in the State of _____; hereby agree to execute, within the time limit specified in the Contract, the Bonds, in the forms and in the amounts required for the faithful performance and proper fulfillment of the Contract for Construction of **Kentucky River Station Additional Residuals Processing Facilities,**

on behalf of _____,
(Bidder)

hereinafter called the Bidder, provided that the Notice of Award be delivered to the Bidder within the time period that Bids are subject to acceptance or within any extended period for which the Bidder agrees not to withdraw his bid; and the Surety further agrees that should the Surety, after notification of such award, omit or refuse to execute the required bonds, then the Surety shall pay to the **Kentucky American Water Company** the amount of the Bid Bond.

_____ Date

_____ Corporate Surety

_____ (AFFIX CORPORATE SEAL)

_____ Title

_____ Business Address

_____

AGREEMENT

THIS AGREEMENT is dated as of the _____ day of _____ in the year 19___ by and between **Kentucky-American Water Company** (hereinafter called OWNER) and _____ (hereinafter called CONTRACTOR). OWNER and CONTRACTOR, in consideration of the mutual covenants hereinafter set forth, agree as follows:

Article 1. WORK

CONTRACTOR shall complete all Work as specified or indicated in the Contract Documents. The Work is generally described as follows:

Kentucky River Station
Additional Residuals Processing Facilities.

Article 2. ENGINEER

The ENGINEER for the Project is the **American Water Works Service Company, 1025 Laurel Oak Road, Voorhees, New Jersey 08043** and who is to act as OWNER's representative, assume all duties and responsibilities and have the rights and authority assigned to ENGINEER in the Contract Documents in connection with completion of the Work in accordance with the Contract Documents.

Article 3. CONTRACT TIMES

3.1 The Work will be substantially completed within _____ days from the date when the Contract Times commences to run as provided in Paragraph 2.3 of the General Conditions, and completed and ready for final payment in accordance with Paragraph 14.13 of the General Conditions within _____ days from the date when the Contract Times commences to run. OWNER and CONTRACTOR recognize that time is of the essence of this Agreement and that OWNER will suffer financial loss if the Work is not completed within the times specified in Paragraph 3.1 above, plus any extensions thereof allowed in accordance with Article 12 of the General Conditions.

Article 4. CONTRACT PRICE

4.1 OWNER shall pay CONTRACTOR for completion of the Work in accordance with the Contract Documents in current funds as follows:

Article 5. PAYMENT PROCEDURES

CONTRACTOR shall submit Applications for Payment in accordance with Article 14 of the General Conditions. Applications for Payment will be processed by ENGINEER as provided in the General Conditions. The net sum will be paid to the CONTRACTOR within thirty (30) days following receipt of the approved estimate.

5.1 Progress Payments; Retainage. OWNER shall make progress payments on account of the Contract Price on the basis of CONTRACTOR's Applications for Payment as recommended by ENGINEER, on or about the 25th day of each month during construction. All such payments will be measured by the schedule of values established in paragraph 2.9 of the General Conditions. Prior to Substantial Completion, progress payments will be made in an amount equal to the percentage indicated below, but, in each case, less the aggregate of payments previously made and less such amounts as ENGINEER shall determine, or OWNER may withhold, in accordance with paragraph 14.7 of the General Conditions.

5.1.1 90% of the Work completed and Cost of the Work applicable to materials and equipment not incorporated in the Work, but delivered, suitably stored and accompanied by documentation satisfactory to OWNER as provided in paragraph 14.2 of the General Conditions (with the balance being retainage). If Work has been 50% completed as determined by ENGINEER, and if the character and progress of the Work have been satisfactory to OWNER and ENGINEER, OWNER, on recommendation of ENGINEER, may determine that as long as the character and the progress of the Work remain satisfactory to them, there will be no additional retainage on account of Work completed, in which case the remaining progress payments prior to Substantial Completion will be in an amount equal to 100% of the Work completed.

5.1.2 Upon Substantial Completion and receipt of Release of Liens from suppliers and subcontractors whose Work is completed, in an amount sufficient to increase the total payments to CONTRACTOR such that retained funds will be approximately equal to the value of the remaining Work. Value to be agreed upon by the OWNER, ENGINEER and CONTRACTOR, less such amounts as ENGINEER shall determine, or OWNER may withhold, in accordance with paragraph 14.7 of the General Conditions.

5.2 Final Payment. Upon final completion and acceptance of the Work in accordance with Paragraph 14.13 of the General Conditions, OWNER shall pay the remainder of the Contract Price and any retained funds, as recommended by ENGINEER as provided in said Paragraph 14.13.

Article 6. CONTRACTOR'S REPRESENTATIONS

In order to induce OWNER to enter into this Agreement CONTRACTOR makes the following representations:

6.1 CONTRACTOR has familiarized itself with the nature and extent of the Contract Documents, Contract Times, Work, site, locality, and all local conditions and Laws and Regulations that in any manner may affect cost, progress, performance or furnishing of the Work.

6.2 CONTRACTOR has studied carefully all reports of explorations and tests of subsurface conditions and drawings of physical conditions which are identified in the Supplementary Conditions as provided in Paragraph 4.2 of the General Conditions, and accepts the limitations set forth in Article 4, Section 4.2 of the General Conditions.

6.3 CONTRACTOR has obtained and carefully studied (or assumes responsibility for obtaining and carefully studying) all such examinations, investigations, explorations, tests, reports and studies (in addition to or to supplement those referred to in Paragraph 6.2 above) which pertain to the subsurface or physical conditions at or contiguous to the site or otherwise which may affect the cost, progress, performance or furnishing of the Work as CONTRACTOR considers necessary for the performance or furnishing of the Work at the Contract Price, within the Contract Times and in accordance with the other terms and conditions of the Contract Documents, including specifically the provisions of Paragraph 4.2 of the General Conditions; and no additional examinations, investigations, explorations, tests, reports, studies or similar information or data are or will be required by CONTRACTOR for such purposes.

6.4 CONTRACTOR has reviewed and checked all information and data shown or indicated on the Contract Documents with respect to existing Underground Facilities at or contiguous to the site and assumes responsibility for the accurate location of said Underground Facilities. No additional examinations, investigations, explorations, tests, reports, studies or similar information or data in respect of said Underground Facilities are or will be required by CONTRACTOR in order to perform and furnish the Work at the Contract Price, within the Contract Times and in accordance with the other terms and conditions of the Contract Documents, including specifically the provisions of Paragraph 4.3 of the General Conditions.

6.5 CONTRACTOR has correlated the results of all such observations, examinations, investigations, explorations, tests, reports and studies with the terms and conditions of the Contract Documents.

6.6 CONTRACTOR has given ENGINEER written notice of all conflicts, errors or discrepancies that he has discovered in the Contract Documents and the written resolution thereof by ENGINEER is acceptable to CONTRACTOR.

Article 7. CONTRACT DOCUMENTS

The Contract Documents which comprise the entire agreement between OWNER and CONTRACTOR concerning the Work consist of the following:

7.1 This Agreement (pages 1 to 6, inclusive).

7.2 Performance and Labor and Material Payment Bonds, identified as exhibits A and B and consisting of 5 pages.

7.3 Notice of Award. (Note: This document is not attached to this Agreement.)

7.4 General Conditions (Document Identification: 12/93 American Water System Standard General Conditions pages GC-0 to GC-29, inclusive).

7.5 Supplementary Conditions (pages SC-1 to SC-8, inclusive).

7.6 Specifications bearing the title **Kentucky River Station Additional Residuals Processing Facilities**, and consisting of 17 divisions as listed in table of contents thereof.

7.7 Drawings, consisting of a cover sheet and sheets numbered 001 through 103, inclusive with each sheet bearing the following general title:

Kentucky American Water Company
Kentucky River Station
Additional Residuals Processing Facilities

7.8 Addenda numbers ____ to ____, inclusive.

7.9 CONTRACTOR's Bid (pages ____ to ____, inclusive) marked exhibit _____.

7.10 Documentation submitted by CONTRACTOR prior to Notice of Award (pages ____ to ____, inclusive).

7.11 The following which may be delivered or issued after the Effective Date of the Agreement and are not attached hereto: All Written Amendments and other documents amending, modifying, or supplementing the Contract Documents pursuant to Paragraphs 3.5 and 3.6 of the General Conditions.

7.12 The documents listed in Paragraphs 7.2 et seq. above are attached to this Agreement (except as expressly noted otherwise above).

There are no Contract Documents other than those listed above in this Article 7. The Contract Documents may only be amended, modified or supplemented as provided in Paragraphs 3.5 and 3.6 of the General Conditions.

Article 8. MISCELLANEOUS

8.1 Terms used in this Agreement which are defined in Article 1 of the General Conditions will have the meaning indicated in the General Conditions.

8.2 No assignment by a party hereto of any rights under or interests in the Contract Documents will be binding on another party hereto without the written consent of the party sought to be bound; and specifically but without limitation moneys that may become due and moneys that are due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law), and unless specifically stated to the contrary in any written consent to an assignment no assignment will release or discharge the assignor from any duty or responsibility under the Contract Documents.

8.3 OWNER and CONTRACTOR each binds itself, its partners, successors, assigns and legal representatives to the other party hereto, its partners, successors, assigns and legal representatives in respect of all covenants, agreements and obligations contained in the Contract Documents.

Article 9. OTHER PROVISIONS

9.1 Government Regulations

The following clauses, where applicable, are incorporated in this Agreement by reference as is fully set out; the Equal Opportunity Clause prescribed in 41 CFR 60-1.40, the Affirmative Action Clause prescribed in 41 CFR 60-250.4, regarding veterans and veterans of the Vietnam Era, and the Affirmative Action Clause for Handicapped Workers prescribed in 41 CFR 60-741.4.

CONTRACTOR accepts this Agreement and will supply any information relating to federal or state laws, rules or regulations relating to the above.

IN WITNESS WHEREOF, OWNER and CONTRACTOR have signed this Agreement in quadruplicate. Two counterparts have been delivered to OWNER, and one counterpart each has been delivered to CONTRACTOR and ENGINEER. All portions of the Contract Documents have been signed or identified by OWNER and CONTRACTOR or by ENGINEER on their behalf.

This Agreement will be effective on _____, 19___.

OWNER:
Kentucky-American Water Company

By _____

(Corporate Seal)

Attest _____

Address for giving notices

2300 Richmond Road

Lexington, KY 40502

CONTRACTOR:

By _____

(Corporate Seal)

Attest _____

Address for giving notices

_____

_____

License No. _____

(If CONTRACTOR is a corporation, attach evidence of authority to sign.)

LABOR AND MATERIAL PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS: that _____, having an office at _____, as Principal, hereinafter called CONTRACTOR, and _____, having an office at _____, as Surety, hereinafter called Surety, are held and firmly bound unto **Kentucky American Water Company**, having an office at **2300 Richmond Road, Lexington, Kentucky 40502**, as Obligee, hereinafter called OWNER, for the use and benefit of claimants as hereinbelow defined in the amount of _____ ($_____), for the payment whereof CONTRACTOR and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, CONTRACTOR has by written agreement dated _____, 19__, entered into a Contract with the OWNER for the construction of the project entitled **Kentucky River Station Additional Residuals Processing Facilities**, in accordance with Drawings and Specifications prepared by **Montgomery Watson, Inc.**, which Contract is by reference made a part hereof, and is hereinafter referred to as the Contract.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION is such that, if CONTRACTOR shall promptly make payment of all claimants as hereinafter defined, for all labor and material used or reasonably required for use in the performance of the Contract, then this obligation shall be void; otherwise it shall remain in full force and effect, subject, however to the following conditions:

1. A claimant is defined as one having a direct contract with the CONTRACTOR or with a Subcontractor of the CONTRACTOR for labor, material, or both, used or reasonably required for use in the performance of the Contract, labor and material being construed to include that part of water,gas, power, light, heat, oil, gasoline, telephone service or rental of equipment directly applicable to the Contract.

2. The above named CONTRACTOR and Surety hereby jointly and severally agreed with the OWNER that every claimant as herein defined, who has not been paid in full before the expiration of a period of ninety (90) days after the date on which the last of such claimant's work or labor was done or performed, or materials were furnished by such claimant, may sue on this bond for the use of such claimant, prosecute the suit to final judgment for such sum or sums as may be justly due claimant, and have execution thereon. The OWNER shall not be liable for the payment of any costs or expenses of any such suit.

3. No suit or action shall be commenced hereunder by any claimant:

a) Unless claimant, other than one having a direct contract with the CONTRACTOR, shall have given written notice to any two of the following: the CONTRACTOR, the OWNER or the Surety above named, within ninety (90) days after such claimant did or performed the last of the work or labor, or furnished the last of the materials for which said claim is made, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were furnished, or for whom the work or labor was done or performed. Such notice shall be served by mailing the same by registered mail or certified mail, postage prepaid, in an envelope addressed to the CONTRACTOR, OWNER or Surety, at any place where an office is regularly maintained for the transaction of business, or served in any manner in which legal process may be served in the state in which the aforesaid project is located, save that such service need not be made by a public officer.

b) After the expiration of one (1) year following the date on which CONTRACTOR ceased Work on said Contract or after the expiration of one (1) year following the Date of Substantial Completion of the Project, whichever is later, it being understood, however, that if any limitation embodied in this bond is prohibited by any law controlling the construction hereof such limitation shall be deemed to be amended so as to be equal to the minimum period of limitation permitted by such law.

c) Other than in a state court of competent jurisdiction in and for the county or other political subdivision of the state in which the project, or any part thereof, is situated, or in the United States District Court for the district in which the project, on any part thereof, is situated, and not elsewhere.

4. The amount of this bond shall be reduced by and to the extent of any payment or payments made in good faith hereunder, inclusive of the payment by Surety of mechanics' liens which may be filed of record against such improvement, whether or not claim for the amount of such lien be presented under and against this bond.

Signed and sealed this _____ day of _____, 19___.

WITNESS:

_____
CONTRACTOR (SEAL)

By_____

_____
(Witness' Signature)

_____
(Title)

WITNESS:

_____
(Name of Surety) (SEAL)

By_____
(Attach Power of Attorney)

_____
(Witness' Signature)

_____
(Title)

PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS: that _____, having an office at _____, as Principal, hereinafter called CONTRACTOR, and _____, having an office at _____, as Surety, hereinafter called Surety, are held and firmly bound unto the **Kentucky American Water Company**, having an office at **2300 Richmond Road, Lexington, Kentucky 40502**, as Obligee, hereinafter called OWNER, for the use and benefit of claimants as hereinbelow defined, in the amount of _____ ($_____), for the payment whereof CONTRACTOR and Surety bind themselves, their heirs, executors, administrations, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, CONTRACTOR has by written agreement dated _____, 19___, entered into a Contract with the OWNER for the construction of the project entitled **Kentucky River Station Additional Residuals Processing Facilities**, in accordance with Drawings and Specifications prepared by **Montgomery Watson, Inc.**, which Contract is by reference made a part hereof, and is hereinafter referred to as the Contract.

NOW, THEREFORE, the condition of this obligation is such that, if CONTRACTOR shall promptly and faithfully perform said Contract, then this obligation shall be null and void; otherwise it shall remain in full force and effect.

The Surety hereby waives notice of any alteration or extension of Contract Times made by the OWNER.

Whenever CONTRACTOR shall be and declared by OWNER to be in default under the Contract, the Surety shall promptly remedy the default. If the OWNER terminates the Contract for such default, the following precautions shall govern the liability of the CONTRACTOR and the Surety hereunder.

In the event of such termination, the CONTRACTOR and the Surety shall remain fully liable to the OWNER for the CONTRACTOR'S failure to timely complete the Contract, any additional costs incurred by the OWNER in completing the Contract, and liquidated damages from the originally scheduled completion date to the date of the actual completion of the work by the OWNER.

In the event of such termination, the Surety company may elect to take over and complete performance of the Contract by giving written notice to the OWNER of such determination within seven (7) days of the OWNER'S mailing of notice of termination to the Surety and actually commencing completion with fourteen (14) days of the OWNER'S notice to the Surety. The Surety shall fully complete the work by the originally scheduled date of completion and the CONTRACTOR and the Surety shall remain liable to the OWNER for all damages sustained by the OWNER and for liquidated damages for delay.

Any suit under this bond must be instituted before the expiration of two (2) years from the date on which final payment under the Contract falls due or before the expiration of two (2) years from the Date of Substantial Completion of the Project, whichever is later.

No right of action shall accrue on this bond to or for the use of any person or corporation other than the OWNER named herein or the heirs, executors, administrators or successors of the OWNER.

Signed and sealed this _____ day of _____, 19___.

WITNESS:

_____
CONTRACTOR (SEAL)

By_____

_____
(Witness' Signature)

_____
(Title)

WITNESS:

_____
(Name of Surety) (SEAL)

By_____
(Attach Power of Attorney)

_____
(Witness' Signature)

_____
(Title)

GENERAL CONDITIONS

The General Conditions contained in this part of the Contract Documents are based on the Standard General Conditions of the Construction Contract prepared by the Engineers Joint Contract Documents Committee with modifications to be consistent with American Water System Policies. Only the General Conditions contained herein are a part of the Contract Documents for the project.

TABLE OF CONTENTS OF GENERAL CONDITIONS

GENERAL CONDITIONS

ARTICLE 1 - DEFINITIONS

Whenever used in these General Conditions or in the other Contract Documents the following terms have the meanings indicated which are applicable to both the singular and plural thereof:

1.1 *Addenda* -- Written or graphic instruments issued prior to the opening of Bids which clarify, correct or change the bidding requirements or the Contract Documents.

1.2 *Agreement* -- The written contract between OWNER and CONTRACTOR covering the Work to be performed; other Contract Documents are attached to the Agreement and made a part thereof as provided therein.

1.3 *Application for Payment* -- The form accepted by ENGINEER which is to be used by CONTRACTOR in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.

1.4 *Asbestos* -- Any material that contains more than one percent asbestos and is friable or is releasing asbestos fibers into the air above current action levels established by the United States Occupational Safety and Health Administration.

1.5 *Bid* -- The offer or proposal of the bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

1.6 *Bonds* -- Performance and Payment bonds and other instruments of security.

1.7 *Change Order* -- A document recommended by ENGINEER which is signed by CONTRACTOR and OWNER and authorizes an addition, deletion or revision in the Work, or an adjustment in the Contract Price or the Contract Times, issued on or after the Effective Date of the Agreement.

1.8 *Contract Documents* -- The Agreement, Addenda (which pertain to the Contract Documents), CONTRACTOR's Bid (including documentation accompanying the Bid and any post-Bid documentation submitted prior to the Notice of Award) when attached as an exhibit to the Agreement, the Bonds, these General Conditions, the Supplementary Conditions, the Specifications and the Drawings as the same are more specifically identified in the Agreement, together with all Written Amendments, Change Orders, Work Change Directives, Field Orders and ENGINEER's written interpretations and clarifications issued pursuant to paragraphs 3.5, 3.6.1, and 3.6.3 on or after the Effective Date of the Agreement. Shop Drawing submittals approved pursuant to paragraphs 6.26 and 6.27 and the reports and drawings referred to in paragraphs 4.2.1 and 4.2.2 are not Contract Documents.

1.9 *Contract Price* -- The moneys payable by OWNER to CONTRACTOR for completion of the Work in accordance with the Contract Documents as stated in the Agreement (subject to the provisions of paragraph 11.9.1 in the case of Unit Price Work).

1.10 *Contract Times* -- The number of days or the dates stated in the Agreement (i) to achieve Substantial Completion, and (ii) to complete the Work so that it is ready for final payment as evidenced by ENGINEER's written recommendation of final payment in accordance with paragraph 14.13.

1.11 *CONTRACTOR* -- The person, firm or corporation with whom OWNER has entered into the Agreement.

1.12 *Defective* -- An adjective which when modifying the word Work refers to Work that is unsatisfactory, faulty or deficient, in that it does not conform to the Contract Documents, or does not meet the requirements of any inspection, reference standard, test or approval referred to in the Contract Documents, or has been damaged prior to ENGINEER's recommendation of final payment (unless responsibility for the protection thereof has been assumed by OWNER at Substantial Completion in accordance with paragraph 14.8 or 14.10).

1.13 *Drawings* -- The drawings which show the scope, extent and character of the Work to be furnished and performed by the CONTRACTOR and which have been prepared or approved by ENGINEER and are referred to in the Contract Documents. Shop Drawings are not Drawings as so defined.

1.14 *Effective Date of the Agreement* – The date indicated in the agreement on which it becomes effective, but if no such date is indicated it means the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver. However, the contractor has no rights or remedies arising from execution of the Agreement prior to the Commencement of Contract Times.

1.15 *ENGINEER* -- The person, firm or corporation named as such in the Agreement.

1.16 *ENGINEER's Consultant* -- A person, firm or corporation having a contract with OWNER to furnish professional services for the benefit of OWNER and ENGINEER with respect to the Project and who is identified as such in the Supplementary Conditions. The term ENGINEER's Consultant shall be deemed also to include a person, firm or corporation having a contract with ENGINEER's Consultant to furnish professional services as an independent professional associate or consultant to ENGINEER's Consultant with respect to the Project and who is identified as such in the Supplementary Conditions.

1.17 *Field Order* -- A written order issued by ENGINEER which orders minor changes in the Work in accordance with paragraph 9.5 but which does not involve a change in the Contract Price or the Contract Times.

1.18 *General Requirements* -- Sections of Division 1 of the Specifications.

1.19 *Hazardous Waste* -- The term Hazardous Waste shall have the meaning provided in Section 1004 of the Solid Waste Disposal Act (42 USC Section 9603) as amended from time to time.

1.20 *Laws and Regulations: Laws or Regulations* -- Any and all applicable laws, rules, regulations, ordinances, codes and orders of any and all governmental bodies, agencies, authorities or courts having jurisdiction.

1.21 *Liens* -- Liens, charges, security interests or encumbrances upon real or personal property.

1.22 *Notice of Award* -- The written notice to the apparent successful bidder stating that upon compliance by the apparent successful bidder with the conditions precedent enumerated therein, within the time specified, OWNER will sign and deliver the Agreement.

1.23 *Notice to Proceed* -- A written notice to CONTRACTOR fixing the date on which the Contract Time will commence to run and on which CONTRACTOR shall start to perform CONTRACTOR's obligations under the Contract Documents.

1.24 *OWNER* -- The public body or authority, corporation, association, firm or person with whom CONTRACTOR has entered into the Agreement and for whom the Work is to be provided.

1.25 *Partial Utilization* -- Use by OWNER of a finished part of the Work for the purpose for which it is intended (or a related purpose) before reaching Substantial Completion for all the Work.

1.26 *Petroleum* -- Petroleum, including crude oil or any fraction thereof which is liquid at standard conditions of temperature and pressure (60 degrees Fahrenheit and 14.7 pounds per square inch absolute), such as oil, petroleum, fuel oil, oil sludge, oil refuse, gasoline and kerosene and oil mixed with other non-Hazardous Wastes and crude oils.

1.27 *PCBs* -- Shall mean Polychlorinated Biphenyls.

1.28 *Project* -- The total construction of which the Work to be provided under the Contract Documents may be the whole, or a part as indicated elsewhere in the Contract Documents.

1.29 *Radioactive Material* -- Source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954, (42 USC Section 2011 et seq.) as amended from time to time.

1.30 *Resident Project Representative* -- The authorized representative of ENGINEER who may be assigned to the site or any part thereof.

1.31 *Samples* -- Physical examples of materials, equipment or workmanship that are representative of some portion of the Work and which establish the standards by which such portion of the Work will be judged.

1.32 *Shop Drawings* -- All drawings, diagrams, illustrations, schedules and other data or information which are specifically prepared or assembled by or for CONTRACTOR and submitted by CONTRACTOR to illustrate some portion of the Work.

1.33 *Specifications* -- Those portions of the Contract Documents consisting of written technical descriptions of materials, equipment, construction systems, standards and workmanship as applied to the Work and certain administrative details applicable thereto.

1.34 *Specifications Special Conditions* -- The part of the Contract Documents if used, that amends or supplements the Specifications.

1.35 *Subcontractor* -- An individual, firm or corporation having a direct contract with CONTRACTOR or with any other Subcontractor for the performance of a part of the Work at the site.

1.36 *Substantial Completion* -- The Work (or a specified part thereof) has progressed to the point where, in the opinion of ENGINEER as evidenced by ENGINEER's definitive certificate of Substantial Completion, it is sufficiently complete, in accordance with the Contract Documents, so that the Work (or specified part) can be utilized for the purposes for which it is intended; or if no such certificate is issued, when the Work is complete and ready for final payment as evidence by ENGINEER's written recommendation of final payment in accordance with paragraph 14.13. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.

1.37 *Supplementary Conditions* -- The part of the Contract Documents which amends or supplements these General Conditions.

1.38 *Supplier* -- A manufacturer, fabricator, supplier, distributor, materialman or vendor having a direct contract with CONTRACTOR or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by CONTRACTOR or any Subcontractor.

1.39 *Underground Facilities* -- All pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels or other such facilities or attachments, and any encasements containing such facilities which have been installed underground to furnish any of the following services or materials: electricity, gases, steam, liquid petroleum products, telephones or other communications, cable television, sewage and drainage removal, traffic or other control systems or water.

1.40 *Unit Price Work* -- Work to be paid for on the basis of unit prices.

1.41 *Work* --The entire completed construction or the various separately identifiable parts thereof required to be furnished under the Contract Documents. Work includes and is the result of performing or furnishing labor and furnishing and incorporating materials and equipment into the construction and performing or furnishing services and furnishing documents, all as required by the Contract Documents.

1.42 *Work Change Directive* -- A written directive to CONTRACTOR, issued on or after the Effective Date of the Agreement and signed by OWNER and recommended by ENGINEER, ordering an addition, deletion or revision in the Work, or responding to differing or unforeseen physical conditions under which the Work is to be performed as provided in paragraph 4.2 or 4.3 or to emergencies under paragraph 6.23. A Work Change Directive will not change the Contract Price or the Contract Times, but is evidence that the parties expect that the change directed or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Times as provided in paragraph 10.2.

1.43 *Written Amendment* -- A written amendment of the Contract Documents, signed by OWNER and CONTRACTOR on or after the Effective Date of the Agreement and normally dealing with the nonengineering or nontechnical rather than strictly construction-related aspects of the Contract Documents.

ARTICLE 2 - PRELIMINARY MATTERS

Delivery of Bonds:

2.1 When CONTRACTOR delivers the executed Agreements to OWNER, CONTRACTOR shall also deliver to OWNER such Bonds as CONTRACTOR may be required to furnish in accordance with paragraph 5.1.

Copies of Documents:

2.2 OWNER shall furnish to CONTRACTOR up to ten copies (unless otherwise specified in the Supplementary Conditions) of the Contract Documents as are reasonably necessary for the execution of the Work. Additional copies will be furnished, upon request, at the cost of reproduction.

Commencement of Contract Times; Notice to Proceed:

2.3 The Contract Times will commence to run on the thirtieth day after the Effective Date of the Agreement, or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within thirty days after the Effective Date of the Agreement. In no event will owner have any obligations or duties to CONTRACTOR under the Agreement until Contract Times commence to run.

Starting the Work:

2.4 CONTRACTOR shall start to perform the Work on the date when the Contract Times commence to run, but no Work shall be done at the site prior to the date on which the Contract Times commence to run.

Before Starting Construction:

2.5 Before undertaking each part of the Work, CONTRACTOR shall carefully study and compare the Contract Documents and check and verify pertinent figures shown thereon and all applicable field measurements. CONTRACTOR shall promptly report in writing to ENGINEER any conflict, error, ambiguity or discrepancy which CONTRACTOR may discover and shall obtain a written interpretation or clarification from ENGINEER before proceeding with any Work affected thereby; however, CONTRACTOR shall not be liable to OWNER or ENGINEER for failure to report any conflict, error, ambiguity or discrepancy in the Contract Documents, unless CONTRACTOR knew or should have known thereof.

2.6 Within ten days after the Effective Date of the Agreement (unless otherwise specified in Division 1 -General Requirements), CONTRACTOR shall submit to ENGINEER for review:

2.6.1 a preliminary progress schedule indicating the times (number of days or dates) for starting and completing the various stages of the Work, including any principal events (milestones) specified in the Contract Documents;

2.6.2 a preliminary schedule of Shop Drawings and Sample submittals which will list each required submittal and the times for submitting, reviewing and processing such submittal;

2.6.3 a preliminary schedule of values for all of the Work which will include quantities and prices of items aggregating the Contract Price and will subdivide the Work into component parts in sufficient detail to serve as the basis for progress payments during construction.

2.7 Before any Work at the site is started, CONTRACTOR and OWNER shall each deliver to the other, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance which either of them or any additional insured may reasonably request) which CONTRACTOR and OWNER respectively are required to purchase and maintain in accordance with paragraphs 5.4, 5.6 and 5.7.

Preconstruction Conference:

2.8 Within twenty days after the Contract Times start to run, but before any Work at the site is started, a conference attended by CONTRACTOR, ENGINEER and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules referred to in paragraph 2.6, procedures for handling Shop Drawings and other submittals, processing Applications for Payments, and maintaining required records.

Finalizing Schedules:

2.9 Unless otherwise provided in the Supplementary Conditions, at least ten days before submission of the first Application for Payment a conference attended by CONTRACTOR, ENGINEER and others as appropriate will be held to finalize the schedules submitted in accordance with paragraph 2.6. CONTRACTOR shall have an additional ten days to make corrections and adjustments and to complete and submit the finalized schedules. No progress payment shall be made to CONTRACTOR until the finalized schedules are submitted to and acceptable to the ENGINEER as provided below. The finalized progress schedule will be as indicated in the Specifications and will be acceptable to ENGINEER as providing an orderly progression of the Work to completion within any specified milestone completion Times and the Contract Times, but such acceptance will neither impose on ENGINEER responsibility for the sequencing scheduling or progress of the Work nor relieve CONTRACTOR from full responsibility therefore. CONTRACTOR's finalized schedule of Shop Drawings and Sample submissions will be acceptable to ENGINEER as providing a workable arrangement for reviewing and processing the submittals. The CONTRACTOR's finalized schedule of values will be acceptable to ENGINEER as to form and substance.

ARTICLE 3 – CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

Intent:

3.1 The Contract Documents comprise the entire agreement between OWNER and CONTRACTOR concerning the Work. The Contract Documents are complementary; what is called for by one is as binding as if called for by all. The Contract Documents will be construed in accordance with the law of the place of the Project.

3.2 It is the intent of the Contract Documents to describe a functionally complete Project (or part thereof) to be constructed in accordance with the Contract Documents. Any Work, materials or equipment that may reasonably be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce the intended result will be furnished and performed whether or not specifically called for. When words or phrases which have a well-known technical or construction industry or trade meaning are used to describe Work, materials or equipment such words or phrases shall be interpreted in accordance with that meaning. Clarifications and interpretations of the Contract Documents shall be issued by ENGINEER as provided in paragraph 9.4.

3.3 *Reference to Standards and Specifications of Technical Societies: Reporting and Resolving Discrepancies:*

3.3.1 Reference to standards, specifications, manuals or codes of any technical society, organization or association, or to the Laws or Regulations of any governmental authority, whether such reference be specific or by implication, shall mean the latest standard, specification, manual, code or Laws or Regulations in effect at the time of opening of Bids (or, on the Effective Date of the Agreement if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.

3.3.2 If, during the performance of the Work, CONTRACTOR discovers any conflict, error, ambiguity or discrepancy between the Contract Documents and any provision of any such Law or Regulation applicable to the performance of the Work or of any such standard, specification, manual or code or of any instruction of any Supplier referred to in paragraph 6.5, CONTRACTOR shall report it to ENGINEER in writing at once, and, CONTRACTOR shall not proceed with the Work affected thereby (except in an emergency as authorized by paragraph 6.23) until an amendment or supplement to the Contract Documents has been issued by one of the methods indicated in paragraphs 3.5 or 3.6; provided, however, that CONTRACTOR shall not be liable to OWNER or ENGINEER for failure to report any such conflict, error, ambiguity or discrepancy unless CONTRACTOR knew or should have known thereof.

3.3.3 Except as otherwise specifically stated in the Contract Documents or as may be provided by amendment or supplement thereto issued by one of the methods indicated in paragraph 3.5 or 3.6, the provisions of the Contract Documents shall take precedence in resolving any conflict, error, ambiguity or discrepancy between the provisions of the Contract Documents and:

3.3.3.1 the provisions of any such standard, specification, manual, code or instruction (whether or not specifically incorporated by reference in the Contract Documents); or

3.3.3.2 the provisions of any such Laws or Regulations applicable to the performance of the Work (unless such an interpretation of compliance with the provisions of the Contract Documents would result in violation of such Law or Regulation).

No provisions of any such standard, specification, manual, code or instruction shall be effective to change the duties and responsibilities of OWNER, CONTRACTOR or ENGINEER or any of their subcontractors, consultants, agents, or employees from those set forth in the Contract Documents, nor shall it be effective to assign to OWNER, ENGINEER or any of ENGINEER's Consultants, agents or employees any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of paragraph 9.13 or any other provision of the Contract Documents.

3.4 Whenever in the Contract Documents the terms "as ordered", "as directed", "as required", "as allowed", "as approved", or terms of like effect or import are used, or the adjectives "reasonable", "suitable", "acceptable", "proper" or "satisfactory" or adjectives of like effect or import are used to describe a requirement, direction, review or judgement of ENGINEER as to the Work, it is intended that such requirement, direction, review or judgement will be solely to evaluate, in general, the completed Work for compliance with the information in the Contract Documents and conformance with the design concept of the completed Project as a functioning whole as indicated by and reflected in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective shall not be effective to assign to ENGINEER any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority to undertake responsibility contrary to the provisions of paragraph 9.13 or any other provision of the Contract Documents. Where "provide" is used in the Specifications or Drawings, it shall be understood to mean, "provide complete in place", that is, furnish and install.

Amending and Supplementing Contract Documents:

3.5 The Contract Documents may be amended to provide for additions, deletions and revisions in the Work or to modify the terms and conditions thereof in one or more of the following ways:

3.5.1 a formal Written Amendment,

3.5.2 a Change Order (pursuant to paragraph 10.4), or

3.5.3 a Work Change Directive (pursuant to paragraph 10.1).

3.6 In addition, the requirements of the Contract Documents may be supplemented, and minor variations and deviations in the Work may be authorized, in one or more of the following ways:

3.6.1 a Field Order (pursuant to paragraph 9.5),

3.6.2 ENGINEER's approval of a Shop Drawing or sample (pursuant to paragraphs 6.26 and 6.27), or

3.6.3 ENGINEER's written interpretation or clarification (pursuant to paragraph 9.4).

3.6.4 Any variations and deviation in the Work arising from any of the methods set forth in Paragraph 3.6 will not authorize any ammendment to the Contract Price or Contract Times. The sole method to amend the Contract Price or Contract Times is pursuant to Paragraph 3.5.

Reuse of Documents:

3.7 CONTRACTOR, and any Subcontractor or Supplier or other person or organization performing or furnishing any of the Work under a direct or indirect contract with OWNER (i) shall not have or acquire any title to or ownership rights in any of the Drawings, Specifications or other documents (or copies of any thereof) prepared by or bearing the seal of ENGINEER, or ENGINEER's Consultant; and (ii) shall not reuse any of such Drawings, Specifications, other documents or copies or extensions of the Project or any other project without written consent of OWNER and ENGINEER and specific written verification or adaption by ENGINEER.

ARTICLE 4 – AVAILABILITY OF LANDS: SUBSURFACE AND PHYSICAL CONDITIONS; REFERENCE POINTS

Availability of Lands:

4.1 OWNER shall furnish, as indicated in the Contract Documents, the lands upon which the Work is to be performed, rights-of-way and easements for access thereto, and such other lands which are designated for the use of CONTRACTOR. Upon reasonable written request, OWNER shall furnish CONTRACTOR with a correct statement of record legal title and legal description of the lands upon which the Work is to be performed and OWNER's interest therein as necessary for giving notice of or filing a mechanic's lien against such lands in accordance with applicable Laws and Regulations. OWNER shall identify any encumbrances or restrictions not of general application but specifically related to use of lands so furnished with which CONTRACTOR will have to comply in performing the Work. Easements for permanent structures or permanent changes in existing facilities will be obtained and paid for by OWNER, unless otherwise provided in the Contract Documents. If CONTRACTOR and OWNER are unable to agree on entitlement to or the amount or extent of any adjustments in the Contract Price or the Contract Times as a result of any delay in OWNER's furnishing these lands, rights-of-way or easements, CONTRACTOR may make a claim therefor as provided in Articles 11 and 12. CONTRACTOR shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

4.2 Subsurface and Physical Conditions:

4.2.1 Reports and Drawings: Reference is made to the Supplementary Conditions for identification of:

4.2.1.1 Subsurface Conditions at the Site: Those reports of explorations and tests of subsurface conditions at the site that have been utilized by ENGINEER in preparation of the Contract Documents; and

4.2.1.2 Physical Conditions: Those drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the site (except Underground Facilities) that have been utilized by the ENGINEER in preparing the Contract Documents.

4.2.2 Limited Reliance by CONTRACTOR Authorized; Technical Data: CONTRACTOR may rely upon the accuracy of the technical data contained in such reports and drawings, but such reports and drawings are not Contract Documents. Except for such reliance on technical data, CONTRACTOR may not rely upon and shall make no claim against OWNER, ENGINEER or any of the

ENGINEER's Consultants with respect to:

4.2.2.1 the completeness of such reports and drawings for CONTRACTOR's purposes,

4.2.2.2 nontechnical data, interpretations, opinions and information contained in such reports or otherwise relating to subsurface conditions at the site, or

4.2.2.3 nontechnical data, interpretations, opinions and information shown or indicated in such drawings or otherwise relating to such structures.

4.2.3 Reports of Differing Subsurface or Physical Conditions: If any subsurface or latent physical condition at the site that is uncovered or revealed (i) differs materially from that shown or indicated in the Contract Documents, or (ii) is of an unusual nature, which differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents, or (iii) is of such a nature as to require a change in the Contract Documents, or (iv) is of such a nature as to establish that any technical data on which CONTRACTOR is entitled to rely as provided in paragraphs 4.2.1 and 4.2.2 is materially inaccurate, then CONTRACTOR shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as permitted by paragraph 6.23), notify OWNER and ENGINEER in writing about such condition.

4.2.4 ENGINEER's Review: ENGINEER will promptly review the pertinent conditions, determine the necessity of OWNER's obtaining additional explorations or tests with respect thereto and advise OWNER in writing (with a copy to CONTRACTOR) of ENGINEER's findings and conclusions.

4.2.5 Possible Contract Documents Change: If ENGINEER concludes that a change in the Contract Documents is required as a result of a condition described in paragraph 4.2.3, a Work Change Directive or a Change Order will be issued as provided in Article 10 to reflect and document the consequences of such change.

4.2.6 Possible Price and Time Adjustments: If a condition described in paragraph 4.2.3 causes an increase or decrease in the Contract Price or Contract Times, an equitable adjustment in the Contract Price (subject to the provisions of paragraphs 9.10 and 11.9 with respect to Unit Price Work) or an equitable adjustment of the Contract Times, or any combination thereof, will be allowed, to the extent that such condition has caused an increase or decrease in CONTRACTOR's cost of, or time required for performance of the Work, whether or not the Contract Documents are changed pursuant to paragraph 4.2.5, provided that:

4.2.6.1 such subsurface or physical condition was unknown to and could not reasonably have been anticipated by CONTRACTOR, and

4.2.6.2 such subsurface or physical condition meets the criteria established in paragraph 4.2.3, and

4.2.6.3 CONTRACTOR has timely given the written notice required by paragraph 4.2.3, and

4.2.6.4 CONTRACTOR has complied with the requirements of Article 6 of the Agreement.

If OWNER and CONTRACTOR are unable to agree on entitlement to or as to the amount or length of any such equitable adjustment in the Contract Price or Contract Times, a claim may be made therefor as provided in Articles 11 and 12. However, OWNER, ENGINEER and ENGINEER's Consultants shall not be liable to CONTRACTOR for any costs, losses or damages sustained by CONTRACTOR on or in connection with any other project or anticipated project or that otherwise do not increase CONTRACTOR's cost of the Work.

4.3 Physical Conditions – Underground Facilities:

4.3.1 Shown or Indicated: The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or contiguous to the site is based on information and data furnished to OWNER or ENGINEER by the owners of such Underground Facilities or by others. Unless it is otherwise expressly provided in the Supplementary Conditions:

4.3.1.1 OWNER and ENGINEER shall not be responsible for the accuracy or completeness of any such information or data; and

4.3.1.2 The cost of all of the following will be included in the Contract Price and CONTRACTOR shall have full responsibility for: (i) reviewing and checking all such information and data, (ii) locating all Underground Facilities shown or indicated in the Contract Documents, (iii) coordination of the Work with the owners of such Underground Facilities during construction, and (iv) the safety and protection of all such Underground Facilities as provided in paragraph 6.20 and repairing any damage thereto resulting from the Work.

4.3.2 Not Shown or Indicated: If an Underground Facility is uncovered or revealed at or contiguous to the site which was not shown or indicated in the Contract Documents, CONTRACTOR shall promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by paragraph 6.23), identify the owner of such Underground Facility and give

written notice thereof to that owner and to OWNER and ENGINEER. ENGINEER will promptly review the Underground Facility and determine the extent, if any, to which a change is required in the Contract Documents to reflect and document the consequence of the existence of the Underground Facility. If ENGINEER concludes that a change in the Contract Documents is required, a Work Change Directive or a Change Order will be issued as provided in Article 10 to reflect and document such consequences. During such time, CONTRACTOR shall be responsible for the safety and protection of such Underground Facility as provided in paragraph 6.20. CONTRACTOR shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, to the extent that they are attributable to the existence of any Underground Facility that was not shown or indicated in the Contract Documents and that CONTRACTOR did not know of and could not reasonably have been expected to be aware of or to have anticipated. If OWNER and CONTRACTOR are unable to agree on entitlement to or the amount or length of any such adjustment in Contract Times or Contract Price, CONTRACTOR may make a claim therefor as provided in Articles 11 and 12.

However, OWNER, ENGINEER and ENGINEER's Consultants shall not be liable to CONTRACTOR for any costs, losses or damages sustained by CONTRACTOR on or in connection with any other project or anticipated project or that otherwise do not increase CONTRACTOR's cost of the Work.

Reference Points:

4.4 OWNER shall provide engineering surveys to establish reference points for construction which in ENGINEER's judgement are necessary to enable CONTRACTOR to proceed with the Work. CONTRACTOR shall be responsible for laying out the Work, shall protect and preserve the established reference points and shall make no changes or relocations without the prior written approval of OWNER. CONTRACTOR shall report to ENGINEER whenever any reference point is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points by professionally qualified personnel.

4.5 Asbestos, PCBs, Petroleum, Hazardous Waste or Radioactive Material:

4.5.1 OWNER shall be responsible for any Asbestos, PCBs, Petroleum, Hazardous Waste or Radioactive Material uncovered or revealed at the site which was not shown or indicated in Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work and which may present a substantial danger to persons or property exposed thereto in connection with the Work at the site. OWNER shall not be responsible for any such materials brought onto the job site by CONTRACTOR, Subcontractors, Suppliers or anyone else for whom CONTRACTOR is responsible.

4.5.2 CONTRACTOR shall immediately (i) stop all Work in connection with such hazardous condition and in any area affected thereby (except in an emergency as required by paragraph 6.23) and (ii) notify OWNER and ENGINEER (and thereafter confirm such notice in writing). OWNER shall promptly consult with ENGINEER concerning the necessity for OWNER to retain a qualified expert to evaluate such hazardous condition or take corrective action, if any. CONTRACTOR shall not be required to resume Work in connection with such hazardous condition or in any such affected area until after OWNER has obtained any required permits related thereto and delivered to CONTRACTOR special written notice (i) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work, or (ii) specifying any special conditions under which such Work may be resumed safely. If OWNER and CONTRACTOR cannot agree as to entitlement to or the amount or extent of an adjustment, if any, in Contract Price or Contract Times as a result of such Work stoppage or such special conditions under which Work is agreed by CONTRACTOR to be resumed, either party may make a claim therefor as provided in Articles 11 and 12.

4.5.3 If after receipt of such special written notice CONTRACTOR does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then OWNER may order such portion of the Work that is in connection with such hazardous condition or in such affected area to be deleted from the Work. If OWNER and CONTRACTOR cannot agree to entitlement to or the amount or extent of an adjustment, if any, in Contract Price or Contract Times as a result of deleting such portion of the Work, then either party may make a claim therefor as provided in Articles 11 and 12. OWNER may have such deleted portion of the Work performed by OWNER's own forces or others in accordance with Article 7.

4.5.4 To the fullest extent permitted by Laws and Regulations OWNER shall indemnify and hold harmless CONTRACTOR and ENGINEER and their respective officers, directors, consultants, Subcontractors, agents and employees from and against all claims, damages, losses and expenses, direct, indirect or consequential (including but not limited to fees and charges of engineers, architects, attorneys and other professionals and court and arbitration or other dispute resolution costs) arising out of or resulting from such hazardous condition, provided that (a) any such claim, damage, loss or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom, and (b) nothing in this subparagraph 4.5.4 shall obligate OWNER to indemnify any person or entity from and against the consequences of that person's or entity's own negligence.

4.5.5 The provisions of paragraphs 4.2 and 4.3 are not intended to apply to Asbestos, PCB's, Petroleum, Hazardous

Waste or Radioactive Material uncovered or revealed at the site.

4.5.6 In accordance with the intent of the Federal Occupational Safety and Health Administration (OSHA) Standard Section 29CFR-1910.12, Hazard Communication with effective date of May 25, 1986, as it may be amended from time to time, the OWNER hereby notifies the CONTRACTOR Work is to be performed on company property where the CONTRACTOR's employees may be exposed to hazardous materials existing on the premises.

Chemicals known to be used or stored by the OWNER and required to be disclosed by said OSHA Standard Section 29CFR-1910.12 are listed in the Supplementary Conditions.

OWNER, CONTRACTOR and any Subcontractors will each provide or make available to the others: (a) any written hazard communication program required to be maintained with respect to the site and any material safety data sheet and other hazard communication information required to be provided in accordance with applicable Laws and applicable Regulations, or (b) in the event that applicable Laws and Regulations do not require the provision or exchange of such hazard communications, CONTRACTOR and any Subcontractors shall, nevertheless, provide or make available to OWNER and any other employers at the site a written hazard communication program, material safety data sheets and other hazard communication information of the type and consistent with the intent of said OSHA Standard Section 29CFR-1910.12 and acceptable to OWNER and ENGINEER. CONTRACTOR shall be responsible for coordinating any such required exchange of documents or information between or among OWNER, and any other employers at the site, or any of them. CONTRACTOR shall include the provisions of this paragraph 4.5.6 in any subcontract for any part of the Work at the site.

ARTICLE 5 -- BONDS AND INSURANCE

Performance and Other Bonds:

5.1 CONTRACTOR shall furnish a Performance Bond, and a Labor and Material Payment Bond, each in an amount at least equal to the Contract Price as security for the faithful performance and payment of all CONTRACTOR's obligations under the Contract Documents. These Bonds shall remain in effect at least until one year after the date when final payment becomes due, except as otherwise provided by Laws or Regulations or by the Contract Documents. CONTRACTOR shall also furnish such other Bonds as are required by the Supplementary Conditions. All Bonds shall be in the forms prescribed by the Contract Documents, except as otherwise provided by Laws or Regulations, and be executed by such sureties having a rating of "A" by the most recent Best's Key Rating Guide, and as are named in the current list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the Audit Staff, Bureau of Government Financial Operations, U.S. Treasury Department. All Bonds signed by an agent must be accompanied by a certified copy of such agent's authority to act.

5.2 If the surety on any Bond furnished by CONTRACTOR is declared bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of the Project is located or it ceases to meet the requirements of paragraphs 5.1, CONTRACTOR shall within ten days thereafter substitute another Bond and surety, both of which must be acceptable to OWNER.

5.3 Licensed Sureties and Insurers; Certificates of Insurance:

5.3.1 All Bonds and insurance required by the Contract Documents to be purchased and maintained by OWNER or CONTRACTOR shall be obtained from surety or insurance companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue bonds or insurance policies for the limits and coverages so required. Such surety and insurance companies shall also meet such additional requirements and qualifications as may be provided in the Supplementary Conditions.

5.3.2 CONTRACTOR shall deliver to OWNER, with copies to each additional insured indicated in the Supplementary Conditions, including ENGINEER, certificates of insurance (and other evidence of insurance requested by OWNER or any other additional insured) which CONTRACTOR is required to purchase and maintain in accordance with paragraph 5.4. OWNER shall deliver to CONTRACTOR certificates of insurance (and other evidence of insurance requested by CONTRACTOR or any other additional insured) which OWNER is required to purchase and maintain in accordance with paragraphs 5.6 and 5.7 hereof.

CONTRACTOR's Liability Insurance:

5.4 CONTRACTOR shall purchase and maintain such liability and other insurance as is appropriate for the Work being performed and furnished and as will provide protection from claims set forth below which may arise out of or result from CONTRACTOR's performance and furnishing of the Work and CONTRACTOR's other obligations under the Contract Documents, whether it is to be performed or furnished by CONTRACTOR, by any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform or furnish any of the Work, or by anyone for whose acts any of them may be liable:

5.4.1 claims under workers' compensation, disability benefits and other similar employee benefit acts;

5.4.2 claims for damages because of bodily injury, occupational sickness or disease, or death of CONTRACTOR's employees;

5.4.3 claims for damages because of bodily injury, sickness or disease, or death of any person other than CONTRACTOR's employees;

5.4.4 claims for damages insured by customary personal injury liability coverage which are sustained (i) by any person as a result of an offense directly or indirectly related to the employment of such person by CONTRACTOR, or (ii) by any other person for any other reason;

5.4.5 claims for damages, other than to the Work itself because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom; and

5.4.6 claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance or use of any motor vehicle.

The policies of insurance so required by this paragraph 5.4 to be purchased and maintained shall:

5.4.7 with respect to insurance required by paragraphs 5.4.3 through 5.4.6 inclusive, include as additional insureds OWNER and ENGINEER (subject to any customary exclusion in respect of professional liability) and any other persons or entities indicated in the Supplementary Conditions, all of whom shall be listed by name as additional insureds, and include coverage for the respective officers and employees of all such additional insureds;

5.4.8 include the specific coverages and be written for not less than the limits of liability provided in the Supplementary Conditions or required by Law and Regulation, whichever is greater;

5.4.9 include completed operations insurance;

5.4.10 include contractual liability insurance covering CONTRACTOR's indemnity obligations under paragraphs 6.16, 6.31 and 6.32;

5.4.11 contain a provision or endorsement that the coverage afforded will not be cancelled, materially changed or renewal refused until at least 30 days prior written notice has been given to OWNER, ENGINEER and each other additional insured indicated in the Supplementary Conditions to whom a certificate of insurance had been issued (and the certificates of insurance furnished by the CONTRACTOR pursuant to paragraph 5.3.2 will so provide);

5.4.12 remain in effect at least until final payment and at all times thereafter when CONTRACTOR may be correcting, removing or replacing *defective* Work in accordance with paragraph 13.12; and

5.4.13 with respect to completed operations insurance and any other insurance coverage written on a claims-made basis, remain in effect for at least two years after final payment (and CONTRACTOR shall furnish OWNER and any other additional insured indicated in the Supplementary Conditions to whom a certificate of insurance has been issued evidence satisfactory to OWNER and any such additional insured of continuation of such insurance at final payment and one year thereafter).

OWNER's Liability Insurance:

5.5 OWNER shall be responsible for purchasing and maintaining OWNER's own liability insurance and, at OWNER's option, may purchase and maintain such insurance as will protect OWNER against claims which may arise from operations under the Contract Documents.

Builders Risk Property Insurance:

5.6 Unless otherwise provided in the Supplementary Conditions, OWNER shall purchase and maintain "builders risk" property insurance upon the Work at the site in the amount of the full replacement cost there (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws or Regulations). This insurance shall:

5.6.1 include the interests of OWNER, CONTRACTOR, Subcontractors, ENGINEER, ENGINEER's Consultant, and any other persons or entities indicated in the Supplementary Conditions, all of whom shall be listed as insureds or additional insureds;

5.6.2 be written on a Builder's Risk "all-risk" policy form, shall at least include insurance for physical loss and damage, and shall insure against the peril of fire and extended coverage, theft, vandalism and malicious mischief, earthquake, temporary buildings, falsework, collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations and water damage, and such other perils as may be provided in the Supplementary Conditions;

5.6.3 include damages, losses and expenses arising out of or resulting from any insured loss or incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers, architects, attorneys and other professionals);

5.6.4 cover materials and equipment stored on or off the site or in transit prior to being incorporated in the Work where such materials and equipment are included in an approved Application for Payment; and

5.6.5 be maintained in effect until final payment is made unless otherwise agreed to in writing by OWNER, CONTRACTOR and ENGINEER, with thirty days written notice to each other additional insured to whom a certificate of insurance has been issued.

5.7 OWNER shall purchase and maintain such boiler and machinery insurance or additional property insurance as may be required by the Supplementary Conditions or Laws and Regulations which will include the OWNER, CONTRAC-

TOR, Subcontractors, ENGINEER, ENGINEER's Consultants, and any other insureds as may be indicated in the Supplementary Conditions, all of whom shall be listed by name as insureds or additional insureds.

5.8 All the policies of insurance (or the certificates or other evidence thereof) required to be purchased and maintained by OWNER in accordance with paragraphs 5.6 and 5.7 will contain a provision or endorsement that the coverage afforded will not be cancelled or materially changed or renewal refused until at least thirty days prior written notice has been given to CONTRACTOR, and to each other additional insured to whom a certificate of insurance has been issued and will contain waiver provisions in accordance with paragraph 5.11.

5.9 OWNER shall not be responsible for purchasing and maintaining any property insurance to protect the interests of CONTRACTOR, Subcontractors or others in the Work to the extent of any deductible amounts that are identified in the Supplementary Conditions. The risk of loss within such identified deductible amount will be borne by the CONTRACTOR, Subcontractors or others suffering any such loss and if any of them wishes property insurance coverage within the limits of such amounts, each may purchase and maintain it at the purchaser's own expense.

5.10 If CONTRACTOR requests in writing that other special insurance be included in the property insurance policy, OWNER shall, if possible, include such insurance, and the cost thereof will be charged to CONTRACTOR by appropriate Change Order or Written Amendment. Prior to commencement of the Work at the site, OWNER shall in writing advise CONTRACTOR whether or not such other insurance has been procured by OWNER.

Waiver of Rights:

5.11 OWNER and CONTRACTOR intend that all policies provided in response to paragraphs 5.6 and 5.7 will protect all of the parties listed as insureds or additional insureds in such policies and provide primary coverage for all losses and damages covered by perils insured thereby. All such policies shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any of the parties so listed. Accordingly, OWNER and CONTRACTOR waive all rights against each other for all losses and damages caused by any of the perils covered by such policies and any other property insurance applicable to the Work to the extent of insurance proceeds received under all such policies; and, in addition, waive all such rights against Subcontractors and all other parties so listed, and also against ENGINEER and ENGINEER's Consultants, for losses and damages so caused. None of the above waivers shall extend to the rights that any of the parties so listed may have to the proceeds of insurance held by OWNER as trustee or otherwise payable under any policy so issued.

Receipt and Application of Proceeds:

5.12 Any insured loss under the policies of insurance required by paragraphs 5.6 and 5.7 will be adjusted with OWNER and made payable to OWNER as fiduciary for the insureds, as their interests may appear, subject to the requirements of any applicable mortgage clause and of paragraph 5.13. OWNER shall deposit in a separate account any money so received, and shall distribute it in accordance with such agreement as the parties in interest may reach. If no other special agreement is reached the damaged Work shall be repaired or replaced, the monies so received applied on account thereof and the Work and the cost thereof covered by an appropriate Change Order or Written Amendment.

5.13 OWNER as fiduciary shall have power to adjust and settle any loss with the insurers unless one of the parties in interest shall object in writing within fifteen days after the occurrence of loss to OWNER's exercise of this power. If such objection is made, OWNER as fiduciary shall make settlement with the insurers in accordance with such agreement as the parties in interest may reach. If no such agreement among the parties in interest is reached, OWNER as fiduciary shall adjust and settle the loss with the insurers and, if required in writing by any party in interest, OWNER as fiduciary shall give bond for the proper performance of such duties.

Acceptance of Insurance:

5.14 If OWNER has any objection to the coverage afforded by or other provisions of the Bonds or insurance required to be purchased and maintained by CONTRACTOR in accordance with paragraphs 5.1, 5.2, 5.3 and 5.4 and any applicable provisions of the Supplementary Conditions on the basis of their not complying with the Contract Documents, OWNER shall notify CONTRACTOR in writing thereof within ten days of the date of delivery of such certificates (or other evidence requested) in accordance with paragraph 2.7. If CONTRACTOR has any objection to the coverage afforded by or other provisions of the policies of insurance required to be purchased and maintained by OWNER in accordance with paragraphs 5.6 and 5.7 and any applicable provisions of the Supplementary Conditions on the basis of their not complying with the Contract Documents, CONTRACTOR shall notify OWNER in writing thereof within ten days of the date of delivery of such certificates (or other evidence requested) in accordance with paragraph 2.7. OWNER and CONTRACTOR shall each provide to the other such additional information in respect of insurance provided by each as the other may reasonably request.

Partial Utilization -- Property Insurance:

5.15 If OWNER finds it necessary to occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work, such use or occupancy may be accomplished in accordance with paragraph 14.10; provided that no such use or occupancy shall commence before the insurers providing the property insurance have acknowledged notice thereof and in writing effected the changes in coverage necessitated thereby. The insurers providing the property insurance shall consent by endorsement on the policy or policies, but the property insurance shall not be cancelled or permitted to lapse on account

of any such partial use or occupancy.

ARTICLE 6 -- CONTRACTOR's RESPONSIBILITIES

Supervision and Superintendence:

6.1 CONTRACTOR shall supervise, inspect and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. CONTRACTOR shall be solely responsible for the means, methods, techniques, sequences and procedures of construction, but CONTRACTOR shall not be responsible for the negligence of others in the design or specification of a specific means, method, technique, sequence or procedure of construction which is indicated in and expressly required by the Contract Documents. CONTRACTOR shall be responsible to see that the completed Work complies accurately with the Contract Documents.

6.2 CONTRACTOR shall keep on the Work at all times during its progress a competent resident superintendent, who shall not be replaced without written notice to OWNER and ENGINEER except under extraordinary circumstances. The OWNER shall have the right to reject or demand replacement of such superintendent at any time, with or without cause, solely at the OWNER's discretion, based upon objective or subjective reasons, which reasons the OWNER may, but is not required to, disclose to the CONTRACTOR. The superintendent will be CONTRACTOR's representative at the site and shall have authority to act on behalf of CONTRACTOR. All communications given to the superintendent shall be as binding as if given to CONTRACTOR.

Labor, Materials and Equipment:

6.3 CONTRACTOR shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. CONTRACTOR shall at all times maintain good discipline and order at the site. Except as otherwise required for the safety or protection of persons or the Work or property at the site or adjacent thereto, and except as otherwise indicated in the Contract Documents, all Work at the site shall be performed during regular working hours, and CONTRACTOR will not permit overtime work or the performance of Work on Saturday, Sunday or any legal holiday without OWNER's written consent given after prior written notice to ENGINEER.

6.4 Unless otherwise specified in the General Requirements, CONTRACTOR shall furnish and assume full responsibility for all materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities and all other facilities and incidentals necessary for the furnishing, performance, testing, start-up and completion of the Work.

6.5 All materials and equipment shall be of good quality and new, except as otherwise provided in the Contract Documents. All warranties and guarantees specifically called for by the Specifications shall expressly run to the benefit of OWNER. If required by ENGINEER, CONTRACTOR shall furnish satisfactory evidence (including reports of required tests) as to the kind and quality of materials and equipment. All materials and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned in accordance with the instructions of the applicable Supplier, except as otherwise provided in Contract Documents.

Progress Schedule:

6.6 CONTRACTOR shall adhere to the finalized progress schedule established in accordance with paragraph 2.9, as it may be adjusted from time to time in accordance with the Contract Documents. CONTRACTOR shall submit to the ENGINEER for acceptance (to the extent indicated in paragraph 2.9) adjustments in the finalized progress schedule to reflect the impact thereon of new developments. Such adjustments will conform generally to the progress schedule then in effect and additionally will comply with any provisions of the General Requirements applicable thereto.

Substitutes and "Or-Equal" Items:

6.7 Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, no like, equivalent, or "or equal" item or substitution is permitted.

6.8 Concerning Subcontractors, Suppliers and Others:

6.8.1 CONTRACTOR shall not employ any Subcontractor, Supplier or other person or organization (including those acceptable to OWNER and ENGINEER as indicated in paragraph 6.8.2) whether initially or as a substitute, against whom OWNER or ENGINEER may have reasonable objection. CONTRACTOR shall not be required to employ any Subcontractor, Supplier or other person or organization to furnish or perform any of the Work against whom CONTRACTOR has reasonable objection.

6.8.2 If the Supplementary Conditions require the identity of certain Subcontractors, Suppliers or other persons or organizations (including those who are to furnish the principal items of materials and equipment) to be submitted to OWNER in advance of the specified date prior to the Effective Date of the Agreement for acceptance by OWNER and ENGINEER and if CONTRACTOR has submitted a list thereof in accordance with the Supplementary Conditions, OWNER's or ENGINEER's acceptance (either in writing or by failing to make written objection thereto by the date indicated for acceptance or objection in the bidding documents or the Contract Documents) of any such Subcontractor, Supplier or other person or organization so identified may be revoked on the basis of

reasonable objection after due investigation, in which case CONTRACTOR shall submit an acceptable substitute. The Contract Price or Contract Times will be adjusted by the difference in the cost or time occasioned by such substitution and an appropriate Change Order will be issued or Written Amendment signed. No acceptance by OWNER or ENGINEER of any such Subcontractor, Supplier or other person or organization shall constitute a waiver of any right of OWNER or ENGINEER to reject *defective* Work.

6.9 CONTRACTOR Responsible for Subcontractors:

6.9.1 CONTRACTOR shall be fully responsible to OWNER and ENGINEER for all acts and omissions of the Subcontractors, Suppliers, and other persons and organizations performing or furnishing any of the Work under a direct or indirect contract with CONTRACTOR, just as CONTRACTOR is responsible for CONTRACTOR's own acts and omissions. Nothing in the Contract Documents shall create for the benefit of any such Subcontractor, Supplier or other person or organization any contractual relationship between OWNER or ENGINEER and any such Subcontractor, Supplier or other person or organization, nor shall it create any obligation on the part of OWNER or ENGINEER to pay or to see to the payment of any moneys due any such Contractor, Supplier, or other person or organization except as may otherwise be required by Laws or Regulations.

6.9.2 CONTRACTOR shall be fully responsible for scheduling and coordinating the Work of Subcontractors, Suppliers and other persons and organizations performing or furnishing any of the Work under a direct or indirect contract with CONTRACTOR. CONTRACTOR shall require any Subcontractor, Suppliers or other persons and organizations performing or furnishing any of the Work to communicate with the ENGINEER through CONTRACTOR.

6.10 The divisions and sections of the Specifications and the identification of any Drawings shall not control CONTRACTOR in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.

6.11 All Work performed for CONTRACTOR by a Subcontractor or Supplier will be pursuant to an appropriate agreement between CONTRACTOR and the Subcontractor or Supplier which specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of OWNER and ENGINEER. Whenever any such agreement is with a Subcontractor or Supplier who is listed as an additional insured on the property insurance provided in paragraph 5.6 or 5.7, the agreement between the CONTRACTOR and the Subcontractor or Supplier will contain provisions whereby the Subcontractor or Supplier waives all rights against OWNER, CONTRACTOR, ENGINEER, ENGINEER's Consultants and all other additional insureds for all losses and damages caused by any of the perils covered by such policies and any other property insurance applicable to the Work. If the insurers on any such policies require separate waiver forms to be signed by any Subcontractor or Supplier, CONTRACTOR will obtain the same.

Patent Fees and Royalties:

6.12 CONTRACTOR shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product or device is specified in the Contract Documents for use in the performance of the Work and if to the actual knowledge of OWNER or ENGINEER its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by OWNER in the Contract Documents. CONTRACTOR shall idemnify and hold harmless and defend OWNER and ENGINEER and ENGINEER's Consultants and anyone directly or indirectly employed by any of them from and against all claims, damages, losses and expenses (including but not limited to fees of engineers, architects, attorneys, and other professionals, and court and arbitration costs) arising out of any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product or device not specified in the Contract Documents.

Permits:

6.13 Unless otherwise provided in the Supplementary Conditions, CONTRACTOR shall obtain and pay for all construction permits and licenses. OWNER shall assist CONTRACTOR, when necessary, in obtaining such permits and licenses. CONTRACTOR shall pay all governmental charges and inspection fees necessary for the prosecution of the Work, which are applicable at the time of opening of Bids, or if there are no Bids, on the Effective Date of the Agreement. CONTRACTOR shall pay all charges of utility owners for connections to the Work, and OWNER shall pay all charges of such utility owners for capital costs related thereto such as plant investment fees.

6.14 Laws and Regulations:

6.14.1 CONTRACTOR shall give all notices and comply with all Laws and Regulations applicable to furnishing and performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither OWNER nor ENGINEER shall be responsible for monitoring CONTRACTOR's compliance with any Laws or Regulations.

6.14.2 If CONTRACTOR performs any Work knowing or having reason to know that it is contrary to Laws or Regulations, CONTRACTOR shall bear all costs arising therefrom; however, it shall not be CONTRACTOR's primary responsibility to make certain that the Specifications and Drawings are in accordance with such Laws and

Regulations, but this shall not relieve CONTRACTOR of CONTRACTOR's obligations under paragraph 3.3.2.

Taxes:

6.15 Unless otherwise provided in the Supplementary Conditions, CONTRACTOR shall pay all sales, consumer, use and other similar taxes required to be paid by CONTRACTOR in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work.

Use of Premises:

6.16 CONTRACTOR shall confine construction equipment, the storage of materials and equipment and the operations of workers to the site and land and areas identified in and permitted by the Contract Documents and other land and areas permitted by Laws and Regulations, rights-of-way, permits and easements, and shall not unreasonably encumber the premises with construction equipment or other materials or equipment. CONTRACTOR shall assume full responsibility for any damage to any such land or area, or to the owner or occupant thereof or of any adjacent land or areas, resulting from the performance of the Work. Should any claim be made against OWNER or ENGINEER by any such owner or occupant because of the performance of the Work, CONTRACTOR shall promptly attempt to settle with such other party by agreement or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law. CONTRACTOR shall, to the fullest extent permitted by Laws and Regulations, idemnify, hold harmless and defend OWNER, ENGINEER and ENGINEER's Consultants and anyone directly or indirectly employed by any of them from and against all claims, damages, losses and expenses (including, but not limited to, fees of engineers, architects, attorneys and other professionals and court and arbitration or other dispute resolution costs) arising directly, indirectly or consequentially out of any action, legal or equitable, brought by any such other party against OWNER, ENGINEER or ENGINEER's Consultant to the extent caused by or based upon CONTRACTOR's performance of the Work.

6.17 During the progress of the Work, CONTRACTOR shall keep the premises free from accumulations of waste materials, rubbish and other debris resulting from the Work. At the completion of the Work CONTRACTOR shall remove all waste materials, rubbish and debris from and about the premises as well as all tools, appliances, construction equipment and machinery, and surplus materials, and shall leave the site clean and ready for occupancy by OWNER at Substantial Completion of the Work. CONTRACTOR shall restore to original condition all property not designated for alteration by the Contract Documents.

6.18 CONTRACTOR shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall CONTRACTOR subject any part of the Work or adjacent property to stresses or pressures that will endanger it.

Record Documents:

6.19 CONTRACTOR shall maintain in a safe place at the site one record copy of all Drawings, Specifications, Addenda, Written Amendments, Change Orders, Work Change Directives, Field Orders and written interpretations and clarifications (issued pursuant to paragraph 9.4) in good order and annotated to show all changes made during construction. These record documents together with all approved Samples and a counterpart of all approved Shop Drawings will be available to ENGINEER for reference. Upon completion of the Work, these record documents, Samples and Shop Drawings will be delivered to ENGINEER for OWNER.

Safety and Protection:

6.20 CONTRACTOR shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. CONTRACTOR shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:

6.20.1 all persons on the Work who may be affected by the Work;

6.20.2 all the Work and materials and equipment to be incorporated therein, whether in storage on or off the site; and

6.20.3 other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities and Underground Facilities not designed for removal, relocation or replacement in the course of construction.

CONTRACTOR shall comply with all applicable Laws and Regulations of any public body having jurisdiction for the safety of persons or property or to protect them from damage, injury or loss; and shall erect and maintain all necessary safeguards for such safety and protection. CONTRACTOR shall notify owners of adjacent property and of Underground Facilities and utility owners when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation and replacement of their property. All damage, injury or loss to any property referred to in paragraph 6.20.2 or 6.20.3 caused, directly or indirectly, in whole or in part, by CONTRACTOR, any Subcontractor, Supplier or any other person or organization directly or indirectly employed by any of them to perform or furnish any of the Work or anyone for whose acts any of them may be liable, shall be remedied by CONTRACTOR (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of OWNER or ENGINEER or ENGINEER's Consultant or anyone employed by any of them or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of CONTRACTOR or any Subcontractor, Supplier or other person or organization directly or indirectly employed by any of them). CONTRACTOR's duties and responsibilities for safety and the protection of the Work shall continue until such time as all the Work is completed and ENGINEER has issued a notice to OWNER and CONTRAC-

TOR in accordance with paragraph 14.13 that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

6.21 Safety Representative: CONTRACTOR shall designate an experienced safety representative at the site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs.

6.22 In performing the Work, CONTRACTOR shall take all measures to prevent the release, spillage or improper disposal of any hazardous substance or construction or waste materials which may contaminate the OWNER's or adjacent properties or the environment or substantially endanger human health. The transportation, handling, storage and use of gasoline, oils, paints, residual cleaning solvents and other hazardous substances or contaminating materials by CONTRACTOR or any Subcontractor shall be in such a manner to prevent release, spillage or improper disposal. Should any such hazardous substances or contaminating materials be released, spilled or improperly disposed of by the CONTRACTOR or any Subcontractors, the CONTRACTOR shall immediately notify the OWNER and ENGINEER, notify any applicable environmental agency as required by Laws and Regulations, and immediately remedy or remove such substances or materials, and clean and restore the affected areas to a safe condition and to the satisfaction of the OWNER and any applicable environmental agency. The CONTRACTOR shall pay all costs for the remedy or removal of contaminate materials and the proper disposal of them at an approved and permitted site and the restoration of the affected areas. The CONTRACTOR shall also be responsible for the payments of and shall indemnify, hold harmless and defend the OWNER, ENGINEER and ENGINEER's Consultant from all penalties, fines and damage claims resulting from the release, spillage or improper disposal by CONTRACTOR or any Subcontractor of any such hazardous substances or contaminating material.

Emergencies:

6.23 In emergencies affecting the safety or protection of persons or the Work or property at the site or adjacent thereto, CONTRACTOR, without special instruction or authorization from ENGINEER or OWNER, is obligated to act to prevent threatened damage, injury or loss. CONTRACTOR shall give ENGINEER prompt written notice if CONTRACTOR believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby. If ENGINEER determines that a change in the Contract Documents is required because of the action taken by CONTRACTOR in response to such an emergency, a Work Change Directive or Change Order will be issued to document the consequences of the changes or variations.

Shop Drawings and Samples:

6.24 CONTRACTOR shall submit:

6.24.1 Shop Drawings to ENGINEER for review and approval in accordance with the accepted schedule of Shop Drawings and Sample submittals (see paragraph 2.9). All submittals will be identified as ENGINEER may require and in the number of copies specified in the General Requirements. The data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials and similar data to show ENGINEER the materials and equipment CONTRACTOR proposes to provide and to enable ENGINEER to review the information for the limited purposes required by paragraph 6.26.

6.24.2 Samples to ENGINEER for review and approval in accordance with said accepted schedule of Shop Drawings and Sample submittals. Each Sample will be identified clearly as to material, Supplier, pertinent data such as catalog numbers and the use for which intended and otherwise as ENGINEER may require to enable ENGINEER to review the submittal for the limited purposes required by paragraph 6.26. The numbers of each Sample to be submitted will be as specified in the Specifications.

6.25 *Verification and Notice of Variations:*

6.25.1 Before submitting each Shop Drawing or Sample, CONTRACTOR shall have determined and verified (i) all field measurements, quantities, dimensions, specified performance criteria, installation requirements, materials, catalog numbers and similar information with respect thereto, (ii) all materials with respect to intended use, fabrication, shipping, handling, storage, assembly and installation pertaining to the performance of the Work, and (iii) all information relative to CONTRACTOR's sole responsibilities in respect of means, methods, techniques, sequences and procedures of construction and safety precautions and programs incident thereto. CONTRACTOR shall also have reviewed and coordinated each Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents.

6.25.2 Each submittal will bear a stamp or specific written indication that CONTRACTOR has satisfied CONTRACTOR's obligations under the Contract Documents with respect to CONTRACTOR's review and approval of that submittal.

6.25.3 At the time of each submission, CONTRACTOR shall give ENGINEER specific written notice of such variations, if any, that the Shop Drawing or Sample submitted may have from the requirements of the Contract Documents, such notice to be in a written communication separate from the submittal; and, in addition, shall cause a specific notation to be made on each Shop Drawing and Sample submitted to ENGINEER for review and approval of each such variation.

6.26 ENGINEER will review and approve Shop Drawings and Samples in accordance with the final schedule of Shop Drawings and Sample submittals accepted by ENGINEER as

required by paragraph 2.9. ENGINEER's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. ENGINEER's review and approval will not extend to means, methods, techniques, sequences or procedures of construction (except where a specific means, method, technique, sequence or procedure of construction is specifically and expressly called for by the Contract Documents) or to safety precautions or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions. CONTRACTOR shall make corrections required by ENGINEER, and shall return the required number of corrected copies of Shop Drawings and submit as required new Samples for review and approval. CONTRACTOR shall direct specific attention in writing to revisions other than the corrections called for by ENGINEER on previous submittals.

6.27 ENGINEER's review and approval of Shop Drawings or Samples shall not relieve CONTRACTOR from responsibility for any variation from the requirements of the Contract Documents unless CONTRACTOR has in writing called ENGINEER's attention to each such variation at the time of submission as required by paragraph 6.25.3 and ENGINEER has given written approval of each such variation by a specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample approval; nor will any approval by ENGINEER relieve CONTRACTOR from responsibility for complying with the requirements of paragraph 6.25.1.

6.28 Where a Shop Drawing or Sample is required by the Contract Documents or the final schedule of Shop Drawings and Sample submissions accepted by ENGINEER as required by paragraph 2.9, any related Work performed prior to ENGINEER's review and approval of the pertinent submittal will be at the sole expense and responsibility of CONTRACTOR.

Continuing the Work:

6.29 CONTRACTOR shall carry on the Work and adhere to the progress schedule during all disputes or disagreements with OWNER. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, except as permitted by paragraph 15.5 or as CONTRACTOR and OWNER may otherwise agree in writing.

6.30 CONTRACTOR's General Warranty and Guarantee

6.30.1 CONTRACTOR warrants and guarantees to OWNER, ENGINEER and ENGINEER's Consultants that all Work will be in accordance with the Contract Documents and will not be *defective*.

6.30.2 CONTRACTOR's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute and unconditional. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of CONTRACTOR's obligation to perform the Work in accordance with the Contract Documents:

6.30.2.1 observations by ENGINEER;

6.30.2.2 recommendation of any progress or final payment by ENGINEER;

6.30.2.3 the issuance of a certificate of Substantial Completion or any payment by OWNER to CONTRACTOR under the Contract Documents;

6.30.2.4 any use or occupancy of the Work or any part thereof by OWNER;

6.30.2.5 any act or acceptance by OWNER or any failure to do so;

6.30.2.6 any review and approval of a Shop Drawing or Sample submittal, or the issuance of a notice of acceptability by ENGINEER pursuant to paragraph 14.13; or

6.30.2.7 any inspection, test or approval by others; or

6.30.2.8 any correction of *defective* Work by OWNER.

6.31 *Indemnification:*

6.31.1 To the fullest extent permitted by Laws and Regulations CONTRACTOR shall indemnify and hold harmless OWNER, ENGINEER, ENGINEER's Consultant and the affiliated companies, consultants, agents, officers, directors and employees of each and any of them from and against all claims, damages, losses and expenses, direct, indirect or consequential (including but not limited to fees and charges of engineers, architects, attorneys and other professionals and court and arbitration or other dispute resolution costs) arising out of or resulting from the performance of the Work, provided that any such claim, damage, loss or expense (a) is attributable to bodily injury, personal injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself) including the loss of use resulting therefrom and (b) is caused in whole or in part by any negligent act or omission of CONTRACTOR, any Subcontractor, any Supplier, any person or organization directly or indirectly employed by any of them to perform or furnish any of the Work or anyone for whose acts any of them may be liable, regardless of whether or not caused in part by any negligence or omission of a person or entity indemnified hereunder or whether liability is imposed upon such indemnified party by Laws and Regulations regardless of the negligence of any such person or entity.

6.31.2 In any and all claims against OWNER, ENGINEER, ENGINEER's Consultant or the affiliated companies, consultants, agents, officers, directors, or employees of each or any of them by any employee (or the survivor or personal representative of such employee) of CONTRACTOR, any Subcontractor, any Supplier, any

person or organization directly or indirectly employed by any of them to perform or furnish any of the Work or anyone for whose acts any of them may be liable, the indemnification obligation under paragraph 6.31 shall not be limited in any way by any limitation on the amount or type of damages, compensation or benefits payable by or for CONTRACTOR or any such Subcontractor, Supplier or other person or organization under workers' compensation acts, disability benefit acts or other employee benefit acts.

6.31.3 If any provisions of paragraphs 6.31 or 6.32 in respect of indemnification is prohibited or unenforceable by applicable law, then said paragraphs 6.31 and 6.32, as applicable, shall be reformed and amended so that the parties indemnified hereunder are provided with the fullest extent of indemnification as is permitted under applicable law and the remainder of the Contract Documents shall remain in full force and effect and not be invalidated.

6.32 *Survival of Obligations:*

All representations, indemnifications, warranties and guarantees made in, required by, or given in accordance with the Contract Documents will survive final payment, completion and acceptance of the Work and termination or completion of the Agreement.

ARTICLE 7 -- OTHER WORK

Related Work at Site:

7.1 OWNER may perform other work related to the Project at the site by OWNER's own forces, or let other direct contracts therefor which shall contain General Conditions similar to these, or have other Work performed by utility owners. If the fact that such other Work is to be performed was not noted in the Contract Documents, then (i) written notice thereof will be given to CONTRACTOR prior to starting any such other Work and (ii) CONTRACTOR may make a claim therefor as provided in Articles 11 and 12 if CONTRACTOR believes that such performance will involve additional expense to CONTRACTOR or requires additional time and the parties are unable to agree as to the amount or extent thereof.

7.2 CONTRACTOR shall afford each other contractor who is a party to such a direct contract and each utility owner (and OWNER, if OWNER is performing the additional Work with OWNER's employees) proper and safe access to the site and a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such work and shall properly connect and coordinate the Work with theirs. Unless otherwise provided in the Contract Documents, CONTRACTOR shall do all cutting, fitting and patching of the Work that may be required to make its several parts come together properly and integrate with such other work. CONTRACTOR shall not endanger any work of others by cutting, excavating or otherwise altering their work and will only cut or alter their work with the written consent of ENGINEER and the others whose work will be affected. The duties and responsibilities of CONTRACTOR under this paragraph are for the benefit of such utility owners and other contractors to the extent that there are comparable provisions for the benefit of CONTRACTOR in said direct contracts between OWNER and such utility owners and other contractors.

7.3 If the proper execution or results of any part of CONTRACTOR's Work depends upon work performed by others under this Article 7, CONTRACTOR shall inspect such other work and promptly report to ENGINEER in writing any delays, defects or deficiencies in such work that render it unavailable or unsuitable for the proper execution and results of CONTRACTOR's Work. CONTRACTOR's failure so to report will constitute an acceptance of the other work as fit and proper for integration with CONTRACTOR's Work except for latent or nonapparent defects and deficiencies in such other work.

Coordination:

7.4 If OWNER contracts with others for the performance of other work on the Project at the site, the following will be set forth in Supplementary Conditions:

7.4.1 the person, firm or corporation who will have authority and responsibility for coordination of the activities among the various prime contractors will be identified;

7.4.2 the specific matters to be covered by such authority and responsibility will be itemized; and

7.4.3 the extent of such authority and responsibilities will be provided. Unless otherwise provided in the Supplementary Conditions, OWNER shall have sole authority and responsibility in respect of such coordination.

ARTICLE 8 -- OWNER's RESPONSIBILITIES

8.1 Except as otherwise provided in these General Conditions, OWNER shall issue all communications to CONTRACTOR through ENGINEER.

8.2 In case of termination of the employment of ENGINEER's Consultant, OWNER may appoint a replacement whose status under the Contract Documents shall be that of the former ENGINEER's Consultant.

8.3 OWNER shall furnish the data required of OWNER under the Contract Documents promptly and shall make payments to CONTRACTOR promptly after they are due as provided in paragraphs 14.4 and 14.13.

8.4 OWNER's duties in respect of providing lands and easements and providing engineering surveys to establish reference points are set forth in paragraphs 4.1 and 4.4. Paragraph 4.2 refers to OWNER identifying and making available to CONTRACTOR copies of reports of explorations and tests of subsurface conditions at the site and drawings of

physical conditions in or relating to existing structures which have been utilized by ENGINEER in preparing the Drawings and Specifications.

8.5 OWNER's responsibilities in respect of purchasing and maintaining liability and property insurance are set forth in paragraphs 5.5 through 5.10.

8.6 OWNER is obligated to execute Change Orders as indicated in paragraph 10.4.

8.7 OWNER's responsibility in respect of certain inspections, tests and approvals is set forth in paragraph 13.4.

8.8 In connection with OWNER's right to stop Work or suspend Work, see paragraphs 13.10 and 15.1. Paragraph 15.2 deals with OWNER's right to terminate services of CONTRACTOR under certain circumstances.

8.9 The OWNER shall not supervise, direct or have control or authority over, nor be responsible for, CONTRACTOR's means, methods, techniques, sequences or procedures of construction or the safety precautions and programs incident thereto, or for any failure of CONTRACTOR to comply with Laws and Regulations applicable to the furnishing or performance of the Work. OWNER will not be responsible for CONTRACTOR's failure to perform or furnish the Work in accordance with the Contract Documents.

8.10 OWNER's responsibility in respect of undisclosed Asbestos, PCBs, Petroleum, Hazardous Waste or Radioactive Material uncovered or revealed at the site is set forth in paragraph 4.5.

ARTICLE 9 -- ENGINEER's STATUS

9.1 *OWNER's Representative:*

9.1.1 ENGINEER will be OWNER's representative during the construction period. The duties and responsibilities and the limitations of authority of ENGINEER as OWNER's representative during construction are set forth in the Contract Documents and shall not be extended without written consent of OWNER and ENGINEER.

9.1.2 The assignment of any authority, duties or responsibilities to ENGINEER under the Contract Documents, or any undertaking, exercise or performance thereof by ENGINEER, is intended to be for the sole and exclusive benefit of OWNER and not for the benefit of CONTRACTOR, Subcontractor, Supplier or any other person or organization.

Visits to Site:

9.2 Subject to the limitations of authority and responsibilities indicated in paragraph 9.13, ENGINEER will make visits to the site at intervals appropriate to the various stages of construction as ENGINEER deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of CONTRACTOR's executed Work. Based on information obtained during such visits and observations, ENGINEER will endeavor for the benefit of OWNER to determine, in general, if the Work is proceeding in accordance with the Contract Documents. ENGINEER will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. ENGINEER's efforts will be directed toward providing for OWNER a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and on-site observations, ENGINEER will keep OWNER informed of the progress of the Work and will endeavor to guard OWNER against *defective* Work. ENGINEER will not supervise, direct or have control over any of CONTRACTOR's Work during such visits or as a result of such observations of CONTRACTOR's Work.

Project Representative:

9.3 If OWNER and ENGINEER agree, ENGINEER will furnish a Resident Project Representative to assist ENGINEER in providing more continuous observation of the Work. The duties, responsibilities and limitations of authority of any such Resident Project Representative and assistants will be as provided in the Supplementary Conditions. If OWNER designates another agent to represent OWNER at the site who is not ENGINEER's agent or employee, the duties, responsibilities and limitations of authority of such other person will be as provided in the Supplementary Conditions.

Clarifications and Interpretations:

9.4 ENGINEER will issue with reasonable promptness such written clarifications or interpretations of the requirements of the Contract Documents (in the form of Drawings or otherwise) as ENGINEER may determine necessary which shall be consistent with the intent of and reasonably inferable from the Contract Documents. Such written clarifications and interpretations will be binding on OWNER and CONTRACTOR. If CONTRACTOR or OWNER believes that a written clarification or interpretation justifies an adjustment in the Contract Price or an adjustment, if any, of the Contract Times and the parties are unable to agree to the amount or extent thereof, CONTRACTOR or OWNER may make a claim therefor as provided in Article 11 or Article 12. All requests from CONTRACTOR for clarification or interpretation shall be submitted to ENGINEER in writing.

Authorized Variations in Work:

9.5 ENGINEER may authorize minor variations in the Work from the requirements of the Contract Documents which do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the complete project as a functioning whole as indicated by the Contract Documents. These may be accomplished by a Field Order and will be binding on OWNER and also on CONTRACTOR who shall perform the Work involved promptly. If CONTRACTOR or OWNER believes

that a Field Order justifies an adjustment in the Contract Price or an extension of the Contract Times and the parties are unable to agree as to the amount or extent thereof. CONTRACTOR or OWNER may make a claim therefor as provided in Article 11 or 12.

Rejecting Defective Work:

9.6 ENGINEER will have authority to disapprove or reject Work which ENGINEER believes to be *defective* or that ENGINEER believes will not produce a completed Project that conforms to the Contract Documents or that will prejudice the integrity of the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. ENGINEER will also have authority to require special inspection or testing of the Work as provided in paragraph 13.9, whether or not the Work is fabricated, installed or completed.

Shop Drawings, Change Orders and Payments:

9.7 In connection with ENGINEER's authority as to Shop Drawings and Samples, see paragraphs 6.24 through 6.28 inclusive.

9.8 In connection with ENGINEER's authority as to Change Orders, see Articles 10, 11 and 12.

9.9 In connection with ENGINEER's authority as to Applications for Payment, see Article 14.

Determinations for Unit Prices:

9.10 ENGINEER will determine the actual quantities and classifications of Unit Price Work performed by CONTRACTOR. ENGINEER will review with CONTRACTOR ENGINEER's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Appeal in accordance with paragraph 9.12 will not be subject to procedures of paragraph 9.11.

Decisions on Disputes:

9.11 Claims, disputes and other matters relating to the acceptability of the Work or the interpretation of the requirements of the Contract Documents pertaining to the performance and furnishing of the Work and claims under Articles 11 and 12 in respect of changes in the Contract Price or Contract Times will be referred initially to ENGINEER in writing with a request for a formal decision in accordance with this paragraph. Written notice of each such claim, dispute and other matter will be delivered by the claimant to ENGINEER and the other party to the Agreement promptly (but in no event later than thirty days) after the start of the occurrence or event giving rise thereto, and written supporting data will be submitted to ENGINEER and the other party within sixty days after the start of such occurrence or event unless ENGINEER allows an additional period of time for the submission of additional or more accurate data in support of such claim, dispute or other matter. The opposing party shall submit any response to ENGINEER and the claimant within thirty days after receipt of the claimant's last submittal (unless ENGINEER allows additional time). ENGINEER will render a formal decision in writing within a reasonable time after receipt of the opposing party's submittal, if any, in accordance with this paragraph.

9.12 ENGINEER's written decisions pursuant to paragraphs 9.10 and 9.11 will be final and binding upon OWNER and CONTRACTOR, unless, within ten days after the date of any such decision, either OWNER or CONTRACTOR delivers to the other party to the Agreement and to ENGINEER written notice of intention to appeal ENGINEER's decision. Delivery of such written notice of intention to appeal a decision by ENGINEER pursuant to paragraphs 9.10 or 9.11 with respect to any claim, dispute or other matter (except any which have been waived by the making or acceptance of final payment as provided in paragraph 14.15) will be a condition precedent to any exercise by OWNER or CONTRACTOR of such rights or remedies as either may otherwise have under the Contract Documents or by Laws or Regulations in respect of any such claim, dispute or other matter pursuant to Article 16. OWNER and CONTRACTOR agree to defer the exercise of their respective rights and remedies under Article 16 with respect to any claim, dispute or other matter that is the subject of such notice of intention to appeal until the making and acceptance of final payment, unless such deferral would irrevocably prejudice the rights of OWNER or CONTRACTOR. OWNER and CONTRACTOR intend to attempt to negotiate a settlement of any outstanding claims at or before the making and acceptance of final payment.

9.13 Limitations on ENGINEER's Authority and Responsibilities

9.13.1 Neither ENGINEER's responsibility or authority to act under this Article 9 or under any other provision of the Contract Documents or under any agreement between OWNER and ENGINEER or OWNER and ENGINEER's Consultant nor any decision made by ENGINEER in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise or performance of any authority or responsibility by ENGINEER shall create, impose or give rise to any duty owed by ENGINEER to CONTRACTOR, any Subcontractor, any Supplier, or any other person or organization, or to any surety, or employee or agent for any of them.

9.13.2 ENGINEER will not supervise, direct, control or have authority over or be responsible for CONTRACTOR's means, methods, techniques, sequences or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of CONTRACTOR to comply with Laws and Regulations applicable to the furnishing or performance of the Work. ENGINEER will not be responsible for CONTRACTOR's failure to perform or furnish the Work in accordance with the Contract Documents.

9.13.3 ENGINEER will not be responsible for the acts or omissions of CONTRACTOR or of any Subcontractor, any

Suppliers, or of any other person or organization performing or furnishing any of the Work.

9.13.4 ENGINEER will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work thereunder. When functioning as initial interpreter and judge, ENGINEER will not be liable in connection with any interpretation or decision rendered in good faith in such capacity.

ARTICLE 10 -- CHANGES IN THE WORK

10.1 Without invalidating the Agreement and without notice to any surety, OWNER may, at any time or from time to time, order additions, deletions or revisions in the Work. Such additions, deletions or revisions will be authorized by a Written Amendment, a Change Order, or a Work Change Directive. Upon receipt of any such document, CONTRACTOR shall promptly proceed with the Work involved which will be performed under the applicable conditions of the Contract Documents (except as otherwise specifically provided).

10.2 If OWNER and CONTRACTOR are unable to agree as to the extent, if any, of an adjustment in the Contract Price or an adjustment of the Contract Times that should be allowed as a result of a Work Change Directive, a claim may be made therefor as provided in Article 11 and Article 12.

10.3 CONTRACTOR shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any Work performed that is not required by the Contract Documents as amended, modified and supplemented as provided in paragraphs 3.5 and 3.6, except in the case of an emergency as provided in paragraph 6.23 or in the case of uncovering Work as provided in paragraph 13.9.

10.4 OWNER and CONTRACTOR shall execute appropriate Change Orders recommended by ENGINEER (or Written Amendments) covering:

10.4.1 changes in the Work which are (i) ordered by OWNER pursuant to paragraph 10.1, (ii) required because of acceptance of *defective* Work under paragraph 13.13 or correcting *defective* Work under paragraph 13.14, or (iii) agreed to by the parties;

10.4.2 changes in the Contract Price or Contract Times which are agreed to by the parties; and

10.4.3 changes in the Contract Price or Contract Times which embody the substance of any written decision rendered by ENGINEER pursuant to paragraph 9.11;

provided that in lieu of executing any such Change Order, an appeal may be taken from any such decision in accordance with the provisions of the Contract Documents and applicable Laws and Regulations, but during any such appeal, CONTRACTOR shall carry on the Work and adhere to the progress schedule as provided in paragraph 6.29.

10.5 If notice of any change affecting the general scope of the Work or the provisions of the Contract Documents (including but not limited to, Contract Price or Contract Times) is required by the provisions of any Bond to be given to a surety, the giving of any such notice will be CONTRACTOR's responsibility, and the amount of each applicable Bond will be adjusted accordingly.

ARTICLE 11 -- CHANGE OF CONTRACT PRICE

11.1 The Contract Price constitutes the total compensation (subject to authorized adjustments) payable to CONTRACTOR for performing the Work. All duties, responsibilities and obligations assigned to or undertaken by CONTRACTOR shall be at CONTRACTOR's expense without change in the Contract Price.

11.2 The Contract Price may only be changed by a Change Order or by a Written Amendment. Any claim for an adjustment in the Contract Price shall be based on written notice delivered by the party making the claim to the other party and to ENGINEER promptly (but in no event later than thirty days) after the start of the occurrence or event giving rise to the claim and stating the general nature of the claim. Notice of the amount of the claim with supporting data shall be delivered within sixty days after such start of the occurrence or event (unless ENGINEER allows additional time for claimant to submit additional or more accurate data in support of the claim) and shall be accompanied by claimant's written statement that the amount claimed covers all known amounts (direct, indirect and consequential) to which the claimant is entitled as a result of said occurrence or event. All claims for adjustment in the Contract Price shall be determined by ENGINEER in accordance with paragraph 9.11 if OWNER and CONTRACTOR cannot otherwise agree on the amount involved. No claim for an adjustment in the Contract Price will be valid if not submitted in accordance with this paragraph 11.2.

11.3 The value of any Work covered by a Change Order or of any claim for an adjustment in the Contract Price will be determined as follows:

11.3.1 where the Work involved is covered by unit prices contained in the Contract Documents, by application of such unit prices to the quantities of the items involved (subject to the provisions of paragraphs 11.9.1 through 11.9.3 inclusive);

11.3.2 where the Work involved is not covered by unit prices contained in the Contract Documents, by a mutually agreed lump sum (which may include an allowance for overhead and profit). Such allowance shall not exceed a fee calculated in accordance with paragraph 11.6.2.

11.3.3 where the Work involved is not covered by unit prices contained in the Contract Documents and agreement to a lump sum is not reached under paragraph 11.3.2, on the basis of the Cost of the Work (determined as provided in paragraphs 11.4 and 11.5) plus a CONTRACTOR's fee for overhead and

profit (determined as provided in paragraph 11.6).

Cost of the Work:

11.4 The term Cost of the Work means the sum of all costs necessarily incurred and paid by CONTRACTOR in the proper performance of the Work. Except as otherwise may be agreed to in writing by OWNER, such costs shall be in amounts no higher than those prevailing in the locality of the Project, shall include only the following items and shall not include any of the costs itemized in paragraph 11.5.

11.4.1 Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by OWNER and CONTRACTOR. Such employees shall include without limitation superintendents, foremen and other personnel employed full-time at the site. Payroll costs for employees not employed full-time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits which shall include social security contributions, unemployment, excise and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, vacation and holiday pay applicable thereto. The expenses of performing Work after regular working hours, on Saturday, Sunday or legal holidays, shall be included in the above to the extent authorized by OWNER.

11.4.2 Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to CONTRACTOR unless OWNER deposits funds with CONTRACTOR with which to make payments, in which case the cash discounts shall accrue to OWNER. All trade discounts, rebates and refunds and all returns from sale of surplus materials and equipment shall accrue to OWNER, and CONTRACTOR shall make provisions so that they may be obtained.

11.4.3 Payments made by CONTRACTOR to the Subcontractors for Work performed or furnished by Subcontractors. If required by OWNER, CONTRACTOR shall obtain competitive bids from subcontractors acceptable to OWNER and CONTRACTOR and shall deliver such bids to OWNER who will then determine, with the advice of ENGINEER, which bids, if any, will be accepted. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as CONTRACTOR's Cost of the Work and fee as provided in paragraphs 11.4, 11.5, 11.6 and 11.7. All Subcontractors shall be subject to the other provisions of the Contract Documents insofar as applicable.

11.4.4 Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys and accounts) employed for services specifically related to the work, only to the extent authorized and approved in writing by the ENGINEER.

11.4.5 Supplemental costs including the following:

11.4.5.1 The proportion of necessary transportation, travel, and subsistence expenses of CONTRACTOR's employees incurred in discharge of duties connected with the Work.

11.4.5.2 Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office and temporary facilities at the site and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost less market value of such items used but not consumed which remain the property of CONTRACTOR.

11.4.5.3 Rentals of all construction equipment and machinery and the parts thereof whether rented from CONTRACTOR or others in accordance with rental agreements approved by OWNER with the advice of ENGINEER, and the costs of transportation, loading, unloading, installation, dismantling and removal thereof all in accordance with the terms of said rental agreements. The rental of any such equipment, machinery or parts shall cease when the use thereof is no longer necessary for the Work.

11.4.5.4 Sales, consumer, use or similar taxes related to the Work, and for which CONTRACTOR is liable, imposed by Laws and Regulations.

11.4.5.5 Deposits lost for causes other than negligence of CONTRACTOR, any Subcontractor or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.

11.4.5.6 Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by CONTRACTOR in connection with the performance and furnishing of the Work (except losses and damages within the deductible amounts of property insurance established by OWNER in accordance with paragraph 5.9), provided they have resulted from causes other than the negligence of CONTRACTOR, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of OWNER. No such losses, damages and expenses shall be included in the Cost of the Work for the purpose of determining CONTRACTOR's fee. If, however, any such loss or damage requires reconstruction and CONTRACTOR is placed in charge thereof, CONTRACTOR shall be paid for services a fee proportionate to that stated in paragraph 11.6.2.

11.4.5.7 The cost of utilities, fuel and sanitary facilities at the site.

11.4.5.8 Minor expenses such as telegrams, long distance telephone calls, telephone service at the site, express delivery and similar petty cash items in connection

with the Work.

11.4.5.9 Cost of premiums for additional Bonds and insurance required because of changes in the Work.

11.5 The term Cost of the Work shall not include any of the following:

11.5.1 Payroll costs and other compensation of CONTRACTOR's officers, executives, principals (of partnership and sole proprietorships), general managers, project managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expeditors, timekeepers, clerks and other personnel employed by CONTRACTOR whether at the site or in CONTRACTOR's principal or a branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in paragraph 11.4.1 or specifically covered by paragraph 11.4.4 all of which are to be considered administrative costs covered by the CONTRACTOR's fee.

11.5.2 Expenses of CONTRACTOR's principal and branch offices other than CONTRACTOR's office at the site.

11.5.3 Any part of CONTRACTOR's capital expenses, including interest on CONTRACTOR's capital employed for the Work and charges against CONTRACTOR for delinquent payments.

11.5.4 Cost of premiums for all Bonds and for all insurance whether or not CONTRACTOR is required by the Contract Documents to purchase and maintain the same (except for the cost of premiums covered by subparagraph 11.4.5.9 above).

11.5.5 Costs due to the negligence of CONTRACTOR, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of *defective* Work, disposal of materials or equipment wrongly supplied and making good any damage to property.

11.5.6 Other overhead or general expense costs of any kind.

11.5.7 The costs of any item not specifically and expressly included in paragraph 11.4.

CONTRACTOR's Fee:

11.6 The CONTRACTOR's fee allowed to CONTRACTOR for overhead and profit shall be determined as follows:

11.6.1 a mutually acceptable fixed fee; or

11.6.2 if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:

11.6.2.1 for costs incurred under paragraphs 11.4.1 and 11.4.2 the CONTRACTOR's Fee shall be fifteen percent;

11.6.2.2 for costs incurred under paragraph 11.4.3 the CONTRACTOR's fee shall be five percent;

11.6.2.3 where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of paragraphs 11.4.1, 11.4.2, 11.4.3 and 11.6.2 is that the Subcontractor who actually performs or furnishes the Work, at whatever tier, will be paid a fee of fifteen percent of the costs incurred by such Subcontractor under paragraphs 11.4.1 and 11.4.2 and that any higher tier Subcontractor and CONTRACTOR will each be paid a fee of five percent of the amount paid to the next lower tier Subcontractor, for example:

Cost of the Work Performed by Sub-Subcontractor	= $10,000.00
Sub-Subcontractor's Fee (15 percent)	1,500.00
Total to Sub-Subcontractor	$11,500.00
Subcontractor's Fee (5 percent)	575.00
Subtotal	$12,075.00
CONTRACTOR's Fee (5 percent)	603.75
Total Change Order	= $12,678.75

11.6.2.4 no fee shall be payable on the basis of costs itemized under paragraphs 11.4.4, 11.4.5 and 11.5;

11.6.2.5 the amount of credit to be allowed by CONTRACTOR or OWNER for any such change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in CONTRACTOR's fee by an amount equal to ten percent of the net decrease; and

11.6.2.6 when both additions and credits are involved in any one change, the adjustment in CONTRACTOR's fee shall be computed on the basis of the net change in accordance with paragraphs 11.6.2.1 through 11.6.2.5 inclusive.

11.7 Whenever the cost of any Work is to be determined pursuant to paragraph 11.4 and 11.5, CONTRACTOR will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in form acceptable to ENGINEER an itemized cost breakdown together with supporting data.

Cash Allowances:

11.8 It is understood that CONTRACTOR has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be done by such Subcontractors or Suppliers and for such sums within the limit of the allowances as may be acceptable to ENGINEER. CONTRACTOR agrees that:

11.8.1 The allowances include the cost to CONTRACTOR (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the site, and all applicable taxes; and

11.8.2 CONTRACTOR's costs for unloading and handling on the site, labor, installation costs, overhead, profit

and other expenses contemplated for the allowances have been included in the Contract Price and not in the allowances. No demand for additional payment on account of any of the foregoing will be valid.

Prior to final payment, an appropriate Change Order will be issued as recommended by ENGINEER to reflect actual amounts due CONTRACTOR on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

Unit Price Work:

11.9.1 Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the established unit prices for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Determinations of the actual quantities and classifications of Unit Price Work performed by CONTRACTOR will be made by ENGINEER in accordance with paragraph 9.10.

11.9.2 Each unit price will be deemed to include an amount considered by CONTRACTOR to be adequate to cover CONTRACTOR's overhead and profit for each separately identified item.

11.9.3 CONTRACTOR or OWNER may make a claim for an adjustment in the Contract Price in accordance with Article 11 if:

11.9.3.1 the quantity of any item of Unit Price Work performed by CONTRACTOR differs materially and significantly from the estimated quantity of such item indicated in the Agreement; and

11.9.3.2 there is no corresponding adjustment with respect to any other item of Work; and

11.9.3.3 if CONTRACTOR believes that CONTRACTOR has incurred additional expense as a result thereof or OWNER believes that OWNER is entitled to a decrease in Contract Price; and

11.9.3.4 the parties are unable to agree as to the amount of any such increase or decrease.

Delays Beyond the Control of Both Parties:

11.10 Neither OWNER nor CONTRACTOR shall be entitled to an increase or decrease in the Contract Price, nor to any other compensation or damages from the other as the result of delays beyond the control of both OWNER and CONTRACTOR, such as fires, floods, epidemics, abnormal weather conditions or acts of God.

ARTICLE 12 -- CHANGE OF CONTRACT TIMES

12.1 The Contract Times (or any applicable specified milestone completion date or time) may only be changed by a Change Order or a Written Amendment. Any claim for an adjustment of the Contract Times shall be based on written notice delivered by the party making the claim to the other party and to ENGINEER promptly (but in no event later than thirty days) after the start of the occurrence of the event giving rise to the claim and stating the general nature of the claim. Notice of the extent of the claim with supporting data shall be delivered to the other party and the ENGINEER within sixty days after the start of such occurrence (unless ENGINEER allows an additional period of time to submit additional or more accurate data in support of the claim) and shall be accompanied by the claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant has reason to believe it is entitled as a result of the occurrence of said event. All claims for adjustment in the Contract Times shall be determined by ENGINEER in accordance with paragraph 9.11 if OWNER and CONTRACTOR cannot otherwise agree. No claim for an adjustment in the Contract Times will be valid if not submitted in accordance with the requirements of this paragraph 12.1.

12.2 All time limits stated in the Contract Documents are of the essence of the Agreement.

12.3 Where CONTRACTOR is prevented from completing the Work within the Contract Times (or any applicable specified milestone completion date or time), the Contract Times (or any applicable specified milestone completion date or time) will be extended in an amount equal to the time lost due to delays beyond the control of CONTRACTOR if a claim is made therefor as provided in paragraph 12.1. At OWNERs option, the Contract Times (or any applicable specified milestone completion date or time) will be extended for the entire Work or only that portion of the Work affected by the event giving rise to the claim. The CONTRACTOR will be notified in writing of the OWNERs decision in this matter. If OWNER elects to extend the Contract Times (or any applicable specified milestone completion date or time) for the affected portion of Work only, liquidated damages, if applicable, will be apportioned between affected Work and non-affected Work based on the value each portion represents as a percentage of the Contract Price. Delays beyond the control of CONTRACTOR shall include, but not be limited to, acts or neglect by OWNER, acts or neglect of utility owners or other contractors performing other work as contemplated by Article 7, fires, floods, epidemics, abnormal weather conditions or acts of God. Delays attributable to and within the control of a Subcontractor or Supplier shall be deemed to be delays within the control of CONTRACTOR.

12.4 Where CONTRACTOR is prevented from completing the Work within the Contract Times (or any applicable specified milestone completion date or time), an extension of the Contract Times (or any applicable milestone completion

date or time) in an amount equal to the time lost due to delays beyond the control of both OWNER and CONTRACTOR shall be CONTRACTOR's sole and exclusive remedy for such delays. At OWNERs option, the Contract Times (or any applicable specified milestone completion date or time) will be extended for the entire Work or only that portion of the Work affected by the event giving rise to the claim. The CONTRACTOR will be notified in writing of the OWNERs decision in this matter. If OWNER elects to extend the Contract Times (or any applicable specified milestone completion date or time) for the affected portion of Work only, liquidated damages, if applicable, will be apportioned between affected Work and non-affected Work based on the value each portion represents as a percentage of the Contract Price. In no event shall OWNER or CONTRACTOR be liable to the other for damages arising out of or resulting from (i) delays caused by or within the control of the other, or (ii) delays beyond the control of both parties including but not limited to fires, floods, epidemics, abnormal weather conditions, acts of God or acts or neglect by utility owners or other contractors performing other work as contemplated by Article 7.

ARTICLE 13 – TESTS AND INSPECTIONS: CORRECTION, REMOVAL OR ACCEPTANCE OF *DEFECTIVE* WORK

13.1 Notice of Defects: Prompt notice of all *defective* Work of which OWNER and ENGINEER have actual knowledge will be given to CONTRACTOR. All *defective* Work may be rejected, corrected or accepted as provided in this Article 13.

Access to Work:

13.2 ENGINEER, ENGINEER's Consultants, other representatives and personnel of OWNER, independent testing laboratories and governmental agencies with jurisdictional interests will have access to the Work at reasonable times for their observation, inspecting and testing. CONTRACTOR shall provide them proper and safe conditions for such access and advise them of CONTRACTOR's site safety procedures and progress so that they may comply therewith as applicable.

Tests and Inspections:

13.3 CONTRACTOR shall give ENGINEER timely notice of readiness of the Work for all required inspections, tests, or approvals, and shall cooperate with inspection and testing personnel to facilitate required inspections or tests.

13.4 OWNER shall employ and pay for the services of an independent testing laboratory to perform all inspections, tests, or approvals required by the Contract Documents except:

13.4.1 for inspections, tests or approvals covered by paragraph 13.5 below;

13.4.2 that costs incurred in connection with tests or inspections conducted pursuant to paragraph 13.9 below shall be paid as provided in said paragraph 13.9; and

13.4.3 as otherwise specifically provided in the Contract Documents.

13.5 If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested or approved by an employee or other representative of such public body, CONTRACTOR shall assume full responsibility for arranging and obtaining such inspection, tests or approvals, pay all costs in connection therewith, and furnish ENGINEER the required certificates of inspection, or approval. CONTRACTOR shall also be responsible for arranging and obtaining and shall pay all costs in connection with any inspections, tests or approvals required for OWNER's or ENGINEER's acceptance of materials or equipment to be incorporated in the Work, or of materials, mix designs, or equipment submitted for approval prior to CONTRACTOR's purchase thereof for incorporation in the Work.

13.6 If any Work (including the Work of others) that is to be inspected, tested or approved is covered by CONTRACTOR without written concurrence of ENGINEER, it must, if requested by ENGINEER, be uncovered for observation. Such uncovering shall be at CONTRACTOR's expense unless CONTRACTOR has given ENGINEER timely notice of CONTRACTOR's intention to cover the same and ENGINEER has not acted with reasonable promptness in response to such notice.

13.7 Neither observations by ENGINEER nor inspections, tests or approvals by others shall relieve CONTRACTOR from CONTRACTOR's obligations to perform the Work in accordance with the Contract Documents.

Uncovering Work:

13.8 If any Work is covered contrary to the written request of ENGINEER, it must, if requested by ENGINEER, be uncovered for ENGINEER's observation and replaced at CONTRACTOR's expense.

13.9 If ENGINEER considers it necessary or advisable that covered Work be observed by ENGINEER or inspected or tested by others, CONTRACTOR, at ENGINEER's request, shall uncover, expose or otherwise make available for observation, inspection or testing as ENGINEER may require, that portion of the Work in question furnishing all necessary labor, material and equipment. If it is found that such Work is *defective*, CONTRACTOR shall bear all direct, indirect and consequential costs and damages of such uncovering, exposure, observation, inspection and testing and of satisfactory replacement or reconstruction, (including but not limited to fees and charges of engineers, architects, attorneys and other professionals and court and arbitration or other dispute resolution costs), and OWNER shall be entitled to an appropriate decrease in the Contract Price, and, if the parties are unable to agree as to the amount thereof, OWNER may make a claim therefor as provided in Article 11. If, however, such Work is not found to be *defective*, CONTRACTOR shall be allowed an increase in the Contract Price or an extension of the Contract Times (or any applicable specified milestone completion date), or both, directly attributable to such un-

covering, exposure, observation, inspection, testing, replacement and reconstruction; and, if the parties are unable to agree as to the amount or extent thereof, CONTRACTOR may make a claim therefor as provided in Article 11 and 12.

Owner May Stop the Work:

13.10 If the Work is *defective*, or CONTRACTOR fails to supply sufficient skilled workers or suitable materials or equipment, or fails to furnish or perform the Work in such a way that the completed Work will conform to the Contract Documents, OWNER may order CONTRACTOR to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of OWNER to stop the Work shall not give rise to any duty on the part of OWNER to exercise this right for the benefit of CONTRACTOR or any other party.

Correction or Removal of Defective Work:

13.11 If required by ENGINEER, CONTRACTOR shall promptly, as directed, either correct all *defective* Work, whether or not fabricated, installed or completed, or, if the Work has been rejected by ENGINEER, remove it from the site and replace it with Work that is not *defective*. CONTRACTOR shall bear all direct, indirect and consequential costs and damages of such correction or removal (including but not limited to fees and charges of engineers, architects, attorneys and other professionals and court and arbitration or other dispute resolution costs) made necessary thereby.

13.12 *Correction Period:*

13.12.1 If within one year after the date of Substantial Completion or such longer period of time as may be prescribed by Laws or Regulations or by the terms of any applicable special guarantee required by the Contract Documents or by any specific provision of the Contract Documents, any Work is found to be *defective*, CONTRACTOR shall promptly, without cost to OWNER and in accordance with OWNER's written instructions, (i) correct such *defective* Work, or, if it has been rejected by OWNER, remove it from the site and replace it with Work that is not *defective*, and (ii) satisfactorily correct or remove and replace any damage to other Work resulting therefrom. If CONTRACTOR does not promptly comply with the terms of such instructions, or in an emergency where delay would cause serious risk of loss or damage, OWNER may have the *defective* Work corrected or the rejected Work removed and replaced, and all direct, indirect and consequential costs and damages of such removal and replacement (including but not limited to fees and charges of engineers, architects, attorneys and other professionals and court and arbitration or other dispute resolution costs) will be paid by CONTRACTOR.

13.12.2 In special circumstances where a particular item of equipment is placed in continuous service for the benefit of the OWNER before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications or by Written Amendment.

13.12.3 Where *defective* Work (and damage to other Work resulting therefrom) has been corrected, removed or replaced under this paragraph 13.12, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

Acceptance of Defective Work:

13.13 If, instead of requiring correction or removal and replacement of *defective* Work, OWNER (and, prior to ENGINEER's recommendation of final payment, also ENGINEER) prefers to accept it, OWNER may do so. CONTRACTOR shall bear all direct, indirect and consequential costs attributable to OWNER's evaluation of and determination to accept such *defective* Work (such costs to be approved by ENGINEER as to reasonableness and to include but not be limited to fees and charges of engineers, architects, attorneys and other professionals and court and arbitration or other dispute resolution costs). If any such acceptance occurs prior to ENGINEER's recommendation of final payment, a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and OWNER shall be entitled to an appropriate decrease in the Contract Price, and, if the parties are unable to agree as to the amount thereof, OWNER may make a claim therefor as provided in Article 11. If the acceptance occurs after such recommendation, an appropriate amount will be paid by CONTRACTOR to OWNER.

OWNER May Correct Defective Work:

13.14 If CONTRACTOR fails within a reasonable time after written notice from ENGINEER to correct *defective* Work or to remove and replace rejected Work as required by ENGINEER in accordance with paragraph 13.11, or if CONTRACTOR fails to perform the Work in accordance with the Contract Documents, or if CONTRACTOR fails to comply with any other provision of the Contract Documents, OWNER may, after seven days' written notice to CONTRACTOR, correct and remedy any such deficiency. In exercising the rights and remedies under this paragraph OWNER shall proceed expeditiously. To the extent necessary to complete corrective and remedial action, OWNER may exclude CONTRACTOR from all or part of the site, take possession of all or part of the Work, and suspend CONTRACTOR's services related thereto, take possession of CONTRACTOR's tools, appliances, construction equipment and machinery at the site and incorporate in the Work all materials and equipment stored at the site or for which OWNER has paid CONTRACTOR but which are stored elsewhere. CONTRACTOR shall allow OWNER, OWNER's representatives, agents and employees, OWNER's other contractors and ENGINEER and ENGINEER's Consultant such access to the site as may be necessary to enable OWNER to exercise the rights and remedies under this paragraph. All direct, indirect and consequential costs and damages of OWNER in exercising such rights and remedies will be charged against CONTRACTOR, and a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and OWNER shall

be entitled to an appropriate decrease in the Contract Price, and, if the parties are unable to agree as to the amount thereof, OWNER may make a claim therefor as provided in Article 11. Such direct, indirect and consequential costs and damages will include but not be limited to fees and charges of engineers, architects, attorneys and other professionals, court and arbitration or other dispute resolution costs and all cost of repair and replacement of Work of others destroyed or damaged by correction, removal or replacement of CONTRACTOR's *defective* Work. CONTRACTOR shall not be allowed an extension of the Contract Time because of any delay in performance of the Work attributable to the exercise by OWNER of OWNER's rights and remedies hereunder.

ARTICLE 14 -- PAYMENTS TO CONTRACTOR AND COMPLETION

Schedule of Values:

14.1 The schedule of values established as provided in paragraph 2.9 will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to ENGINEER. Progress payments on account of Unit Price Work will be based on the number of units completed.

Application for Progress Payment:

14.2 At least thirty days before the date established for each progress payment, CONTRACTOR shall submit to ENGINEER for review an Application for Payment filled out and signed by CONTRACTOR covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents. If payment is required on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice or other documentation warranting that OWNER has received the materials and equipment free and clear of all Liens and evidence that the materials and equipment are covered by appropriate property insurance and other arrangements to protect OWNER's interest therein, all of which will be satisfactory to OWNER. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

CONTRACTOR's Warranty of Title:

14.3 CONTRACTOR warrants and guarantees that title to all Work, materials and equipment covered by any Application for Payment, whether incorporated in the Project or not, will pass to OWNER no later than the time of payment free and clear of all Liens.

Review of Applications for Progress Payment:

14.4 ENGINEER will, within fifteen days after receipt of each Application for Payment, either indicate in writing a recommendation of payment and present the Application to OWNER, or return the Application to CONTRACTOR indicating in writing ENGINEER's reasons for refusing to recommend payment. In the latter case, CONTRACTOR may make the necessary corrections and resubmit the Application. Fifteen days after presentation of the Application for Payment to OWNER with ENGINEER's recommendation, the amount recommended will (subject to the provisions of the last sentence of paragraph 14.7) become due and when due will be paid by OWNER to CONTRACTOR.

14.5 ENGINEER's recommendation of any payment requested in an Application for Payment will constitute a representation by ENGINEER to OWNER, based on ENGINEER's on-site observations of the executed Work as an experienced and qualified engineer and on ENGINEER's review of the Application for Payment and the accompanying data and schedules that to the best of ENGINEER's knowledge, information and belief (i) the Work has progressed to the point indicated, and (ii) the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, to the results of any subsequent tests called for in the Contract Documents, to a final determination of quantities and classifications for Unit Price Work under paragraph 9.10 and to any other qualifications stated in the recommendation), and (iii) the conditions precedent to CONTRACTOR's being entitled to such payment appear to have been fulfilled in so far as it is ENGINEER's responsibility to observe the Work. However, by recommending any such payment ENGINEER will not thereby be deemed to have represented that (i) exhaustive or continuous on-site inspections have been made to check the quality or the quantity of the Work beyond the responsibilities specifically assigned to ENGINEER in the Contract Documents or (ii) there may not be other matters or issues between the parties that might entitle CONTRACTOR to be paid additionally by OWNER or OWNER to withhold payment to CONTRACTOR.

14.6 ENGINEER's recommendation of any payment, including final payment shall not mean that ENGINEER is responsible for CONTRACTOR's means, methods, techniques, sequences or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of CONTRACTOR to comply with Laws and Regulations applicable to the furnishing or performance of Work, or for any failure of CONTRACTOR to perform or furnish Work in accordance with the Contract Documents.

14.7 ENGINEER may refuse to recommend the whole or any part of any payment if, in ENGINEER's opinion, it would be incorrect to make such representations to OWNER. ENGINEER may also refuse to recommend any such payment, or, because of subsequently discovered evidence or the results of subsequent inspections or tests, nullify any such payment previously recommended, to such extent as may be necessary in ENGINEER's opinion to protect OWNER from loss because:

14.7.1 the Work is *defective*, or completed Work has been damaged requiring correction or replacement,

14.7.2 the Contract Price has been reduced by Written Amendment or Change Order,

14.7.3 OWNER has been required to correct *defective* Work or complete Work in accordance with paragraph 13.14, or

14.7.4 of ENGINEER's actual knowledge of the occurrence of any of the events enumerated in paragraphs 15.2.1 through 15.2.4 inclusive.

OWNER may refuse to make payment of the full amount recommended by ENGINEER because:

14.7.5 claims have been made against OWNER on account of CONTRACTOR's performance or furnishing of the Work,

14.7.6 Liens have been filed in connection with the Work,

14.7.7 there are other items entitling OWNER to a set-off against the amount recommended, or

14.7.8 OWNER has actual knowledge of the occurrence of any of the events enumerated in paragraphs 14.7.1 through 14.7.3 or paragraphs 15.2.1 through 15.2.4 inclusive;

but OWNER must give CONTRACTOR immediate written notice (with a copy to ENGINEER) stating the reasons for such action.

Substantial Completion:

14.8 When CONTRACTOR considers the entire Work ready for its intended use CONTRACTOR shall notify OWNER and ENGINEER in writing that the entire Work is substantially complete (except for items specifically listed by CONTRACTOR as incomplete) and request that ENGINEER issue a certificate of Substantial Completion. Within a reasonable time thereafter, OWNER, CONTRACTOR and ENGINEER shall make an inspection of the Work to determine the status of completion. If ENGINEER does not consider the Work substantially complete, ENGINEER will notify CONTRACTOR in writing giving the reasons therefor. If ENGINEER considers the Work substantially complete, ENGINEER will prepare and deliver to OWNER a tentative certificate of Substantial Completion which shall fix the date of Substantial Completion. There shall be attached to the certificate a tentative list of items to be completed or corrected before final payment. OWNER shall have seven days after receipt of the tentative certificate during which to make written objection to ENGINEER as to any provisions of the certificate or attached tentative list. If, after considering such objections, ENGINEER concludes that the Work is not substantially complete, ENGINEER will within fourteen days after submission of the tentative certificate to OWNER notify CONTRACTOR in writing, stating the reasons therefor. If, after consideration of OWNER's objections, ENGINEER considers the Work substantially complete, ENGINEER will within said fourteen days execute and deliver to OWNER and CONTRACTOR a definitive certificate of Substantial Completion (with a revised tentative list of items to be completed or corrected) reflecting such changes from the tentative certificate as ENGINEER believes justified after consideration of any objections from OWNER. At the time of delivery of the tentative certificate of Substantial Completion, ENGINEER will deliver to OWNER and CONTRACTOR a written recommendation as to division of responsibilities pending final payment between OWNER and CONTRACTOR with respect to security, operation, safety, maintenance, heat, utilities, insurance and warranties and guarantees. Unless OWNER and CONTRACTOR agree otherwise in writing and so inform ENGINEER prior to ENGINEER's issuing the definitive certificate of Substantial Completion, ENGINEER's aforesaid recommendation will be binding on OWNER and CONTRACTOR until final payment.

14.9 OWNER shall have the right to exclude CONTRACTOR from the Work after the date of Substantial Completion, but OWNER shall allow CONTRACTOR reasonable access to complete or correct items on the tentative list.

Partial Utilization:

14.10 Use by OWNER at OWNER's option of any substantially completed part of the Work, which (i) has specifically been identified in the Contract Documents, or (ii) OWNER, ENGINEER and CONTRACTOR agree constitutes a separately functioning and useable part of the Work that can be used by OWNER for its intended purpose without significant interference with CONTRACTOR's performance of the remainder of the Work, may be accomplished prior to Substantial Completion of all the Work subject to the following:

14.10.1 OWNER at any time may request CONTRACTOR in writing to permit OWNER to use any such part of the Work which OWNER believes to be ready for its intended use and substantially complete. If CONTRACTOR agrees such part of the Work is substantially complete, CONTRACTOR will certify to OWNER and ENGINEER that said part of the Work is substantially complete and request ENGINEER to issue a certificate of Substantial Completion for that part of the Work. CONTRACTOR at any time may notify OWNER and ENGINEER in writing that CONTRACTOR considers any such part of the Work ready for its intended use and substantially complete and request ENGINEER to issue a certificate of Substantial Completion for that part of the Work. Within a reasonable time after either such request, OWNER, CONTRACTOR and ENGINEER shall make an inspection of that part of the Work to determine its status of completion. If ENGINEER does not consider that part of the Work to be substantially complete, ENGINEER will notify OWNER and CONTRACTOR in writing giving the reasons therefore. If ENGINEER considers that part of the Work to be substantially complete, the provisions of paragraphs 14.8 and 14.9 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.

14.10.2 No occupancy or separate operation of part of the Work will be accomplished prior to compliance with the requirements of paragraph 5.15 in respect of property insurance.

Final Inspection:

14.11 Upon written notice from CONTRACTOR that the entire Work or an agreed portion thereof is complete, ENGINEER will make a final inspection with OWNER and CONTRACTOR and will notify CONTRACTOR in writing of all particulars in which this inspection reveals that the Work is incomplete or *defective*. CONTRACTOR shall immediately take such measures as are necessary to remedy such deficiencies.

Final Application for Payment:

14.12 After CONTRACTOR has completed all such corrections to the satisfaction of ENGINEER and delivered in accordance with the Contract Documents all maintenance and operating instructions, schedules, guarantees, Bonds, certificates or other evidence of insurance required by paragraph 5.4, certificates of inspection, marked-up record documents (as provided in paragraph 6.9) and other documents, CONTRACTOR may make application for final payment following the procedure for progress payments, except that the progress payment shall be clearly marked "Final Application for Payment." The final Application for payment shall be accompanied by (i) all documentation called for in the Contract Documents including but not limited to the evidence of insurance required by subparagraph 5.4.13, (ii) consent of the surety, if any, to final payment, and (iii) complete and legally effective releases or waivers (satisfactory to OWNER) of all Liens arising out of or filed in connection with the Work.

Final Payment and Acceptance:

14.13 If, on the basis of ENGINEER's observation of the Work during construction and final inspection, and ENGINEER's review of the final Application for Payment and accompanying documentation, all as required by the Contract Documents, ENGINEER is satisfied that the Work has been completed and CONTRACTOR's other obligations under the Contract Documents have been fulfilled, ENGINEER will, within fifteen days after receipt of the final Application for Payment, indicate in writing ENGINEER's recommendation of payment and present the Application to OWNER for payment. At the same time ENGINEER will give written notice to OWNER and CONTRACTOR that the Work is acceptable subject to the provisions of paragraph 14.15. Otherwise, ENGINEER will return the Application to CONTRACTOR, indicating in writing the reasons for refusing to recommend final payment, in which case CONTRACTOR shall make the necessary corrections and resubmit the Application. Thirty days after presentation to OWNER of the Application and accompanying documentation, in appropriate form and substance, and with ENGINEER's recommendation and notice of acceptability, the amount recommended by ENGINEER will become due and will be paid by OWNER to CONTRACTOR.

14.14 If, through no fault of CONTRACTOR, final completion of the Work is significantly delayed and if ENGINEER so confirms, OWNER shall, upon receipt of CONTRACTOR's final Application for Payment and recommendation of ENGINEER, and without terminating the Agreement, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance to be held by OWNER for Work not fully completed or corrected is less than the retainage stipulated in the Agreement, and if Bonds have been furnished as required in paragraph 5.1, the written consent of the surety to the payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by CONTRACTOR to ENGINEER with the Application for such payment. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of claims.

Waiver of Claims:

14.15 The making and acceptance of final payment will constitute:

14.15.1 a waiver of all claims by OWNER against CONTRACTOR, except claims arising from unsettled Liens, from *defective* Work appearing after final inspection pursuant to paragraph 14.11 or from failure to comply with the Contract Documents or the terms of any special guarantees specified therein; however, it will not constitute a waiver by OWNER of any rights in respect of CONTRACTOR's continuing obligations under the Contract Documents; and

14.15.2 a waiver of all claims by CONTRACTOR against OWNER other than those previously made in writing and still unsettled.

ARTICLE 15 – SUSPENSION OF WORK AND TERMINATION

OWNER May Suspend Work:

15.1 OWNER may, at any time and without cause, suspend the Work or any portion thereof for a period of not more than ninety days by notice in writing to CONTRACTOR and ENGINEER which will fix the date on which Work will be resumed. CONTRACTOR shall resume the Work on the date so fixed. CONTRACTOR shall be allowed an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any suspension if CONTRACTOR makes an approved claim therefor as provided in Articles 11 and 12.

OWNER May Terminate:

15.2 Upon the occurrence of any one or more of the following events:

15.2.1 if CONTRACTOR persistently fails to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the progress schedule established under paragraph 2.9 as revised from time to time);

15.2.2 if CONTRACTOR disregards or violates Laws or Regulations of any public body having jurisdiction or insurance requirements;

15.2.3 if CONTRACTOR disregards the authority of ENGINEER;

15.2.4 if CONTRACTOR violates in any substantial way any provisions of the Contract Documents;

15.2.5 if CONTRACTOR has numerous or serious violations of Laws and Regulations pertaining to worker protection or safety;

15.2.6 if CONTRACTOR makes the assignment for the benefit of creditors of any of the monies due CONTRACTOR under this Agreement;

15.2.7 if CONTRACTOR intentionally submits documentation that is false or misleading;

OWNER may, after giving CONTRACTOR (and the surety, if any,) seven days' written notice and to the extent permitted by Laws and Regulations, terminate the services of CONTRACTOR, exclude CONTRACTOR from the site and take possession of the Work and of all CONTRACTOR's tools, appliances, construction equipment and machinery at the site and use the same to the full extent they could be used by CONTRACTOR (without liability to CONTRACTOR for trespass or conversion), incorporate in the Work all materials and equipment stored at the site or for which OWNER has paid CONTRACTOR but which are stored elsewhere, and finish the Work as OWNER may deem expedient. In such case CONTRACTOR shall not be entitled to receive any further payment until the Work is finished. If the unpaid balance of the Contract Price exceeds the direct, indirect and consequential costs of completing the Work (including but not limited to fees and charges of engineers, architects, attorneys and other professionals and court and arbitration or other dispute resolution costs) such excess will be paid to CONTRACTOR. If such costs exceed such unpaid balance, CONTRACTOR shall pay the difference to OWNER. Such costs incurred by OWNER will be reviewed by ENGINEER as to their reasonableness and when so approved by ENGINEER incorporated in a Change Order, provided that when exercising any rights or remedies under this paragraph OWNER shall not be required to obtain the lowest price for the Work performed.

15.3 Where CONTRACTOR's services have been so terminated by OWNER, the termination will not affect any rights or remedies of OWNER against CONTRACTOR then existing or which may thereafter accrue. Any retention or payment of moneys due CONTRACTOR by OWNER will not release CONTRACTOR from liability.

15.4 Upon seven days' written notice to CONTRACTOR and ENGINEER, OWNER may, without cause and without prejudice to any other right or remedy of OWNER, elect to terminate the Agreement. In such case, CONTRACTOR shall be paid (without duplication of any items):

15.4.1 for completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;

15.4.2 for expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses;

15.4.3 for amounts paid in settlement of terminated contracts with Subcontractors, Suppliers, and others (including but not limited to fees and charges of engineers, architects, attorneys and other professionals and court and arbitration or other dispute resolution costs incurred in connection with termination of contracts with Subcontractors and Suppliers); and

15.4.4 for reasonable expenses directly attributable to termination.

CONTRACTOR shall not be paid on account of loss of anticipated profits or revenue or other economic loss or any consequential damages arising out of such termination.

CONTRACTOR May Stop Work or Terminate:

15.5 If, through no act or fault of CONTRACTOR, the Work is suspended for a period of more than ninety days by OWNER or under an order of court or other public authority, or ENGINEER fails to act on any Application for Payment within thirty days after it is submitted, or OWNER fails for thirty days to pay CONTRACTOR any sum finally determined to be due, then CONTRACTOR may, upon seven days written notice to OWNER and ENGINEER, and provided OWNER or ENGINEER do not remedy such suspension or failure within that time, terminate the Agreement and recover from OWNER payment on the same terms as provided in paragraph 15.4. In lieu of terminating the Agreement, and without prejudice to any other right or remedy, if ENGINEER has failed to act on an Application for Payment within thirty days after it is submitted, or OWNER has failed for thirty days to pay CONTRACTOR any sum finally determined to be due, CONTRACTOR may upon seven days' written notice to OWNER and ENGINEER stop the Work until payment of all amounts due CONTRACTOR, including interest thereon. The provisions of this paragraph 15.5 are not intended to preclude CONTRACTOR from making claim under Articles 11 and 12 for an increase in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to CONTRACTOR's stopping Work as permitted by this paragraph.

ARTICLE 16 -- DISPUTE RESOLUTION

Subject to the provisions of paragraph 9.10, 9.11, and 9.12, OWNER and CONTRACTOR may exercise such rights or remedies as either may otherwise have under the Contract Documents or by Laws or Regulations in respect of any dispute.

ARTICLE 17 -- MISCELLANEOUS

Giving Notice:

17.1 Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended, or if delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice.

Computation of Time:

17.2.1 When any period of time is referred to in the Contract Documents by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

17.2.2 A calendar day of twenty-four hours measured from midnight to the next midnight will constitute a day.

Notice of Claim:

17.3 Should OWNER or CONTRACTOR suffer injury or damage to person or property because of any error, omission or act of the other party or of any of the other Party's employees or agents or others for whose acts the other party is legally liable, claim will be made in writing to the other party within a reasonable time of the first observance of such injury or damage. The provisions of this paragraph 17.3 shall not be construed as a substitute for or a waiver of the provisions of any applicable statute of limitations or repose.

Cumulative Remedies:

17.4 The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto, and, in particular but without limitation, the warranties, guarantees and obligations imposed upon CONTRACTOR by paragraph 6.30, 6.31, 6.32, 13.1, 13.12, 13.14, 14.3, and 15.2 and all of the rights and remedies available to OWNER and ENGINEER thereunder, are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee or by other provisions of the Contract Documents, and the provisions of this paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right and remedy to which they apply.

SUPPLEMENTARY CONDITIONS

The Supplementary Conditions amend or supplement the General Conditions (12/93 American Water System Standard General Conditions) and other provisions of the Contract Documents as indicated below. All provisions which are not so amended or supplemented remain in full force and effect.

Table of Contents

SUPPLEMENTARY CONDITIONS

SC-1 Definitions

The terms used in these Supplementary Conditions which are defined in the General Conditions have the meanings assigned to them in the General Conditions.

Whenever the term "Water Company" is used in these Contract Documents it shall have the same meaning as OWNER or ENGINEER, whichever is applicable.

SC-1.16 ENGINEER'S Consultant

The ENGINEER'S Consultant for this project is:

Montgomery Watson, Inc.
2000 Bond Court Building
1300 East Ninth Street
Cleveland, Ohio 44114

SC-4.2 Subsurface and Physical Conditions

4.2.1 In the preparation of Drawings and Specifications, ENGINEER has relied upon:

4.2.1.1 The following reports of explorations and tests of subsurface conditions at the site of the Work:

Report dated April 27, 1999 prepared by Fuller, Mossbarger, Scott & May Engineers, Inc. entitled Report of Geotechnical Exploration, Residuals Handling Building and Lagoon Decant Structure, Kentucky River Station Water Treatment Plant, Lexington, KY.

4.2.1.2 The following drawings of physical conditions in or relating to existing surface and subsurface structures (except Underground Facilities) which are at or contiguous to the site of the Work:

Drawings dated April 19, 1991 of Kentucky River Station - Residuals Handling Improvements prepared by GRW Engineers Inc.

Copies of these reports and drawings that are not included with the Bidding Documents may be examined at Kentucky River Station during regular business hours. These reports and drawings are not part of the Contract Documents.

SC-4.5.5 Chemicals Used or Stored

Chemicals known to be used or stored by the OWNER include the following:

Chlorine, Ammonia, Ferric Sulfate, PACL, Caustic Soda, Lime, Fluoride, Activated Carbon, Zinc Orthophosphate, Polymers, Potassium Permanganate & Sodium Thiosulfate.

SC-5.4 CONTRACTOR's Liability Insurance

The limits of liability for the insurance required by Paragraph 5.3 of the General Conditions shall provide coverage for not less than the following amounts or greater where required by Laws and Regulations:

Workmen's Compensation Insurance: The CONTRACTOR shall carry Workmen's Compensation Insurance during the life of the Contract to insure his statutory liability to his employees in the state or states in which the work under this Contract is to be performed, plus $100,000 Employer's Liability Coverage.

General Liability: The CONTRACTOR shall carry Commercial General Liability Insurance during the life of the Contract. The policy shall be written on an occurrence basis and shall include broad form property damage coverage. The required limits for this coverage are to meet the limits shown in either of the sample Certificates of Insurance included in Appendix A of these Supplementary Conditions.

Automobile Liability: The CONTRACTOR shall carry the Comprehensive form of Automobile Liability and Property Damage Insurance during the life of the Contract. The required limits for this coverage are to meet the limits shown in either of the sample Certificates of Insurance included as Appendix A to these Supplementary Conditions.

Umbrella and/or Excess Liability: Depending on the limits provided in the above primary insurance policies the CONTRACTOR shall carry Umbrella and/or Excess Liability Insurance during the life of the Contract with limits meeting those shown in either of the sample Certificates of Insurance included as Appendix A to these Supplementary Conditions.

SC-5.4.7 Additional Insureds

The policies of insurance so required by Paragraph 5.4 shall include as additional insureds the following parties:

1. **Kentucky American Water Company**
2. **American Water Works Service Company**
3. **Montgomery Watson, Inc.**

SC-5.6 Builders Risk Insurance

The CONTRACTOR shall bear all risks of all loss or damage to the materials and Work until the Work is finally accepted by the OWNER, except that the CONTRACTOR may claim

reimbursement under the OWNER's builder's risk insurance policy as herein provided and limited. OWNER will carry "All Risk" Builders Risk Insurance subject to deductibles, terms and conditions as stated in the policy and below. It is the obligation and responsibility of the CONTRACTOR to make appropriate claim to the insurance company for all losses claimed under the policy. Should any loss not be covered under this policy, in whole in or parts, the CONTRACTOR shall bear the loss. Any questions regarding coverages, limitation, exclusion, etc. contained in the policy shall be addressed by bidders prior to submittal of bids, to USI Mid Atlantic, 1000 Adams Ave., Trooper, PA 19403, phone no. (610)666-2482.

Such insurance shall cover the full value of the cost of replacement to the OWNER, less applicable deductibles, of all completed portions of the work to be performed throughout the entire time of construction. The deductibles on each separate and unrelated loss are (1) 5% of the value of loss caused by earthquake and (2) $500 on all other losses. OWNER will furnish to the CONTRACTOR evidence of the insurance coverage provided.

Such insurance shall not cover (1) damage to or loss of material or equipment furnished by either party which are damaged or lost due to carelessness or negligence on the part of the CONTRACTOR, or (2) damage to or loss of machinery, tools, equipment, or other property furnished by the CONTRACTOR whether or not used by the CONTRACTOR in carrying out the terms of the Contract unless such machinery, tools, equipment or other property are specifically intended for permanent incorporation into the Contract work and are included in an approved application for payment.

SC-6.13 Permits

OWNER will obtain and pay for all necessary permits which by Laws or Regulations must be obtained by the OWNER. The CONTRACTOR will obtain and pay for all other permits, licenses and certificates of inspection. The CONTRACTOR will pay for all inspection costs and fees.

The CONTRACTOR and/or his Subcontractor(s) shall obtain, complete, seal and sign all applications required to obtain construction permits required by state and local government agencies. A photocopy of the electrician's and plumber's current state and/or local license shall be delivered to the OWNER.

When required by the local governing body, the electrician and plumber will execute a mechanical bond in the form approved by the local government.

All bonds, application forms and copies of licenses shall be delivered to the OWNER so these documents may be submitted with the OWNER's application for a building permit.

SC-6.15 Sales Tax

Add the following language after Paragraph 6.15 of the General Conditions:

SC-6.15.1 CONTRACTOR'S responsibility under Paragraph 6.15 and this Paragraph SC-6.15 to pay all such taxes shall: (i) include the obligation to pay any interest or penalties that may be assessed as a result of CONTRACTOR'S late payment or failure to pay such taxes, and (ii) survive final payment, completion and acceptance of the Work and termination or completion of the Agreement

SC-6.15.2 OWNER is exempt from Kentucky sales and use taxes on certain services, machinery, equipment, materials, apparatus, tools or supplies in connection with the Work. The Contract Price shall not include any sales and use taxes on any exempt items. CONTRACTOR shall be responsible for determining what items are tax exempt.

SC-615.3 Without altering CONTRACTOR's full responsibility to properly determine exemptions and to pay applicable sales and use taxes, the OWNER WILL PROVIDE THE CONTRACTOR, for use at CONTRACTOR'S risk, a copy of any Guidelines developed by the OWNER with respect to sales and sue tax exemptions that may be available in whole or part in the state in which the project is located. A copy of the Guidelines for the state in which the project is located is included in Appendix C attached to the Supplementary Conditions. Such Guidelines are not Contract Documents. They may not necessarily reflect the current status of state tax exemptions or current status interpretations of these exemptions.

SC-615.4 CONTRACTOR shall indemnify, hold harmless and defend OWNER from and against all claims, losses, expenses, damages and liability relating to: (1) CONTRACTOR's nonpayment of any sales, consumer, use and other similar taxes or interest or penalties required to be paid by CONTRACTOR or (ii) CONTRACTOR'S failure to utilize or implement any available sales and use tax exemption or CONTRACTOR'S failure to obtain any necessary exemption certificate or other required exemption evidence.

SC-6.15.5 CONTRACTOR shall furnish evidence satisfactory to OWNER that CONTRACTOR has paid all sales, consumer, use and other similar taxes required to be paid by CONTRACTOR. CONTRACTOR shall also furnish to OWNER WITH CONTRACTOR's application for final payment a schedule of all items incorporated in the Work that CONTRACTOR has determined are entitled to sales and use taxes exemption and for which no sales and use taxes were paid by CONTRACTOR. OWNER reserves the right to audit the CONTRACTOR'S compliance with applicable sales and use taxes requirements prior to release of retainage and final payment. If OWNER disagrees with any of CONTRACTOR'S determinations or exemption or otherwise has reason to believe that CONTRACTOR has not paid all applicable sales and use taxes, OWNER shall be entitled to withhold the amount of sales and use taxes OWNER believes OWNER may be potentially liable for as a result of CONTRACTOR'S nonpayment until: (i) CONTRACTOR presents evidence satisfactory to OWNER the CONTRACTOR has paid the taxes in question or that the items in question are exempt and (ii) all statues of limitation for the applicable taxing authority to bring an action against OWNER for payment of the taxes in question have expired, whichever first occurs.

SC-6.15.6 In addition to OWNER'S other rights and remedies under this Paragraph SC-6. 1 5, OWNER shall be entitled to set off against monies otherwise due CONTRACTOR hereunder the amount of any sales and use tax, or any other tax, which OWNER is required to pay be reason of CONTRACTOR's failure to comply with Paragraph 6.15 of the General Conditions of this Paragraph SC-6.15.

SC-6.82 Approval of Subcontractors and Suppliers

Certain Subcontractors are to be approved by OWNER and ENGINEER. BIDDER shall identify the following Subcontractor(s) within seven (7) days after the date of the bid opening.

Subcontractor

a) Electrical Subcontractor

SC-9.3 Project Representation

The duties, responsibilities and limitations of authority of the Resident Project Representative shall be as follows:

A. General

The Resident Project Representative (RPR) is ENGINEER's agent at the site, will act as directed by and under the supervision of ENGINEER. The RPR will visit the site on a part-time basis. The frequency and duration of the site visits will be determined by the ENGINEER.

B. Duties and Responsibilities of RPR

1. Conferences and Meetings: Attend meetings with CONTRACTOR, such as preconstruction conferences, progress meetings, job conferences and other project-related meetings.

2. Liaison: Serve as ENGINEER's liaison with CONTRACTOR, working principally through CONTRACTOR's superintendent and assist in understanding the intent of the Contract Documents; and assist ENGINEER in serving as OWNER's liaison with CONTRACTOR when CONTRACTOR's operations affect OWNER's on-site operations.

3. Shop Drawings and Samples: Advise ENGINEER and CONTRACTOR of the commencement of any Work requiring a Shop Drawing or sample if the submittal has not been approved by ENGINEER.

4. Review of Work, Rejection of Defective Work, Inspections and Tests:

a. Conduct on-site observations of the Work in progress to assist ENGINEER in determining if the Work is in general proceeding in accordance with the Contract Documents.

b. Report to ENGINEER whenever RPR believes that any Work is unsatisfactory, faulty or defective or does not conform to the Contract Documents, or has been damaged, or does not meet the requirements of any inspection, test or approval required to be made.

c. Verify that tests, equipment and systems startups and operating and maintenance training are conducted in the presence of appropriate personnel, and that CONTRACTOR maintains adequate records thereof.

5. Interpretation of Contract Documents: Report to ENGINEER when clarifications and interpretations of the Contract Documents are needed and transmit to CONTRACTOR clarifications and interpretations as issued by ENGINEER.

6. Modifications: Consider and evaluate CONTRACTOR's suggestions for modifications in Drawings or Specifications and report with RPR's recommendations to ENGINEER. Transmit to CONTRACTOR decisions as issued by ENGINEER.

7. Payment Requests: Review applications for payment with CONTRACTOR for compliance with the established procedure for their submission and forward with recommendations to ENGINEER, noting particularly the relationship of the payment requested to the schedule of values, Work completed and materials and equipment delivered at the site but not incorporated in the Work.

8. Completion:

a. Before ENGINEER issues a Certificate of Substantial Completion, submit to CONTRACTOR a list of observed items requiring completion or correction.

b. Conduct final inspection in the company of ENGINEER, OWNER and CONTRACTOR and prepare a final list of items to be completed or corrected.

c. Observe that all items on final list have been completed or corrected and make recommendations to ENGINEER concerning acceptance.

C. Limitations of Authority

Resident Project Representative:

1. Shall not authorize any deviation from the Contract Documents or substitution of materials or equipment, unless authorized by ENGINEER.

2. Shall not exceed limitations of ENGINEER's authority as set forth in the Agreement or the Contract Documents.

3. Shall not undertake any of the responsibilities of CONTRACTOR, subcontractors or CONTRACTOR's superintendent.

4. Shall not issue directions relative to, or assume control over, any aspect of the means, methods or techniques of construction unless such directions or control are specifically required by the Contract Documents.

SC-14.12 Final Application for Payment

Add the following language at the end of Paragraph 14.12 of the General Conditions:

CONTRACTOR, Subcontractors and Suppliers shall execute and deliver to OWNER their release of liens on forms supplied by OWNER. Blank forms are included in Appendix B of these Supplementary Conditions.

ACORD. CERTIFICATE OF INSURANCE

ISSUE DATE (MM/DD/YY)

PRODUCER

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW

CODE SUB-CODE

INSURED

COMPANIES AFFORDING COVERAGE

COMPANY LETTER A

COMPANY LETTER B

COMPANY LETTER C

COMPANY LETTER D

COMPANY LETTER E

COVERAGES

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

CO TR	TYPE OF INSURANCE	POLICY NUMBER	POLICY EFFECTIVE DATE (MM/DD/YY)	POLICY EXPIRATION DATE (MM/DD/YY)	ALL LIMITS IN THOUSANDS	
	GENERAL LIABILITY				GENERAL AGGREGATE	$1,000
X	COMMERCIAL GENERAL LIABILITY				PRODUCTS-COMP/OPS AGGREGATE	$1,000
	CLAIMS MADE X OCCUR.				PERSONAL & ADV ERTISING INJURY	$1,000
	OWNER'S & CONTRACTOR'S PROT.				EACH OCCURRENCE	$1,000
	Include broad form property damage				FIRE DAMAGE (Any one fire)	$ 50
					MEDICAL EXPENSE (Any one person)	$ 5
	AUTOMOBILE LIABILITY				COMBINED SINGLE LIMIT	$1,000
X	ANY AUTO				BODILY INJURY (Per person)	$ N/A
	ALL OWNED AUTOS				BODILY INJURY (Per accident)	$ N/A
	SCHEDULED AUTOS				PROPERTY DAMAGE	$ N/A
	HIRED AUTOS					
	NON-OWNED AUTOS					
	GARAGE LIABILITY					
	EXCESS LIABILITY				EACH OCCURRENCE $1,000	AGGREGATE $1,000
	OTHER THAN UMBRELLA FORM					
	WORKER'S COMPENSATION AND EMPLOYERS' LIABILITY				STATUTORY	
					$ 100	(EACH ACCIDENT)
					$ 100	(DISEASE—POLICY LIMIT)
					$ 100	(DISEASE—EACH EMPLOYEE)
	OTHER					

DESCRIPTION OF OPERATIONS/LOCATIONS/VEHICLES/RESTRICTIONS/SPECIAL ITEMS

CERTIFICATE HOLDER

CANCELLATION

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, THE ISSUING COMPANY WILL ENDEAVOR TO MAIL 10 DAYS WRITTEN NOTICE TO THE CERTIFICATE HOLDER NAMED TO THE LEFT, BUT FAILURE TO MAIL SUCH NOTICE SHALL IMPOSE NO OBLIGATION OR LIABILITY OF ANY KIND UPON THE COMPANY, ITS AGENTS OR REPRESENTATIVES.

AUTHORIZED REPRESENTATIVE

ACORD. CERTIFICATE OF INSURANCE

ISSUE DATE (MM/DD/YY)

PRODUCER

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CO LTR	TYPE OF INSURANCE	POLICY NUMBER	POLICY EFFECTIVE DATE (MM/DD/YY)	POLICY EXPIRATION DATE (MM/DD/YY)	ALL LIMITS IN THOUSANDS
	GENERAL LIABILITY				
X	COMMERCIAL GENERAL LIABILITY				GENERAL AGGREGATE $2,000
	CLAIMS MADE X OCCUR.				PRODUCTS-COMP/OPS AGGREGATE $2,000
	OWNER'S & CONTRACTOR'S PROT.				PERSONAL & ADVERTISING INJURY $2,000
	Include broad form property damage.				EACH OCCURRENCE $2,000
					FIRE DAMAGE (Any one fire) $ 50
					MEDICAL EXPENSE (Any one person) $ 5
	AUTOMOBILE LIABILITY				COMBINED SINGLE LIMIT $2,000
X	ANY AUTO				
	ALL OWNED AUTOS				BODILY INJURY (Per person) $ N/A
	SCHEDULED AUTOS				
	HIRED AUTOS				BODILY INJURY (Per accident) $ N/A
	NON-OWNED AUTOS				
	GARAGE LIABILITY				PROPERTY DAMAGE $ N/A
	EXCESS LIABILITY				EACH OCCURRENCE $ / AGGREGATE $
	OTHER THAN UMBRELLA FORM				
	WORKER'S COMPENSATION AND EMPLOYERS' LIABILITY				STATUTORY $ 100 (EACH ACCIDENT) / $ 100 (DISEASE—POLICY LIMIT) / $ 100 (DISEASE—EACH EMPLOYEE)
	OTHER				

DESCRIPTION OF OPERATIONS/LOCATIONS/VEHICLES/RESTRICTIONS/SPECIAL ITEMS

CERTIFICATE HOLDER

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SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, THE ISSUING COMPANY WILL ENDEAVOR TO MAIL 10 DAYS WRITTEN NOTICE TO THE CERTIFICATE HOLDER NAMED TO THE LEFT, BUT FAILURE TO MAIL SUCH NOTICE SHALL IMPOSE NO OBLIGATION OR LIABILITY OF ANY KIND UPON THE COMPANY, ITS AGENTS OR REPRESENTATIVES.

AUTHORIZED REPRESENTATIVE

RELEASE OF LIENS

WHEREAS, we, the undersigned, have installed or furnished labor, materials and/or equipment for the installation of the Project entitled **Kentucky River Station - Additional Residuals Processing Facilities**, installed pursuant to a written agreement dated _____, 1999, between the **Kentucky-American Water Company**, having an office at **2300 Richmond Road, Lexington, KY 40502**, hereinafter called OWNER and _____, having an office at _____, hereinafter called CONTRACTOR, which said facilities are owned by the OWNER and described and located as follows:

Kentucky-American Water Company
Kentucky River Station
Additional Residuals Processing Facilities

WHEREAS, we, the undersigned, have agreed to release any and all claims and liens which we have, or might have, against the OWNER, or said facilities by reason of the labor, materials and equipment furnished by us in connection with said installation;

NOW THESE PRESENTS WITNESS that we the undersigned, in consideration of the premises, and of the sum of One Dollar ($1.00) in hand paid by the said OWNER, at and before the sealing and delivery hereof, the receipt whereof we do hereby acknowledge, have remised, released and forever quitclaimed, and by these presents do remise, release and forever quitclaim, unto the said OWNER, its successors and assigns, any and all manner of liens, claims and demands whatsoever which we now have, or might or could have, on or against the said facilities, or the owner thereof, for work done, or for equipment or materials furnished in connection with the installation thereof. It is the intent of this release that the OWNER, its successors and assigns shall and may hold, have, use and enjoy the said facilities free and discharged from all liens and demands whatsoever which we now have, or might or could have against the same if these presents had not been made.

IN WITNESS WHEREOF, we have hereunto set our hand and seal the day written opposite our signature.

Company Name _____ (SEAL)

By _____

Title _____

Dated _____, 19___

Sworn to and subscribed before me,
a Notary Public, this _____ day
of _____, 19___.

_____ (SEAL)
Notary Public

I, _____, duly authorized representative of _____, designated as CONTRACTOR, do hereby state that the parties whose names are signed to the attached releases, pages 1 through ____, are all of the parties who have furnished labor, materials or equipment in connection with the construction of the facilities mentioned above; excepting only such materials as may have been furnished by the OWNER.

Dated: _____, 19__

_____
Representative's Signature

Sworn to and subscribed before me,
a Notary Public, this _____ day
of _____, 19___.

_____ (SEAL)
Notary Public

RELEASE OF LIENS

WHEREAS, we, the undersigned, have installed or furnished labor, materials or equipment for the installation of the Project entitled **Kentucky River Station - Additional Residuals Processing Facilities**, installed pursuant to a written agreement dated _____, 1999, between the **Kentucky-American Water Company**, having an office at **2300 Richmond Road, Lexington, KY 40502**, hereinafter called OWNER and _____, having an office at _____, hereinafter called CONTRACTOR, which said facilities are owned by the OWNER and described and located as follows:

Kentucky-American Water Company
Kentucky River Station
Additional Residuals Processing Facilities

WHEREAS, we, the undersigned, have agreed to release any and all claims and liens which we have, or might have, against the OWNER or said facilities by reason of the labor, materials and equipment furnished by us in connection with said installation;

NOW THESE PRESENTS WITNESS that we, the undersigned, in consideration of the premises, and of the sum of One Dollar ($1.00) in hand paid by the said OWNER, at and before the sealing and delivery hereof, the receipt whereof we, do hereby acknowledge, have remised, released and forever quitclaimed, and by these presents do remise, release and forever quitclaim, unto the said OWNER, its successors and assigns, any and all manner of liens, claims and demand whatsoever which we now have, or might or could have, on or against the said facilities, or the owner thereof, for work done, or for equipment or materials furnished in connection with the installation thereof. It is the intent of this release that the OWNER, its successors and assigns shall and may hold, have, use and enjoy the said facilities free and discharged from all liens and demands whatsoever which we now have, or might or could have against the same if these presents had not been made. And we do further certify and acknowledge, that we have received of and from the said CONTRACTOR, payment in full on account of labor done or materials or equipment furnished for or in connection with said facilities.

IN WITNESS WHEREOF, we have hereunto set our hand and seal the day written opposite our signature.

Company Name _____ (SEAL)
By _____
Title _____
Dated _____, 19___

Sworn to and subscribed before me, a Notary Public,
this _____ day of _____, 19___.

_____ (SEAL)
Notary Public
(Subcontractors and Suppliers)

GUIDELINES FOR KENTUCKY CONTRACTORS

USE OF THIS GUIDELINE:

This guideline may not be complete or current as of the date of the Contract or CONTRACTOR's performance of the Contract. State laws are subject to change. This guideline does not alter the CONTRACTOR's obligations under the Contract to properly determine and pay applicable taxes.

GENERAL RULE:

CONTRACTOR's purchases of property used to construct a water treatment facility are not taxable because the property is considered machinery for new and expanded industry.

INTERPRETATION OF GENERAL RULE:

Property purchased by a construction contractor and incorporated into facilities which are used in the actual filtration and purification of water is considered machinery for a new and expanded industry and not taxable.

Machinery purchased for new and expanded industry must meet four tests to qualify for exemption. The machinery must: 1) be machinery which includes all components making up the process, including the fixed, moving and nonmoving parts; 2) be involved in the actual filtration and purification of water; 3) be incorporated for the first time into plant facilities established in Kentucky; and 4) not merely replace existing machinery. Replacement machinery must perform a different function or have a production capacity higher than the machine it replaces to be exempt from tax.

SPECIFIC ITEMS:

Processing Facilities: Construction materials incorporated into water treatment facilities in which the actual filtration and purification of water occurs are considered machinery for new and expanded industry and, therefore, are not taxable. This exemption encompasses construction materials used and incorporated into the construction of aerators, sedimentation basins, mixing units and basins, conduits, chemical feed units and chain drag equipment.

Pumping Facilities: Machinery and equipment used prior to the start of the water purification processing operation are not part of the processing operations and, therefore, are subject to tax. That is, machinery and equipment such as raw water pumps, which are used to get the water to the facility, are considered to be used before the processing operation begins and therefore subject to tax.

Distribution Facilities: Machinery and equipment used to distribute the final product, the treated water, are not regarded as machinery and equipment used in the processing operation and are subject to tax That is, machinery and equipment, such as clear water pumps, which are used for distribution and transportation to the customer, are subject to tax.

Construction Tools and Equipment: Tools and equipment used by the contractor but not incorporated into the water treatment facility are subject to tax.

Repair Parts: Repair parts for machinery for new and expanded industry are taxable.

Non-Operational Activities: Property not used directly in the water purification process is subject to tax. This includes property used in managerial, sales, or other non-operational activities.

PROCEDURE FOR CLAIMING AN EXEMPTION:

Property used directly to process the water can be purchased free of tax by providing Form 51A111, executed jointly by the water company and the contractor, to the seller of that property.

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SECTION 1000

SUMMARY OF WORK

PART 1: GENERAL

1.01 WORK UNDER THIS CONTRACT

The CONTRACTOR shall furnish all labor, materials, equipment and means to construct the project entitled Kentucky River Station Additional Residuals Processing Facilities, as shown on the Drawings and described herein. The work includes, but is not limited to, the following:

Based upon solids testing analyses and an evaluation of mechanical dewatering technologies, the Kentucky-American Water Company has decided to install belt filter presses.

The new proposed dewatering facilities will consist of two, 2.8 meter belt filter presses operating at a solids loading rate of 4000 lb/hr each. These units will process the plant's average solids production (13,500 lb/day to the dewatering units) in 5 days, with one press operating for approximately 5 hours per day. This will provide several hours for start-up and shutdown. Under maximum conditions, which are based on the maximum 15-day solids production of 76,400 lb/day to the dewatering units, the total processing time required is 19 hours. This can be met with both presses operating for approximately 10 hours per day, which is essentially one and a half shifts of operating time with several hours available for start-up and shutdown.

A new 100 ft. by 68 ft. dewatering building is proposed to house the belt filter presses, along with the polymer systems for the belt filter presses, gravity thickeners and wash water waste, and the solids feed pumps. Several ancillary systems will also be located in the new dewatering building. These systems include plant water booster pumps for cleaning the belt filter presses and supplying water to the polymer blending system, two air compressors for maintaining belt alignment and two batch feed tanks. An electrical room, a HVAC mechanical area, a storage area and a janitorial area will be included in the building.

The existing Wash Water Waste Holding Tanks (WWWHTs) will be converted to flow-through Gravity Thickeners through the removal of the supernatant pumps and the addition of mechanical solids collectors and effluent weir troughs. The existing solids handling pumps will be modified and reused to pump the settled solids to the Dewatering Building. Supernatant will flow by gravity to the lagoons. The existing supernatant pumps will be modified and relocated to the new lagoon supernatant return vault.

The lagoons will now be utilized to settle the wash water waste and the Gravity Thickener effluent flows. The limiting factor on the lagoon system is the existing 6-inch

discharge piping from the lagoons to the lagoon supernatant return vault. The existing lagoon supernatant return vault is not capable of processing the anticipated wash water waste and Gravity Thickener effluent flow rates even if the discharge piping was not the limiting factor. In order to accommodate the additional flows, the lagoon discharge piping will be increased to 12-inch, a second lagoon supernatant return vault and a parallel vault discharge pipe will be installed.

The above general outline of principal features does not in any way limit the responsibility of the CONTRACTOR to perform all work and furnish the required materials, equipment, labor and means as shown or required by the Contract Documents.

Materials, equipment, labor, etc., obviously a part of the work and necessary for the proper operation and installation of same, although not specifically indicated in the Contract Documents, shall be provided as if called for in detail without additional cost to the OWNER.

1.02 LOCATION

All work is to be performed on property owned by the OWNER at its Kentucky River Station.

1.03 WORK BY OTHERS

NOT USED.

1.04 OWNER FURNISHED PRODUCTS

A. Products furnished to the site and paid for by OWNER:

1. Belt Filter Press System

The following abbreviations are utilized to assist in identifying responsibilities for furnished items:

OFOI - Owner Furnished OWNER Installed
OFCI - Owner Furnished CONTRACTOR Installed

B. OWNER's Responsibilities:

1. Arrange for and deliver OWNER reviewed shop drawings, product data, and samples, to CONTRACTOR.
2. Arrange and pay for product delivery to site.
3. On delivery, inspect products jointly with CONTRACTOR.
4. Submit claims for transportation damage and replace damaged, defective, or deficient items.
5. Arrange for manufacturers' warranties.

C. CONTRACTOR's Responsibilities:

1. Review OWNER reviewed shop drawing's product data, and samples.
2. Receive and unload products at site; inspect for completeness or damage, jointly with OWNER.
3. Handle, store, install and finish products.
4. Repair or replace items damaged after receipt.
5. Arrange for manufacturers inspections, service, start-up services and training.

1.05 CONTRACTOR USE OF SITE (AND PREMISES)

A. Access to site: Limited to areas noted on drawings.

B. Construction operations: Limited to areas noted on drawings.

C. Time restrictions for performing all work:

No work will be permitted on Saturday, Sundays, holidays or before 7:30 a.m. or after 6:00 p.m. except as specified herein, or as approved by the OWNER or in case of emergency.

D. Utility outages and shutdown: In accordance with Section 1313 Construction Sequencing and Scheduling Restraints.

1.06 FUTURE WORK

NOT USED.

1.07 WORK SEQUENCE

A. Construct WORK in to accommodate OWNER's occupancy requirements during the construction period, coordinate construction schedule and operations with OWNER & Engineer.

B. The work sequence is described in Section 1313 Construction Sequencing and Scheduling Restraints.

1.08 CHANGE PROCEDURES

A. The Engineer may issue to CONTRACTOR a Proposal Request which includes a detailed description of a proposed change with supplementary or revised drawings and specifications, a change in Contract Times for executing the change and the period of time during which the requested price will be considered valid.

CONTRACTOR will prepare and submit an estimate within 15 working days. The estimate shall contain a detailed breakdown of the labor, equipment, material, subcontract, equipment rental, contingencies, overhead, and profit costs associated with the requested change. The estimate shall also include any requested adjustments to Contract Times including the window of time the OWNER has to render a decision on the matter.

1.09 DEFINED TERMS

Terms used in these Specifications which are defined in the General Conditions of the Contract Documents shall have the meanings assigned to them in the General Conditions.

1.10 ABBREVIATIONS

Where any of the following abbreviations are used in the Contract Documents, they shall have the meaning set forth opposite each.

AASHTO - American Association of State Highway and Transportation Officials
ACI - American Concrete Institute
AFBMA - Anti-Friction Bearing Manufacturers Association
AGA - American Gas Association
AGMA - American Gear Manufacturers Association
IEEE - Institute of Electrical and Electronics Engineers, Inc.
AISC - American Institute of Steel Construction
AMCA - Air Moving and Conditioning Association
ANS - American National Standard
ANSI - American National Standards Institute
API - American Petroleum Institute
ASCE - American Society of Civil Engineers
ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME - American Society of Mechanical Engineers
ASTM - American Society for Testing and Materials
AWPA- American Wood-Preservers' Association
AWWA - American Water Works Association
CS - Commercial Standard
IBR - Institute of Boiler and Radiator Manufacturers
IPS - Iron Pipe Size
JIC - Joint Industry Conference Standards
NBS - National Bureau of Standards
NEC - National Electrical Code; Latest Edition
NEMA - National Electrical Manufacturers Association
NFPA - National Fire Protection Association
SMACNA - Sheet Metal and Air Conditioning Contractors National Association, Inc.

Fed. Spec. - Federal Specifications issued by the Federal Supply Service of the General Services Administration, Washington, D.C.
125 lb ANS - American National Standard for Cast-Iron Pipe
250 lb ANS - Flanges and Flanged Fittings, Designation B16.1-1975, for the appropriate class
AWG - American or Brown and Sharpe Wire Gage
NPT - National Pipe Thread
OS&Y - Outside Screw and Yoke
Stl.WGU.S. - Steel Wire, Washburn and Moen, American Steel and Wire or Roebling Gage
UL - Underwriters' Laboratories
USS Gage - Untied States Standard Gage
WOG - Water, Oil, Gas
WSP - Working Steam Pressure

PART 2: PRODUCTS

NOT USED.

PART 3: EXECUTION

3.01 FIELD SURVEY WORK

Unless otherwise provided in the Supplementary Conditions the OWNER shall provide engineering surveys to establish reference points for construction as provided in Article 4.4 of the General Conditions. Utilizing OWNER's reference points, the CONTRACTOR shall establish the initial control base line and all control bench marks to be utilized throughout the project. Base line shall be set in accordance with all lines, dimensions, reference points, and elevations given in the Contract Drawings.

Should the CONTRACTOR detect a discrepancy between the information as presented in the Contract Drawings and any existing survey gridwork, bench marks, structures, etc., the CONTRACTOR shall notify the ENGINEER immediately. New construction shall not commence until accurate control base lines and bench marks have been established.

The CONTRACTOR shall throughout the course of the project, set all additional stakes which are needed for offset stakes, reference points, slope stakes, pavement and curb line and grade stakes, stakes for structures, sewers, utilities, roadway drainage, pipe underdrains, paved gutter, fence, culverts, or other structures, supplementary bench marks, and any other horizontal or vertical controls necessary to secure a correct layout and construction of the work. Stakes for line and grade for pavements, curbs, storm drains, sewers, etc., shall be set at twenty-five (25) foot maximum intervals. Base lines shall be staked in such manner as to clearly define them for the project.

It shall be the CONTRACTOR's responsibility that the finished work conform to the lines, grades, elevations and dimensions called for in the Contract Documents. The Work shall be

subject to checking by the ENGINEER, but any inspection or checking of CONTRACTOR's layout by the ENGINEER and the acceptance of all or part of it shall not relieve the CONTRACTOR of his responsibility to secure the proper dimensions, grades, elevations and locations on the several parts of the Work. The CONTRACTOR shall exercise care in the preservation of stakes, monuments and bench marks and shall have them reset at his expense when they are lost or displaced.

Prior to the commencement of any Work activity, the CONTRACTOR shall survey and layout the Work to be performed and advise the ENGINEER of any conflicts, obstructions, concerns, etc. which will prevent completion of such work in accordance with the requirements of the Contract Documents. If the CONTRACTOR fails to conduct such survey and layout or if the survey and layout fails to identify a conflict, obstruction, etc., which it reasonably should have, and a conflict, obstruction, concern, etc., is discovered, the CONTRACTOR shall bear the cost of any standby time for labor and/or equipment which occurs pending the ENGINEER's direction and the cost of rework of any Work installed which is affected by the conflict, obstruction, etc.

Where the dimensions and locations of existing structures are of importance in the installation or connection of any part of the Work, the CONTRACTOR shall verify such dimensions and locations in the field before the fabrication of any material or equipment which is dependent on the correctness of such information.

3.02 COORDINATION AND MEETINGS

A. The CONTRACTOR will be required to coordinate his work, to phase the construction operations, and provide, install and maintain any temporary connections necessary to prevent interference to operation of OWNER's facilities. Any construction work requiring the shut-down of facilities must be scheduled and performed only at such times as shall be authorized by the ENGINEER. Such work must be completed during the specific periods authorized by the OWNER. It may be necessary that work will be performed during several shut-down periods and/or during periods of premium time payment to accomplish the desired construction. All costs to perform the CONTRACTOR's work, including premium time payments, shall be borne by the CONTRACTOR and are included in the Contract price.

B. In addition to the above, the CONTRACTOR shall:

1. Coordinate scheduling, submittals, and work of the various sections of specifications to assure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

2. Verify the utility requirement characteristics of operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

3. Coordinate space requirements and installation of mechanical and electrical work which are indicated diagrammatically on drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with line of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

4. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.

5. Coordinate completion and clean up of Work of separate sections in preparation for substantial completion and for portions of Work designated for OWNER's partial occupancy.

6. After OWNER occupancy of premises, coordinate access to site for correction of defective Work and Work not in accordance with Contract Documents, to minimize disruption of OWNER's activities.

C. Job Progress Meetings

Progress meetings will generally be held monthly. CONTRACTOR's attendance shall be required.

1. Schedule - The ENGINEER will establish the meeting place, time and date, notify participants and administer the meeting. CONTRACTOR shall notify major subcontractors and suppliers, as appropriate.

2. Attendance

a. ENGINEER and/or resident project representative.
b. CONTRACTOR's project manager and project superintendent
c. OWNER's representative
d. Subcontractor, as appropriate to the agenda
e. Suppliers, as appropriate to the agenda
f. Other parties as determined by ENGINEER and/or OWNER

3. Agenda

a. Review minutes of previous meeting.
b. Review of work progress since previous meeting.
c. Review field observations, problems, conflicts.
d. Review problems which impede construction schedules.
f. Review of off-site fabrication, delivery schedules.
g. Review corrective measures and procedures to regain projected schedule.
h. Review revisions to construction schedules.

i. Review plan progress, schedule, during succeeding work period.
j. Review coordination of schedules.
k. Review submittal schedules; expedite as required.
l. Review maintenance of quality standards.
m. Review proposed changes for:
(1) effect on construction schedule and on completion date
(2) effect on other contracts of the project
n. Other business

4. Minutes - ENGINEER will prepare and distribute copies to participants and OWNER for review at the next meeting.

End of Section

SECTION 1010

DRAWING INDEX

PART 1: GENERAL

1.01 DRAWINGS

The following drawings, dated June, 1999, prepared by Montgomery Watson accompany this Specification and are part of the Contract Documents.

LIST OF DRAWINGS

SHEET	TITLE
GENERAL	
380-575-001	**Title Sheet List of Drawings**
380-575-002	**General Symbols and Notes**
380-575-003	**General Abbreviations**
380-575-004	**Piping Schedule**
380-575-005	**Process and Equipment Abbreviations**
SITE	
380-575-006	**Existing Partial Site Plan**
380-575-007	**Partial Site Plan**
380-575-008	**Miscellaneous Details**
380-575-009	**Miscellaneous Details**
DEMOLITION	
380-575-010	**Washwater Waste Holding Tanks (1 of 2)**
380-575-011	**Washwater Waste Holding Tanks (2 of 2)**
STRUCTURAL	
380-575-012	**General Names and Abbreviations**
380-575-013	**Gravity Thickeners**
380-575-014	**Dewatering Building Foundation**
380-575-015	**Dewatering Building Floor Plan and Details**
380-575-016	**Dewatering Building Roof Plan**
380-575-017	**Dewatering Building Sections**
380-575-018	**Dewatering Building Plans and Sections**
380-575-019	**Lagoon Supernatant Vault**
380-575-020	**Miscellaneous Details**
380-575-021	**Miscellaneous Details**
380-575-022	**Miscellaneous Details**

SHEET	TITLE
380-575-023	Miscellaneous Details
ARCHITECTURAL	
380-575-024	Dewatering Building Floor Plan
380-575-025	Dewatering Building Roof Plan
380-575-026	Dewatering Building Elevations
380-575-027	Dewatering Building Elevations
380-575-028	Dewatering Building Wall Sections
380-575-029	Schedules and Details
MECHANICAL	
380-575-030	Equipment and Valve Schedule
380-575-031	Overall Residual Solids Systems
380-575-032	Typical Valve House Drain Line
380-575-033	Typical Valve House Flushing Line
380-575-034	Demolition/New Sludge Well Plan and Section
380-575-035	Gravity Thickeners (1 of 2)
380-575-036	Gravity Thickeners (2 of 2)
380-575-037	Dewatering Building Plan at EL. 888.50
380-575-038	Dewatering Building Plan at EL. 907.83
380-575-039	Dewatering Building Sections
380-575-040	Dewatering Building Details
380-575-041	Lagoon Improvements
380-575-042	Lagoon Supernatant Vault No. 2
380-575-043	Miscellaneous Details
380-575-044	Miscellaneous Details
HVAC/PLUMBING	
380-575-045	Dewatering Building Plan and Abbreviations
380-575-046	Dewatering Building Sections and Details
INSTRUMENTATION	
380-575-047	Legends, Symbols and Abbreviations
380-575-048	Valve House 1 of 5 P&ID
380-575-049	Valve House 2 of 5 P&ID
380-575-050	Valve House 3 of 5 P&ID
380-575-051	Valve House 4 of 5 P&ID
380-575-052	Valve House 5 of 5 P&ID
380-575-053	Sludge Well P&ID
380-575-054	Lagoon System P&ID
380-575-055	Gravity Thickener No. 1 P&ID
380-575-056	Gravity Thickener No. 2 P&ID
380-575-057	Thickened Sludge Feed System P&ID
380-575-058	Belt Filter Press System P&ID
380-575-059	Lagoon Supernatant Vault P&ID

SHEET	TITLE
380-575-060	BFP Polymer Feed System P&ID
380-575-061	GT and WWW Polymer Feed System P&ID
380-575-062	Gravity Thickener PBS P&ID
380-575-063	Washwater Waste PBS P&ID
380-575-064	RTU Dewatering Bldg. (New) – (1 of 2)
380-575-065	RTU Dewatering Bldg. (New) – (2 of 2)
380-575-066	RTU B DPC 3330 (Exist) – (1 of 4)
380-575-067	RTU B DPC 3330 (Exist) – (2 of 4)
380-575-068	RTU B RIO 3331 (Exist) – (3 of 4)
380-575-069	RTU B RIO 3331 (Exist) – (4 of 4)
380-575-070	RTU Valve House No. 1 (Exist)
380-575-071	RTU Valve House No. 2 (Exist)
380-575-072	RTU Valve House No. 3 (Exist)
380-575-073	RTU Valve House No. 4 (Exist)
380-575- 074	RTU Valve House No. 5 (Exist)

ELECTRICAL

380-575-075	General Symbol and Notes I
380-575-076	General Symbols and Notes II
380-575-077	Standard Details
380-575-078	Existing Partial One-Lines
380-575-079	Revised Partial One-Lines
380-575-080	One-Line – Unit Substation
380-575-081	MCC-1 One-Line, Layout and Schedule
380-575-082	MCC-2 One-Line, Layout and Schedule
380-575-083	Lighting & Power Panel Schedules I
380-575-084	Elementary Schematics I
380-575-085	Elementary Schematics II
380-575-086	Elementary Schematics III
380-575-087	Elementary Schematics IV
380-575-088	Elementary Schematics V
380-575-089	Site Plan and Duct Sections
380-575-090	Dewatering Building Plan at EL. 907.83
380-575-091	Dewatering Building Plan at EL. 888.50
380-575-092	Dewatering Building Lighting Plan
380-575-093	Gravity Thickeners Plan
380-575-094	Vault Plans
380-575-095	Conduit Development I
380-575-096	Conduit Development II
380-575-097	Conduit Development III
380-575-098	Conduit Development IV
380-575-099	Conduit Schedule I
380-575-100	Conduit Schedule II
380-575-101	Conduit Schedule III
380-575-102	Conduit Schedule IV
380-575-103	Conduit Schedule V

PART 2: PRODUCTS

Not Used.

PART 3: EXECUTION

Not Used.

- END OF SECTION –

SECTION 01075 - BASIS OF PAYMENT

PART 1: GENERAL

1.01 SCOPE

The lump sum Contract price constitutes full payment to the CONTRACTOR for Work to be performed under this Contract. When applicable, and authorized by OWNER, additional work will be paid for in accordance with the supplementary unit price schedule, of the Bid. The cost of labor, equipment, materials or work called for in the Specifications, shown on the Drawings, or necessary for a complete and satisfactory installation, but which are not specifically mentioned in this Section shall be included in the appropriate supplementary unit price by the CONTRACTOR at no additional expense to the OWNER.

1.02 SUPPLEMENTAL UNIT PRICE ITEMS

A. Drilled Piers -- All additional work or deleted work associated with the drilled piers shall be in accordance with Specification Section 02380 - Drilled Piers. The base bid shall be prepared using the established bottom elevations shown between column lines.

1.03 SCHEDULE OF CASH ALLOWANCES

All cash allowances shall be included in the Contract Price in accordance with Article 11.8 of the General Conditions.

A. Specification Section 4231 - Reinforced Brick Masonry

The CONTRACTOR shall include in the Contract Price a Cash Allowance of $10/s.f. for the face brick.

PART 2: PRODUCTS

Not Used.

PART 3: EXECUTION

Not Used.

- END OF SECTION -

SECTION 01090 - REFERENCE STANDARDS

PART 1 – GENERAL

1.1 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Abbreviations within the specifications are as put forth by Section 1000, Article 1.10 – ABBREVIATIONS.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

- END OF SECTION -

SECTION 1100

ALTERNATIVES

PART 1: GENERAL

1.01 RELATED WORK

Alternative equipment and/or materials must be listed in the Bid. Failure to submit information on alternative equipment and/or materials as requested by the ENGINEER is cause for rejection of the proposed alternative and only the specified equipment and/or materials will be permitted to be incorporated in the finished project.

All alternative equipment and/or materials offered in the Bid must comply with the detailed requirements of the Drawings and Specifications and shall be covered by the specified guarantees and warranties. If it is determined that the alternative equipment and/or materials do not conform with the Specifications, such proposed alternative shall not be accepted and the CONTRACTOR will be required to furnish and install the specified equipment and/or materials.

No alternative materials and/or equipment will be incorporated in the finished project except an alternative accepted in writing by OWNER pursuant to the requirements of this Section 1100. Acceptance by OWNER of any such alternative shall not relieve CONTRACTOR of responsibility for assuring that any such alternative will, after installation or incorporation in the Work, conform to any performance requirements and other information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.

1.02 SUBMITTALS

Specified equipment and materials have been used to prepare the Drawings. Changes in piping, wiring, structure, etc., necessary to accommodate alternatives accepted by OWNER shall be submitted by the CONTRACTOR to the ENGINEER for approval.

1.03 PAYMENT

The CONTRACTOR shall pay for all installation costs necessitated by the selection of alternative equipment and material. Such costs are included in the Contract price and any modifications as stated in the Bid.

PART 2: PRODUCTS

Not Used.

PART 3: EXECUTION

Not Used.

End of Section

SECTION 1300

SUBMITTALS

PART 1: GENERAL

1.01 BEFORE STARTING WORK

A. Preliminary Progress Schedule

In accordance with Section 2.6 of the General Conditions, the CONTRACTOR shall prepare and submit to the ENGINEER for approval, a preliminary construction progress schedule. This submittal is to be made within ten (10) days from the effective date of Agreement. The method of schedule preparation required is generally referred to as the Critical Path Method (CPM).

This CPM Schedule will be a computer-generated construction schedule, using Primavera Project Planner (P3) or Suretrak, a project management and control software developed by Primavera Systems, Inc., Two Bala Plaza, Bala Cynwyd, Pennsylvania 19004, (800)423-0245 or (215)667-8600.

In developing the project schedule, the CONTRACTOR shall utilize the Precedence Diagramming Method (PDM). The work day to calendar date correlation of the construction schedule shall be based on a 40-hour work week with adequate allowance for holidays, adverse weather and all other special requirements of the work.

The CONTRACTOR will be required to submit with the preliminary progress schedule, and all subsequent updates, a Primavera Project Planner or Suretrak generated back-up diskette. This back-up diskette must contain all descriptions, durations, logic, constraints, coding, cost information, and any other information required for computer analysis and generation of schedule and cost reports and plots. If resource loading is utilized, all resource loading, minimum and maximum limits, and any other information required for computer analysis must be provided.

The schedule shall include, as a minimum, the following separate activities:

1. Physical construction (includes mobilization, demobilization, setup time, lags, etc.).
2. Issuance by CONTRACTOR of purchase orders for material and equipment and submittal of shop drawings and samples to the ENGINEER.
3. Review by ENGINEER for each submittal of samples and shop drawings. Unless otherwise approved by the ENGINEER, allow a

minimum of fifteen (15) working days for ENGINEER to review each submittal.

4. Fabrication time for materials and equipment.
5. Delivery of materials and equipment.
6. Installation of materials and equipment.
7. Testing, start-up and training for individual pieces of equipment or entire systems as appropriate.
8. Winter affected activities.
9. Outages or interruptions of OWNER's facilities required to perform work.
10. Demolition or removal work under this Contract.

Activity durations shall represent the best estimate of elapsed time considering the scope of the Work involved in the activity and the resources planned for accomplishing the activity expressed in working days.

Activity descriptions shall clearly define the scope of work associated with each activity. If activity descriptions contained in the schedule are not sufficient to describe the work, a supplemental narrative description is to be provided.

The construction work shall be detailed to an extent that progress can be readily monitored on a daily basis. In general, the construction work shall be detailed such that no construction activity shall have a duration greater than fifteen (15) work days.

Each activity shall be coded by the CONTRACTOR as necessary for proper and efficient utilization of the schedule. As a minimum, each activity shall be coded by:

1. Activity type (i.e., submittal, ENGINEER's review, delivery, construction, etc.).
2. Responsibility (i.e., CONTRACTOR, subcontractor A, subcontractor B, OWNER, ENGINEER, etc.).
3. Area (i.e., Building A, Building B, sitework, etc.).
4. Work order (i.e., OWNER assigned number required for monthly invoicing requirements).

The above schedule development requirements are a minimum and the CONTRACTOR shall develop the schedule as necessary to properly control and manage the project.

The preliminary progress schedule shall be submitted in a network analysis format and shall include, as a minimum, a graphic representation of all significant activities and events involved in the construction of the project, and a written statement explanatory thereof for a complete understanding of the diagram. The CONTRACTOR may furnish a Primavision or Suretrak generated pure logic

diagram with a detailed predecessor/successor analysis report if this option is available to the CONTRACTOR.

The network graphic representation and statement must clearly depict and describe the sequence of activities planned by the CONTRACTOR, their interdependence and the times estimated to perform each activity. The network shall be submitted on sheets 24" x 36" or larger and may be divided into as many separate sheets as required.

Accompanying the network graphic representation of the Construction Schedule, the following computer generated schedule reports shall be submitted as part of the network analysis:

1. Detailed Activity Report - This report shall be sorted by activity number and shall include, as a minimum, the following information:

   a. activity number
   b. activity description
   c. estimated duration
   d. early start date (calendar dated)
   e. early finish date (calendar dated)
   f. latest allowable start date (calendar dated)
   g. latest allowable finish date (calendar dated)
   h. total float
   i. activity codes
   j. detailed predecessor(s) and successor(s)
   k. free float

2. Early Start Report - This report shall be sorted by activity type in an early start order.
3. Critical Path Report - This report shall be sorted by total float in an early start order.
4. Activity Cost Values - This report shall list the activity number, description and cost value assigned to it. Once approved, the CONTRACTOR will be provided work order numbers to be assigned to each activity for input into the schedule codes.

The schedule reports shall be bound in booklet form and tabbed.

B. Shop Drawings and Samples Submittal Schedule

The preliminary progress schedule shall contain activities in the network representing submittal and review of shop drawings and material samples. The shop drawing and sample submittal schedule required per Paragraph 2.6 of the General Conditions shall be developed by sorting these activities from the progress

schedule. The schedule shall be presented in a report format containing the following information:

1. activity number
2. activity description (including reference to the appropriate specification section)
3. early and late start dates
4. early and late finish dates
5. total and free float
6. successor activities

C. Schedule of Values

In accordance with Section 2.6 of the General Conditions the CONTRACTOR shall submit to the ENGINEER a schedule of values representing a detailed subdivision of the lump sum Contract amount. This subdivision, when approved by the ENGINEER, will become the basis for computing the CONTRACTOR'S monthly progress payments. If practical, the schedule of values shall be developed by assigning a cost value to the appropriate activities contained in the preliminary progress schedule. If activities, or other line items, in the schedule of values contain costs associated with material, labor or subcontracts these costs are to be identified separately by listing the activity multiple times and identifying material, labor and subcontract with a suffix M, L and S respectively. Cost values for activities representing materials/equipment only shall be assigned to the activity representing delivery of such material/equipment to the job site.

In addition to the cost of material, labor and subcontracts, the following costs are to be identified separately in the schedule of values accompanied by such supporting documentation as required by the ENGINEER to substantiate the amounts listed.

1. Mobilization - To include CONTRACTOR's actual cost to setup temporary facilities at the job site.
2. Bonds, Insurance - To reflect premiums paid, or to be paid, for Bonds and insurance required to be provided per the Contract Documents. Additional insurance coverage or bonds purchased by the CONTRACTOR at his option shall be considered general overhead and apportioned to construction activity costs.
3. Job Site Overhead - To reflect the cost of maintaining the temporary facilities at the job site including the cost of direct field supervision. This value, when approved, will be paid to the CONTRACTOR in equal monthly increments based on the number of months between mobilization and final completion.
4. Demobilization - To reflect the cost of removing the temporary facilities and final site cleanup.

5. Permits - To include fees required for any permits which CONTRACTOR is required to obtain including inspection fees associated with such permits.

The cost of home office overhead, profit, financing, contingencies, etc. are to be apportioned to the construction activities in the schedule of values based on the percentage that each construction activity cost represents when compared to the subtotal of all construction activity costs. This subtotal is excluding mobilization, demobilization, job site overhead, permits, home office overhead, profit, financing, contingencies, etc. The total of all items in the schedule of values shall equal the Contract Price.

D. Cash Flow Schedule

Accompanying the CPM Schedule required above, the CONTRACTOR shall also submit to the ENGINEER, for approval, a Cash Flow Schedule. The Cash Flow Schedule shall show the amounts of money by months which will be required to reimburse the CONTRACTOR for Work performed during each month of the Contract Times. The sum of all the monthly cash requirements shall equal the Contract Price. The monthly cash requirements shall be proportioned based on the CPM Schedule. The initial cash flow schedule shall depict monthly cash requirements based on the early start dates of the CPM Schedule as well as the monthly cash requirements based on late start dates of the CPM Schedule. The approved cash flow schedule will be developed by the ENGINEER and will reflect the CONTRACTOR's schedule performance as of the date of approval. This process of approving cash flow schedules will occur with each required schedule update.

The approved Cash Flow Schedule will be used by the OWNER to program funds for progress payments to the CONTRACTOR. Monthly payments will be made to the CONTRACTOR in accordance with the Contract Agreement, but at no time will the aggregate amount of payments exceed the accumulated amount of payments for the same period of the approved Cash Flow Schedule.

E. Preconstruction Video Taping

Prior to mobilization at the site, the CONTRACTOR shall furnish to the ENGINEER a video cassette recording of all planned construction areas, material storage areas, areas adjacent to these areas, including but not limited to, streets, driveways, sidewalks, curbs, ditches, fencing, railing, visible utilities, retaining structures and adjacent building structures. The purpose of the video taping is to document existing conditions and to provide a fair measure of required restoration. Care should be taken to record all existing conditions which exhibit deterioration, imperfections, structural failures or situations that would be considered substandard.

The tapes shall be high quality, color and in the VHS format. Temporary lighting shall be provided as necessary to properly tape areas where natural lighting is insufficient (indoors, shadows, etc.). The tapes shall include an audio soundtrack to provide the following information:

- detailed description of location being viewed referenced to Contract Drawings (i.e., station no., building designation, pipeline route etc.)
- direction (N, S, E, W, looking up, looking down, etc.) of camera view
- date, time, temperature, environmental conditions at time of taping.

Any areas not readily visible by taping methods shall be described in detail. Unless otherwise approved by ENGINEER, taping shall not be performed during inclement weather or when the ground is covered partially or totally with snow, ice, leaves, etc.

As many tapes as are necessary to satisfy the requirements of this section shall be prepared. The original tapes shall be submitted to the ENGINEER accompanied by a detailed log of the contents of each tape. The log should include location descriptions with corresponding tape counter numbers to facilitate the quick location of information contained on the tapes. The tapes will be maintained by the ENGINEER during construction and may be viewed at any time by CONTRACTOR upon request. Upon final acceptance, the tapes will become the permanent property of the OWNER.

1.02 FINALIZING SCHEDULES

The CONTRACTOR shall be prepared to present and discuss at the preconstruction meeting, the schedules submitted in accordance with this specification. Unless additional information is required to be submitted by the CONTRACTOR, the ENGINEER will, within 15 working days of the preconstruction conference, provide comments to the CONTRACTOR. The CONTRACTOR shall then resubmit the affected schedules addressing the ENGINEER's comments.

Approval of the final schedules by the ENGINEER is advisory only and shall not relieve the CONTRACTOR of responsibility for accomplishing the work within the Contract Times. Omissions and errors in the approved CPM schedule shall not excuse performance less than that required by the Contract. Approval by the ENGINEER in no way makes the ENGINEER an insurer of the success of those schedules or liable for time or cost overruns flowing from shortcomings in such schedules.

1.03 REQUIREMENTS FOR CONFORMING WITH SCHEDULE

If, in the opinion of the ENGINEER, the CONTRACTOR falls behind the progress schedule, the CONTRACTOR shall take such steps as will be necessary to improve his progress, and ENGINEER may require CONTRACTOR to increase the

number of shifts and/or overtime operations, days of work, and/or the amount of construction planned, and to submit for approval such supplementary schedule or schedules as may be deemed necessary to demonstrate the manner in which the agreed rate of progress will be regained, all without additional cost to the OWNER. An updated cash flow schedule will be required in this occurrence and will be provided with the supplementary schedules referenced above.

1.04 UPDATING SCHEDULES

The CONTRACTOR shall submit to the ENGINEER quarterly updates of the schedules required per this specification section.

Progress and shop drawing schedule updates shall reflect the progress to date by providing actual start dates for activities started, actual finish dates for completed activities, and identifying out of sequence work, schedule logic changes and any circumstances or events impacting the current schedule. The updates shall also contain the CONTRACTOR's best estimate of the remaining duration for activities not complete as of the date of the update. All graphic presentations, reports and computer discs required per the initial submittal of these schedules shall be provided with each update.

The schedule of values and cash flow schedules shall be updated to reflect any changes.

1.05 ADJUSTMENT OF PROGRESS SCHEDULE AND CONTRACT TIMES

A. If the CONTRACTOR desires to make changes in his method of operating which affect the approved progress schedule, he shall notify the ENGINEER in writing stating what changes are proposed and the reason for the change. If the ENGINEER approves these changes, the CONTRACTOR shall revise and submit for approval, without additional cost to the OWNER, all of the affected portions of the schedule.

B. Shop drawings and samples which are not approved on the first submittal or within the schedule time shall be immediately rescheduled, as well as any work which fails to pass specified tests or has been rejected.

C. The Contract Times will be adjusted only for causes specified in the General Conditions. In the event the CONTRACTOR requests an adjustment of the Contract times, he shall furnish such justification and supporting evidence as the ENGINEER may deem necessary for a determination as to whether the CONTRACTOR is entitled to an adjustment of Contract Times under the provisions of the General Conditions. The ENGINEER will, after receipt of such justification and supporting evidence, make findings of fact and will advise the CONTRACTOR in writing thereof. If the ENGINEER finds that the CONTRACTOR is entitled to any adjustment of the Contract Times, the ENGINEER's determination as to the total number of days adjustment shall be

based upon the currently approved progress schedule and on all data relevant to the adjustment. The CONTRACTOR acknowledges and agrees that actual delays in activities which, according to the progress schedule, do not affect the Contract completion date shown by the critical path in the network will not be the basis for an adjustment of Contract Times.

D. From time to time it may be necessary for the progress schedule and/or Contract Times to be adjusted by the OWNER to reflect the effects of job conditions, weather, technical difficulties, strikes, unavoidable delays on the part of the OWNER, and other unforeseeable conditions which may indicate schedule and/or Contract Times adjustments. Under such conditions, the ENGINEER shall direct the CONTRACTOR to reschedule the work and/or Contract Time to reflect the changed conditions, and the CONTRACTOR shall revise his schedule accordingly. No additional compensation shall be made to the CONTRACTOR for such changes except as provided in the General Conditions. Unless otherwise directed, the CONTRACTOR shall take all possible actions to minimize any extension to the Contract Times and any additional cost to the OWNER.

1.06 SHOP DRAWINGS

The CONTRACTOR shall promptly supply to the ENGINEER for approval, shop drawings with details and schedules for all items contained in the list of required Shop Drawings included at the end of this Section, or for other items as may be required by the ENGINEER.

A sufficient number of copies to allow the OWNER to retain four (4) reviewed copies of all drawings, schedules and brochures shall be submitted for approval. Black line prints, blue line prints or reproducible transparencies are required. Blueprints (white lines on a blue background) are not acceptable. Each submittal shall have the job name on it and the appropriate specification section or contract drawing reference.

Shop drawings shall be numbered with the WATER COMPANY's file number 380-576-XX Rev. _____. Detailed procedures for numbering will be outlined at the pre-construction meeting.

Each copy of the submittals made to the OWNER for approval shall be prepared by the CONTRACTOR and shall have an identifying title stamp as follows:

Kentucky-American Water Company
Kentucky River Station
Additional Residuals Processing Facilities
Specification Section _____
Shop Drawing No. 380-576-XX Rev. _____.

As required by the General Conditions, each copy of the submittals shall also be stamped with the CONTRACTOR's approval indicating that the shop drawing has been

reviewed for conformance to the Contract Documents and has been coordinated with all other work and/or trades. The CONTRACTOR shall identify and bring to the attention of the ENGINEER any deviations to the Contract Documents contained in the submittal. For shop drawings being resubmitted, the CONTRACTOR shall identify and bring to the attention of the ENGINEER any revisions other than those originally requested by the ENGINEER.

Submittals smaller than 8½x11 inches shall be secured to paper 8½x11 inches.

Submittals will be returned, stamped with the following classifications:

A. "No Exceptions Taken" - There are no notations or comments on the submittal and, in our opinion, the submittal meets the requirements of the Contract Documents and the CONTRACTOR may release the equipment for production.

B. "Make Corrections Noted" - Notations have been made on the submittals to insure conformance with the Contract Documents. The contractor may release the equipment for production in accordance with the notations. The contractor may be required to resubmit part or all of the submittal to acknowledge that the comments are understood and will be complied with.

C. "Rejected - Resubmit" - The submittal does not meet the requirements of the Contract Documents. The contractor must submit the complete package again.

D. "Amend - Resubmit" - When the material submitted is incorrect or insufficient to review properly and it is necessary to see the complete package again.

Where a submittal indicates a departure from the Contract which the ENGINEER deems to be a minor adjustment in the interest of the OWNER not involving a change in Contract Price or extension of Contract Times, the ENGINEER may approve the submittal but the approval will contain, in substance, the following notation:

"The modification indicated on the attached submittal is approved in the interest of the OWNER to effect an improvement for the Project and is accepted with the understanding that it does not involve any change in the Contract Price or Times; that it is subject generally to all Contract stipulations and covenants; and that it is without prejudice to any and all rights of the OWNER under the Contract Bonds."

It is emphasized that the ENGINEER's approval of CONTRACTOR's submitted data is for general conformance to the Contract Drawings and Specifications, but subject to the detailed requirements of Drawings and Specifications. Although the ENGINEER may check submitted data in more or less detail, such checking is an effort to discover errors and omissions in CONTRACTOR's drawings and to assist the CONTRACTOR in coordinating and expediting his work, and shall in no way relieve the CONTRACTOR of

his responsibility to engineer the details of the Work in such manner that the purpose and intent of the Contract will be achieved, nor shall such detail check by the ENGINEER be construed as placing on the ENGINEER, any responsibility for the accuracy, and for proper fit, functioning and performance of any phase of the Work included under this Contract.

1.07 SAMPLES

When required by the ENGINEER or where noted in other Sections of these Specifications, samples or materials shall be submitted for approval.

Submit samples to illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.

Submit samples of finishes from the full range of manufacturer's standard colors, textures, and patterns for ENGINEER's selection.

Include identification on each sample, with full project information.

Submit the number or samples specified in individual specification sections; one of which will be retained by ENGINEER.

Reviewed samples which may be used in the Work are indicated in individual specification sections.

1.08 PROGRESS PAYMENTS

The detailed arrangement for submittal of progress payments shall be discussed at the preconstruction meeting. In general, progress payments shall be submitted monthly in a format acceptable to the ENGINEER. The progress payment request shall be based on the approved schedule of values and should provide the percentage of completion, total dollar value completed, dollar value completed prior to the current payment, and the amount requested for this progress payment for each line item contained in the schedule of values. Progress payment requests for material and/or equipment suitably stored but not yet incorporated into the work shall be accompanied by a copy of the appropriate manufacturers invoice, shipping order, bill of lading, etc. and the progress payment amount shall be the direct cost to the CONTRACTOR, or subcontractor, for such material and/or equipment. Payment will not be made to the CONTRACTOR if, upon inspection by the ENGINEER, it is determined that the material and/or equipment does not conform to the requirements of the Contract Documents including proper storage, receipt of approved shop drawings, receipt of any special guarantees, Bonds, insurance coverage, any evidence of damage or imperfections, etc.

1.09 CONTRACTOR'S DAILY REPORTS

If requested by the ENGINEER or the Resident Project Representative, the CONTRACTOR shall prepare and submit daily reports containing the following information:

- the number of craftsmen and hours worked of each subcontractor,
- the number of hours worked by each trade,
- the number of hours worked of each type of equipment,
- a description of work activities performed,
- a description of any material or equipment deliveries,
- description of obstructions encountered,
- temperature and weather conditions.

The daily reports shall be submitted on a daily basis, by the end of the next business day.

Information provided on the daily report shall not constitute notice of delay or any other notice required by the Contract Documents. Notice shall be as required therein.

1.10 OPERATING AND MAINTENANCE INSTRUCTION MANUALS

Prepare complete written maintenance and operating instructions covering the equipment provided under this Contract. Divide the operating instructions into basic sections according to type of equipment.

Instructions shall describe all equipment and controls, their purpose, and their operation and use. Include maintenance checklists for use by the OWNER's personnel and a complete listing of replacement parts with pertinent information relative to ordering such parts.

Submit instructions in duplicate draft form for review by the ENGINEER at least eight weeks prior to initial operation, and in final form within thirty days after return of one copy of the draft with the ENGINEER's notations.

Prior to release of Final Payments, revise and resubmit copies of the instructions to accord with any changes in procedures or equipment made during start-up or initial operation. Resubmittals are also required for changes made during the guarantee period.

PART 2: PRODUCTS

Not Used.

PART 3: EXECUTION

Not Used.

End of Section

LIST OF REQUIRED SHOP DRAWINGS

SPEC. SECTION	ITEM
02050	Demolition and Salvage
02200	Earthwork (gradation certifications & samples)
02238	Special Backfill (gradation certifications & samples)
02268	Erosion Control Barrier
02380	Drilled Piers
02460	Roadways, Parking Areas and Sidewalks
02540	Precast Concrete Manholes
02565	Ductile Iron Pipe
	material certifications
	layout drawings
02622	Sanitary and Storm Drainage Systems Testing
02643	Water Pipeline Testing and Disinfection
02900	Seeding
03100	Concrete Formwork
	falsework
	form ties
03200	Reinforcement Steel
	material certifications
	shop bending diagrams
	bar placement drawings
	mechanical couplers
	mill test reports
03290	Joints in Concrete
	waterstop
	joint sealant
	joint filler materials
	bentonite waterstop
03310	Cast-in-Place Concete
	material certifications
	aggregate gradations
	mix design
	materials and methods for curing
03315	Grout
	cement grout
	non-shrink grout
	epoxy grout
	topping grout
03400	Precast Concrete
	mix design
	material certifications
	reinforcing and stress computations
	setting plans
04231	Reinforced Brick Masonry
	material certifications
	material samples
	product data on accessories

LIST OF REQUIRED SHOP DRAWINGS

SPEC. SECTION	ITEM
04232	Reinforced Concrete Block Masonry
	material certifications
	material samples
	product data on accessories
05100	Structural Steel Framing
	fabrication drawings
	erection drawings
05210	Open Web Steel Joists
	design calculations
	erection drawings
05500	Miscellaneous Metal Work
	ladders
	stair nosings
	checkered plate
	floor hatches
	anchors
05521	Aluminum Railings
	product data
	structural calculations
	layout drawings
06100	Rough Carpentry
06610	Glass Fiber and Resin Fabrications
	grating
	troughs
	weir plates
	enclosures
07150	Dampproofing
	surface applied cementitous coatings
	surface applied traffic topping
07190	Vapor Retarders
07210	Building Insulation
	masonry wall insulation
	roof insulation
	below grade insulation
07510	Membrane Roofing
07600	Flashing and Sheet Metal Work
	flashing product data
	flashing layout drawings
	gutters & downspouts product data
	gutters & downspouts layout drawings
	guarantee
07920	Sealants and Caulking
	sealants product data
	sealants color chart
	joint fillers product data
	preformed expanding foam sealant product data
08110	Steel Doors and Frames
	product data
	schedules

LIST OF REQUIRED SHOP DRAWINGS

SPEC. SECTION	ITEM
08330	Rolling Service Doors
	product data
	schedules
08520	Aluminum Windows,Horizontal Sliding
	product data
	test reports
	schedules
08710	Finish Hardware
	product data
	schedules
	samples
08800	Glazing
	product data
	samples
09500	Acoustical Ceiling System
	product data
09800	Protective Coatings
	product data
	coatings materials list
	color chart
	samples
09900	Architectural Paint Finishes
	product data
	paint materials list
	color chart
	samples
10010	Building Specialties
	metal bumpers
10020	Enclosures
10400	Identifying Devices
10500	Lockers
10520	Fire Protection Specialties
11104	Lagoon Supernatant Return Pumps
11106	Booster Pumps
11136	Verical Solids Handling Pumps
11144	Progressing Cavity Pumps
11149	Submersible Sump Pumps
11205	Vertical Shaft Mixers
11230	Gravity Thickeners
11259	Transfer Pumps
11260	Polymer Blending System
11511	Compressors, Tank Mounted, Reciprocating
11562	Belt Filter Press System
13300	Polyethylene Tanks
	product data
	fabrication drawings
	certifications

LIST OF REQUIRED SHOP DRAWINGS

SPEC. SECTION	ITEM
	test reports
	O&M
14570	Belt Conveyors
15000	Piping General
	insulating flanges
	flange gaskets
	mechanical type couplings
	sleeve type couplings
	flexible connectors
	expansion joints
15005	Piping Identification Systems
15006	Pipe Supports
15036	Copper Pipe
15060	PVC Pressure Pipe
15145	Pipe, Ductwork and Equipment Insulation
15201	Valve and Gate Actuators
15202	Butterfly Valves
15203	Check Valves
15204	Ball Valves
15207	Plug Valves
15226	Telescoping Valves
15230	Miscellaneous Valves
	corporation stops
	solenoid valves
	disconect couplings
15430	Plumbing Piping and Specialties
	pipe and fittings
	insulation
	hangers and supports
	pipe sleeves
	valves
	floor drains
	floor sinks
	cleanouts
	hose bibbs and hydrants
	hose racks and hoses
	backflow preventors
15440	Plumbing Fixtures
	mop sink
	eye wash
15450	Plumbing Equipment
	water heater

LIST OF REQUIRED SHOP DRAWINGS

SPEC. SECTION	ITEM
15500	Heating, Ventilatiing and Air Conditioning
	ductwork
	piping
	insulation
	hangers and supports
	flues
	dampers
	registers,grilles and diffuseres
	vav boxes
	air filters
	gauges
	wall louvers
	vibration isolators
	roof curbs
	temperature control
16110	Electrical Raceway Systems
	conduit
	fittings and boxes
16111	Underground Raceway Systems
	handholes
	ductbanks
16120	Wires and Cables
16140	Wiring Devices
16310	Secondary Unit Substation
16431	Protective Device Studies
	short circuit study
	protective device evaluation study
	protective device coordination study
	time/current coordination curves
16450	Grounding
16455	Variable Frequency Drive Units
16460	Electric Motors
16470	Panelboards and General Dry-Type Transformers
16480	Low Voltage Motor Control Centers
	MCC-1
	MCC-2
16485	Local Control Stations and Miscellaneous Electrical Devices
16500	Lighting
16850	Electric Heat Tracing
17100	Process Control and Instrumentation Systems
	analog hardware
	project -wide loop drawings
	test procedures
	training
	O&M

LIST OF REQUIRED SHOP DRAWINGS

SPEC. SECTION	ITEM
17220	Field Instruments
	diaphragm seals
	pressure gauges
	magnetic flowmeters
	ultrasonic level transmitters
	ultrasonic level switches
	turbidity analyzers
	sludge blanket level detectors
	zero speed switch
17515	RTU Based Control Systems-Hardware
	hardware
	test procedures
	O&M
17525	RTU Based Control Systems-Software
	product data
	algorithms
	narratives
	listing of database
	displays
	reports

SECTION 01313 - CONSTRUCTION SEQUENCE AND SCHEDULE CONSTRAINTS

PART 1 – GENERAL

1.1 GENERAL

A. Work shall be scheduled, sequenced, and performed in a manner which minimizes disruption to the operation and maintenance of the existing plant facilities and plant operations.

B. The CONTRACTOR shall incorporate the construction and schedule constraints of this Section in preparing the construction schedule required elsewhere within the contract documents. The construction schedule shall include the CONTRACTOR's activities necessary to satisfy all constraints of the Contract Documents.

C. The CONTRACTOR shall, prior to shop drawing submission for yard piping, perform exploratory excavations in order to determine and verify the location of underground piping.

1.2 PERMITS

A. The CONTRACTOR shall abide by the conditions of all permits and shall obtain proof of satisfaction of conditions from issuers of permits prior to acceptance of the WORK by the OWNER.

1.3 SCHEDULE CONSTRAINTS

A. **General:** It is the CONTRACTOR'S responsibility to coordinate and plan the construction activities to integrate each schedule constraint into performance of the overall work.

B. The listing of schedule constraints below does not mean that all constraints or special conditions have been identified. The list does not substitute for the CONTRACTOR's coordination and planning for completion of the work within the Contract Times.

C. The following constraints affect the construction schedule.

1. No purification units shall be taken off line from May to October. Up to two units at one time can be taken off line from January to March. For the rest of the year a maximum of one purification unit shall be taken off line.

2. The Sludge Well can only be taken out of service for a maximum period of two consecutive weeks.

3. Only 1 (one) Lagoon can be taken out of service at a time. All Lagoon improvements, including the new supernatant return vault, shall be completed before any work is done to convert the Wash Water Waste Holding Tanks (WWWHTs) to Gravity Thickeners.

4. There is no limit on how long the Wash Water Waste Holding Tank can be taken out of service as long as all work on Lagoons is complete.

5. The entire lagoon system (i.e. common piping) including the supernatant piping can only be out of service for a maximum of 24 consecutive hours.

1.4 OUTAGE PLAN AND REQUESTS

A. Modifications to existing facilities, the construction of new facilities, and the connection of new to existing facilities may require the temporary outage or bypass of existing treatment processes or facilities. In addition to the construction schedule required elsewhere within the contract documents, the CONTRACTOR shall submit a detailed outage plan and time schedule for all construction activities which will make it necessary to remove a tank, process system, pipeline, channel, electrical circuit, equipment, structure, road or other facilities from service.

B. An outage plan shall be submitted for the OWNER's review and acceptance a minimum of 10 working days in advance of the time that such outages are required. The outage plan shall be coordinated with the construction schedule and shall meet the restrictions and conditions of this Section. The CONTRACTOR's outage plan shall describe in detail the work scheduled to be performed, including durations, manpower, back-up and emergency procedures, temporary power, controls, instrumentation or alarms required to maintain control, monitoring and alarms for the treatment plant processes. The CONTRACTOR shall provide and install all items necessary in order to ensure proper operation of the plant process systems at all times and shall conform to any revisions required in order to satisfy the Plants Operating requirements. All costs for preparing and implementing the outage plans shall be at no increase in cost to the OWNER.

C. Once the outage plan has been approved by the OWNER , the OWNER may postpone said shutdown or outage due to weather, unusual water demands, equipment breakdowns or other unforeseen reasons.

D. The CONTRACTOR shall provide written confirmation of the shutdown date and time two working days prior to the actual shutdown. At this point all equipment and materials required for the completion of the work shall be on site.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION

3.1 SEQUENCE OF CONSTRUCTION

A. A suggested sequence of construction for the work required for this project follows. It should be noted that this suggested sequence of construction does not identify all of the work of this project nor does it preclude some activities from being worked on concurrently. The CONTRACTOR may through his means and methods elect to deviate from this suggested sequence of construction. Revisions to the sequence of construction are subject to the approval of the OWNER and ENGINEER.

1. Lagoon Work:

a. Construct Supernatant Pump Station and Valve Vault No. 2.
b. Install new 10" Supernatant Return Force Main.

c. Remove existing 6"Supernatant Piping and install new 6"and 12" Supernatant Piping starting at Supernatant Pump Station. The work associated with the Lagoon Supernatant Piping must be performed between the allowed outage period defined in Schedule Constraints. Therefore the Contractor will be required to perform the work during successive outages. The new 12" Supernatant piping shall be temporarily connected to the existing 6" Supernatant piping in order to allow the other lagoons to be put back in service prior to the expiration of the outage duration specified in Schedule Constraints.
d. Take Lagoon No. 1 out of service and install the new piping and valves associated with Lagoon No. 1.
e. Upon completion of Lagoon No.1 it shall be put back into service and work shall proceed to Lagoon No.2 and the same procedures followed.
f. Upon completion of Lagoon No.2 it shall be put back into service and work shall proceed to Lagoon No.3 and the same procedures followed.
g. Upon completion of Lagoon No.3 it shall be put back into service and work shall proceed to Lagoon No.4 and the same procedures followed.

2. Sludge Well Work:

a. The work within the Sludge Well shall be performed between the allowed outage periods as defined in Schedule Constraints.
b. During the non-outage periods, at least one pump (existing or new) must be available and in service.
c. Remove one of the existing Submersible Sludge Pumps and its associated equipment.
d. Install one of the new Sludge Pumps including all associated equipment and controls.
e. Following satisfactory start-up and testing of the new pump, repeat steps c and d for the second pump.

3. Wash Water Waste Holding Tank Work:

a. One of the existing Wash Water Waste Holding Tanks (WWWHTs) shall be taken out of service and converted to a Gravity Thickener.
b. Once the Gravity Thickener is complete, it shall be put into service and the other WWWHT taken out of service in order to be reworked.

- END OF SECTION -

SECTION 1500

TEMPORARY FACILITIES

PART 1: GENERAL

1.01 WATER SUPPLY

If reasonably available, water for the purpose of this Contract will be supplied to the CONTRACTOR by the OWNER. The CONTRACTOR shall furnish and install all necessary meters, temporary piping and valves in connection with such water supply.

The OWNER reserves the right to impose limitations upon the CONTRACTOR'S use of water as the OWNER, in its sole discretion, determines may be necessary to assure it of its continued ability to meet the demands of its customers and the volumes and pressures required for fire protection. Any water required by the CONTRACTOR in excess of the quantities the OWNER provides to the CONTRACTOR must be furnished by the CONTRACTOR at his own cost.

1.02 TEMPORARY HEAT

The CONTRACTOR shall provide approved type heating apparatus with the necessary fuel in order to protect and/or dry out the work. The stored materials and finished work shall be protected at all times from damage by the weather elements.

1.03 ELECTRICAL SUPPLY

The CONTRACTOR shall pay all fees, obtain necessary permits and have meter installed for power and light as may be required for the prosecution of his work.

1.04 TEMPORARY LIGHTING

Provide and maintain incandescent lighting for construction operations.

1.05 BARRIERS

Provide barriers to prevent unauthorized entry to construction areas and to protect existing facilities and adjacent properties from damage from construction operations and demolition. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing buildings. Provide protection for plant life designated to remain. Replace damaged plant life.

1.06 FENCING

NOT USED

1.07 PARKING

Arrange for temporary gravel parking areas to accommodate construction personnel. When site space is not adequate, provide additional off-site parking.

1.08 PROGRESS CLEANING

Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust. Remove waste materials, debris, and rubbish from site weekly and dispose off-site.

1.09 SANITARY FACILITIES

The CONTRACTOR shall provide suitable temporary facilities and enclosures for the use of workmen and shall maintain same in a sanitary condition.

The CONTRACTOR is advised that the OWNER is in the business of providing potable water and the CONTRACTOR'S sanitary arrangements shall not endanger the OWNER'S facilities.

1.10 FIELD OFFICES

The CONTRACTOR shall provide, at locations designated or otherwise approved by the OWNER, separate field offices for the CONTRACTOR and the Resident Project Representative. Unless otherwise approved, the CONTRACTOR's field office shall be large enough, and furnished, to conduct progress meetings. The CONTRACTOR's field office is to be an official place of business for the CONTRACTOR at which an authorized agent of the CONTRACTOR will be present while work is in progress. The record documents required to be maintained by the CONTRACTOR per Article 6.19 of the General Conditions shall be kept at the CONTRACTOR's field office.

The Resident Project Representative's field office shall be a substantial, weatherproof, heated, air conditioned, lighted office in like new condition with lock and keys having floor space of not less than 256 square feet (8' x 32'). The field office shall be a Gelcospace Model GS-832 mobile office or equivalent.

For added security, the windows of the office shall have security bars or heavy gage steel wire mesh on the outside and all doors shall be fitted with hasps and padlocks. Install wooden stairs and platforms with hand railing at each exterior door. Provide access walkways as required to each entrance. Trailers shall be leveled on blocks and furnished with tie-down straps and anchors. The office shall be furnished and equipped with the following:

- (2) desks (built-in type, one at each end of trailer), (2) office chairs and (4) folding chairs
- drawing table and drafting stool
- wall shelves - minimum 16 lineal feet of 12" wide wood shelving
- (3) 4-drawer file cabinets
- telephone service: 2 services, one for telephone, one for facsimile machine. Telephone with speaker attachment for conference calls, speed dial capabilities and answering machine (integral or separate). (NOTE: CONTRACTOR to arrange and pay for hook-up, OWNER to pay subsequent monthly phone bills.)
- copying machine - desktop unit is acceptable, CONTRACTOR to service and maintain throughout the project
- facsimile machine
- water, hot and cold at sink. Water service and drains to be frostproof.
- sanitary facilities: flush type water closet with accessories including a wall mirror, paper towel holder and paper holder. Facilities shall be connected to the local sanitary sewer system or a holding tank provided.
- metal wastebasket
- weekly janitorial service
- plan rack with plan hangers
- fire extinguisher
- first-aid kit
- Electric water cooler with hot and cold water faucets and an accessory refrigerator

The field offices shall be maintained until final acceptance of the project unless otherwise approved by the OWNER.

PART 2: PRODUCTS

Not Used.

PART 3: EXECUTION

Not Used.

End of Section

SECTION 1600

PRODUCTS

PART 1: GENERAL

1.01 PROTECTION OF MATERIAL AND EQUIPMENT

All electrical and mechanical equipment shall be stored in a warm, dry shelter with proper ventilation. Under no circumstances shall motors, electrical control equipment or any other electrical or mechanical equipment be stored under polyethylene plastic covers or tarpaulins. When space is available inside existing structures, and the OWNER approves, the CONTRACTOR will be allowed to store equipment inside them. Should such space not be available, the CONTRACTOR shall construct a shelter with a source of heat and proper ventilation as approved by the ENGINEER for the storage of equipment.

The interior of all pipe and accessories shall be kept free from dirt and foreign matter at all times.

After valves and hydrants have been inspected, the CONTRACTOR shall properly store them prior to use. In order to prevent entry of foreign material that could cause damage to the seating surfaces, the valves and hydrants shall be stored in a fully closed position unless recommended otherwise by the manufacturer. Resilient seated valves shall be stored in accordance with the manufacturer's recommendations. This may include storage with protective covers for rubber seats and in marginally open condition. Valves and hydrants should be stored indoors.

If valves must be stored outdoors, the CONTRACTOR shall protect the operating mechanism, such as gears, motor, actuators and cylinders, from weather elements. Valve ports and flanges must be protected from the weather and foreign materials. If valves are subject to freezing temperatures, all water must be removed from the valve interior and the valve closed tightly before storage, unless specifically recommended otherwise by the manufacturer. Valves shall be stored on pallets with the discs in a vertical position to prevent rainwater from accumulating on top of the disc, seeping into the valve body cavity and freezing and cracking the casting.

1.02 SERVICING EQUIPMENT

The CONTRACTOR shall check all equipment upon acceptance to determine if oil reservoirs are full and areas to be greased are properly packed with grease. The CONTRACTOR will provide the proper grease or oil for use in lubricating the required areas in the equipment. Any service to equipment while in storage, or installed pending acceptance, is the responsibility of the CONTRACTOR and shall be performed per

manufacturer's requirements, industry standards or as stated specifically in the technical specifications.

1.03 MATERIAL/EQUIPMENT FURNISHED BY OWNER

Certain material and equipment will be furnished by the OWNER as noted in the Contract Documents. The CONTRACTOR's responsibility for material and/or equipment furnished by the OWNER shall begin upon the CONTRACTOR's acceptance of such material and/or equipment at the point of delivery to him. All material and equipment shall be examined and items found to be defective in manufacture and/or otherwise damaged shall be rejected by the CONTRACTOR at the time and place of delivery to him. The OWNER will thereupon repair or replace the damaged items.

After acceptance of material and/or equipment by CONTRACTOR at point of delivery to him, CONTRACTOR shall be responsible for the proper storage, handling, servicing and installation of such material and/or equipment in accordance with manufacturer's recommendations, industry standards or specific requirements of the Contract Documents. Any material and/or equipment found to be defective prior to acceptance by the ENGINEER shall be repaired or replaced by CONTRACTOR at no additional cost to OWNER unless CONTRACTOR submits proof that such defect was latent and could not have been detected by CONTRACTOR when performing his duties and responsibilities under these Contract Documents.

CONTRACTOR's vs. OWNER's responsibilities for providing guarantees or warranty and manufacturer's representatives for service, inspection, certification of installation, installation, field training, start-up, etc. for material and/or equipment furnished by OWNER shall be as follows unless otherwise specified: OWNER will provide the warranty and CONTRACTOR is responsible for providing manufacturer's representatives for all necessary field service, start-up service, installation certifications, installation, field training of OWNER's personnel, etc. for OWNER furnished material and/or equipment as required for acceptance of such material and/or equipment in the completed project.

PART 2: PRODUCTS

2.01 GENERAL

Unless otherwise specifically provided for in these Specifications, all equipment, materials and articles incorporated in the work shall be new, in current production and the best grade obtainable consistent with general construction usage.

2.02 COORDINATION OF DIMENSIONS

The CONTRACTOR shall verify and make necessary corrections to construction dimensions so that all specified and/or alternative equipment, which is approved by the

ENGINEER, can be installed and will function within the intent of the Contract Drawings and Specifications. The CONTRACTOR will promptly notify the ENGINEER of all necessary corrections required.

2.03 SAFETY AND HEALTH REQUIREMENTS

All materials, equipment, fixtures and devices furnished shall comply with applicable Laws and Regulations.

All equipment furnished and installed under this Contract shall be equipped with suitable and approved safety guards and devices required for the safety of the public and operating personnel. Such guards and safety devices shall be in accord with the latest requirements of safety codes approved by the American National Standards Institute as well as the safety requirements of applicable Laws and Regulations. Where said safety codes of the ANSI are incompatible with applicable Laws and Regulations, said Laws and Regulations shall prevail.

PART 3: EXECUTION

3.01 INSTALLATION

Material and equipment shall be installed in accordance with the appropriate Sections of these Specifications.

3.02 SERVICES OF MANUFACTURER'S REPRESENTATIVE

The CONTRACTOR shall arrange for a qualified service representative from each company, manufacturing or supplying certain equipment as required by the individual Specification Sections to perform the duties herein described.

After installation of the applicable equipment has been completed and the equipment is presumably ready for operation, but before it is operated by others, the representative shall inspect, operate, test, and adjust the equipment. The inspection shall include, but shall not be limited to, the following points as applicable:

A. soundness (without cracked or otherwise damaged parts)
B. completeness in all details, as specified
C. correctness of setting, alignment, and relative arrangement of various parts
D. adequacy and correctness of packing, sealing and lubricants

The operation, testing, and adjustment shall be as required to prove that the equipment is left in proper condition for satisfactory operation under the conditions specified.

On completion of his Work, the manufacturer's or supplier's representative shall submit to the ENGINEER a complete signed report of the result of his inspection, operation, adjustments, and tests. The report shall include detailed descriptions of the points inspected, tests and adjustments made, quantitative results obtained if such are specified, and suggestions for precautions to be taken to ensure proper maintenance. The report also shall include a certificate that the equipment conforms to the requirements of the Contract Documents and is ready for permanent operation and that nothing in the installation will render the manufacturer's warranty null and void.

After the ENGINEER has reviewed the reports from the manufacturers' representatives, the CONTRACTOR shall make arrangements to have the manufacturers' representatives present when the mechanical performance tests are made.

End of Section

SECTION 1650

TESTING

PART 1: GENERAL

1.01 DESCRIPTION

This Section covers testing in accordance with the Specifications, as shown on the Drawings, and as necessary for a complete and satisfactory installation.

1.02 PIPELINES

All pipelines, valves, appurtenances, etc. installed per these Contract Documents shall be tested in the manner described by the technical specifications. Unless otherwise stated, all pipelines shall be hydrostatically tested, with no leakage, at a pressure at least equal to the maximum operating pressure of the pipeline.

1.03 WATER CONTAINING VESSELS

Prior to backfilling around water containing vessels, the CONTRACTOR shall fill said vessels with water for a period of at least 7 days in order to insure vessels are watertight. If any vessel leaks, it shall be repaired to the satisfaction of the ENGINEER and retested until no leakage occurs.

1.04 LIQUID CHEMICAL STORAGE TANKS

Prior to filling bulk storage tanks, batch and day tanks with appropriate chemicals, each tank shall be filled with water for a period of at least 7 days in order to insure each tank is watertight. If any tank leaks, it shall be replaced or repaired by a factory trained representative to the satisfaction of the ENGINEER, and retested until no leakage occurs.

1.05 DAMPPROOFING AND PAINTING

During the application of dampproofing and painting, the CONTRACTOR shall have the manufacturer's representative check the dry mil thickness of each coating and certify to the ENGINEER in writing that the thickness is in compliance with the Specifications. If deficiencies in the dry mil thickness of any coat are found, they shall be corrected by the application of an additional coat(s) to the said deficient area. The certificate shall also state that all surfaces were properly cleaned prior to the application of dampproofing and paint, specified meetings and inspections were made, the quantity of dampproofing and paint were applied in accordance with their recommendations, and all other requirements stated in the Specifications have been satisfactorily completed.

1.06 MECHANICAL PERFORMANCE TESTS

A. General

1. As a prerequisite to the ENGINEER's issuance of the Certificate of Substantial Completion, the CONTRACTOR shall conduct initial and final performance tests as described hereafter. The CONTRACTOR shall perform all tests with his own forces and such equipment representatives and other experts (hereinafter collectively referred to as "CONTRACTOR's personnel") as may be required by the Specifications or necessary for a successful test. All operations and coordination of the tests from their beginning to their satisfactory completion as determined by the OWNER and ENGINEER shall be the complete responsibility of the CONTRACTOR.

2. The general sequencing of the testing shall be developed by the CONTRACTOR. In general the sequence should focus on the testing of individual pieces of equipment prior to testing entire systems including automatic control systems.

3. At least 14 days prior to the proposed testing, the CONTRACTOR shall submit in writing to the ENGINEER a complete outline of his proposed procedure for testing. No testing shall begin until approval is given. Such approval shall be for the general schedules of testing and in no way relieves the CONTRACTOR of his responsibility for conducting the test expeditiously and with an adequate number of personnel to handle all emergencies.

4. All operating costs, until satisfactory completion of the mechanical performance tests, or until the facility is put into operation by the OWNER, whichever comes first, shall be paid for by the CONTRACTOR and shall be included as a part of the lump sum price bid for the Project. Operating costs shall be understood to include, but not be limited to, the costs of: **labor** OWNER will be responsible for the costs of: **electrical power, fuel, heating, lubricants, and all treatment chemicals**. The CONTRACTOR shall also be responsible for maintenance during the testing period and for repair of any damage resulting from the testing procedure. If the CONTRACTOR does not have sufficient personnel to handle an emergency and the OWNER must make repairs of damage, caused by the CONTRACTOR's actions, with his own forces, the CONTRACTOR shall reimburse the OWNER for this work.

5. Wages and salaries of CONTRACTOR's personnel as may be required by any and all tests specified herein shall be paid for by the CONTRACTOR and included in the lump sum price bid.

6. The CONTRACTOR shall dispose of all water used during the tests, in addition to wastes resulting from the tests. The method of disposing the water and wastes shall be in accordance with all applicable Laws and Regulations and shall be subject to approval by the ENGINEER. The CONTRACTOR will not be allowed to pump water for testing into the distribution system until its quality meets requirements for public water supplies. Costs for the disposal of water and wastes shall be included in the lump sum price bid.

B. Initial Mechanical Performance Tests

1. The CONTRACTOR shall give the OWNER at least 14 days written notice prior to the commencement of mechanical performance tests.

2. The initial mechanical performance tests shall be broken down into two phases. The first phase shall consist of the CONTRACTOR's personnel demonstrating to the ENGINEER, in the presence of OWNER's personnel, that the manual and automatic controls, performance over full operative range, efficiency, safety items, alarms, etc., of each mechanical and electrical item of equipment will operate in accordance with the design intent as indicated by the Drawings and/or described in the Specifications. At this time, the CONTRACTOR's personnel shall also instruct and train the OWNER's personnel in the operation of all equipment, controls, safety devices, etc.

3. The second phase shall commence after the first phase has, in the opinion of the ENGINEER, been successfully completed. The second phase shall consist of a preliminary 12-hour operation test of the facility or subsystem. If, in the opinion of the ENGINEER, the results of the operational test are satisfactory, the OWNER will give the CONTRACTOR written notice to proceed with the Final Mechanical Performance Tests. If, in the opinion of the ENGINEER, the results of the operational test are unsatisfactory, the ENGINEER shall provide the CONTRACTOR in writing the deficiencies requiring correction prior to retest. The OWNER reserves the right to have the CONTRACTOR rerun a portion of or the entire operational test until, in the opinion of the ENGINEER, the facilities are completely operational.

C. Final Mechanical Performance Tests

1. Final Mechanical Performance Tests shall cover a continuous two-week period while the facility is in continuous normal operation. During the Final Mechanical Performance Tests, the CONTRACTOR's personnel shall demonstrate, to the satisfaction of the ENGINEER, with OWNER's personnel present, that all equipment is coordinated and operating properly; that all controls, safety features, and alarms operate satisfactorily in coordination with the equipment installed; and that installed equipment complies in all respects mechanically and electrically with applicable Drawings and Specifications. The CONTRACTOR is responsible for mechanical operation of the facilities. The OWNER will be present during the entire test period to provide direction to the CONTRACTOR's personnel in regards to water treatment requirements and plant production rates. Upon completion of the test period, the CONTRACTOR shall be provided with a written list of any operating problems, equipment malfunctions, or other deficiencies related to plant operations. The CONTRACTOR must correct these deficient items and retest the affected system. The retesting shall be performed for a time period sufficient to demonstrate the proper operation of the system. This time period will not exceed two-weeks.

2. After the CONTRACTOR receives from the ENGINEER written acceptance of the Final Mechanical Performance Tests, the CONTRACTOR's responsibilities relative to operation of the facility shall be terminated, and the OWNER will assume the responsibility. The CONTRACTOR shall, however, remain responsible for any further training or extended run-in or adjustment periods for specific pieces of equipment or systems as required by the Specifications.

D. Include costs for the above tests in unit and lump sum price bid for the Project.

PART 2: PRODUCTS

Not applicable to this section.

PART 3: EXECUTION

Not applicable to this section.

End of Section

SECTION 1700

PROJECT CLOSEOUT

PART 1: GENERAL

1.01 TESTING OF FACILITIES

The CONTRACTOR shall produce a first-class job and all Work shall be tested under operating conditions and pressures and any leaks or malfunctions shall be repaired to the satisfaction of the ENGINEER at no additional expense to the OWNER. This provision with reference to leakage shall also apply to water tightness of buildings.

1.02 CLOSEOUT PROCEDURES

Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for ENGINEER's inspection. Provide submittals to ENGINEER that are required by governing or other authorities. Submit Application for final payment identifying total adjusted Contract sum, previous payments, and sum remaining due.

1.03 FINAL CLEANING

Execute final cleaning prior to final inspection. Clean interior and exterior glass and surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces. Clean equipment and fixtures to a sanitary condition. Clean debris from roofs, gutters, downspouts, and drainage systems. Clean site; sweep paved areas, rake clean landscape surfaces. Remove waste and surplus materials, rubbish, and construction facilities from the site.

1.04 PROJECT RECORD DOCUMENTS

Maintain on site, one set of the following record documents; record actual revisions to the Work:

A. contract drawings
B. specifications
C. addenda
D. change orders and other modifications to the Contract
E. reviewed shop drawings, product data, and samples

Store record documents separate from documents used for construction. Record information concurrent with construction progress.

Specifications: Legibly mark and record at each product section description of actual products installed, including the following:

A. manufacturer's name and product model and number
B. product substitutions or alternates utilized
C. changes made by addenda and modifications

Record Documents and Shop Drawings: Legibly mark each item to record actual construction including:

A. Measured depths of foundations in relation to finish floor datum.
B. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
C. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
D. Field changes of dimension and detail.
E. Details not on original Contract Drawings.

Submit documents to ENGINEER with final Application for Payment.

1.05 SPARE PARTS AND MAINTENANCE MATERIALS

A. Provide products, spare parts, maintenance and extra materials in quantities specified in individual specification sections.

B. Deliver to project site and place in location as directed by OWNER; obtain receipt prior to final payment.

1.06 GUARANTEES AND WARRANTIES

The CONTRACTOR expressly warrants that all workmanship and materials performed or furnished under this Contract will conform to the Specifications, Drawings, samples and other applicable descriptions furnished or adopted by the CONTRACTOR and with all applicable laws, provisions and requirements of the Contract Documents. The CONTRACTOR shall remedy any defects due to faulty materials or workmanship which shall appear within a period of one (1) year from the date of acceptance of the work hereunder and pay for any damage to other work resulting therefrom. The OWNER shall give notice of observed defects with reasonable promptness. The CONTRACTOR warranty hereunder is in addition to, and not in limitation of, any obligations found elsewhere in the Contract Documents, any special guarantees provided by the CONTRACTOR or his suppliers, and any obligations imposed by law.

In addition to the above requirements, the CONTRACTOR shall assign material and equipment guarantees and warranties from all manufacturers and suppliers to the OWNER and deliver copies of such guarantees and warranties and the assignments

thereof to the OWNER in order to assure the OWNER of the full benefit of such guarantees and warranties.

1.07 RESTORATION

The CONTRACTOR shall restore and/or replace paving, curbing, sidewalks, gutters, shrubbery, fences, sod or other disturbed surfaces and structures to a condition equal to that before the work began and to the satisfaction of the ENGINEER and shall furnish all labor and materials incidental thereto.

PART 2: PRODUCTS

Not Used.

PART 3: EXECUTION

Not Used.

End of Section

SECTION 02050 - DEMOLITION AND SALVAGE

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall furnish all tools, equipment, materials, and supplies and shall perform all labor, supervision and ancillary services as required for the demolition and removal of equipment, structures, and facilities as shown on the Contract Drawings and as specified.

B. In general, this work shall include, but shall not be limited to, the following items:

1. Clearing, grubbing, stripping and removal of top soil and vegetation.

2. Demolition of asphalt pavement, concrete pads, curbs and gutters, and other features as required to install new piping, equipment, and structures.

3. Demolition, salvage, and removal of existing facilities as shown on the Contract Drawings and as specified.

   This shall include as a minimum the demolition and removal or salvage of equipment, piping, valves, ducts, conduits, wiring, electrical panels, control panels, instrumentation devices, coatings, supports, slabs, windows, roofs, walls as shown on the Contract Drawings or as specified.

C. The requirements of the drawings and General Conditions of the Contract, including Supplemental General Conditions, Special Conditions and Division 1 Specification sections, apply to the work of this Section.

The requirements of the following section(s) also apply to work in this Section:

Section 02200, Earthwork

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. All codes, as referenced herein, are specified in Section 01090, "Reference Standards."

B. All work in connection with demolition and salvage shall be in accordance with applicable local, state, and federal regulations and safety orders, after obtaining required permits and filing required reports.

1.3 DEMOLITION COORDINATION

A. The CONTRACTOR shall carefully coordinate the extent of demolition in areas where existing utilities shall be reconnected to new facilities and where existing facilities equipment shall remain operational. See Section 01313 for sequence of construction and phasing.

B. While work is being performed, the CONTRACTOR shall provide adequate access to all operating equipment and treatment processes for routine operation and maintenance. The CONTRACTOR shall erect and maintain fences, warning signs, barricades, and other devices as required for the protection of the CONTRACTOR's employees and the

OWNER's personnel at the plant. The CONTRACTOR shall remove all such protection when the demolition operations are completed, or as work progresses, or when directed by the ENGINEER.

1.4 CONTRACTOR SUBMITTALS

A. CONTRACTOR submittals shall be in accordance with the requirements of Section 01300 -Contractor Submittals. Demolition and equipment removal procedures, including operational sequence, shall be submitted to the ENGINEER for approval. The procedures shall provide for safe conduct of the WORK, careful removal and disposition of materials and equipment, protection of facilities property which are to remain undisturbed, coordination with existing facilities to remain in service, and timely disconnection of utility services. The procedures shall include a detailed description and time schedule of the methods and equipment to be used for each operation, and the sequence of operation.

1.5 REPAIR OF DAMAGE

A. Any damage to remaining street work improvements, building elements to remain, and other existing facilities to remain, as caused by the CONTRACTOR's operations shall be repaired at the CONTRACTOR's expense.

B. Damaged items shall be repaired or replaced with new materials as required to restore damaged items or surfaces to a condition equal to and matching that existing prior to damage or start of work of this Contract.

C. In buildings with demolition work, the CONTRACTOR shall not use any OWNER equipment (i.e., bridge cranes and monorails) unless authorized in advance in writing by the ENGINEER. Such authorization shall be subject to documentation by the CONTRACTOR of the loading he proposes to place on the equipment, and subject to OWNER requirements for crane use for operating and maintenance needs. Any damage sustained in the use of a crane by the CONTRACTOR shall be repaired or replaced at no cost to the OWNER. The damaged unit shall be repaired or replaced as described above.

1.6 PROTECTION OF EXISTING WORK

A. Before beginning any cutting, trenching or demolition work, the CONTRACTOR shall carefully survey the existing work and examine the Drawings and Specifications to determine the extent of the WORK. The CONTRACTOR shall take all necessary precautions to prevent damage to existing facilities which are to remain in place, and be responsible for any damages to existing facilities, which are caused by the operations. Damages to such work shall be repaired or replaced to its existing condition at no additional cost to the OWNER. The CONTRACTOR shall carefully coordinate the work of this Section with all other work and construct and shall provide shoring, bracing, and supports, as required. The CONTRACTOR shall insure that structural elements are not overloaded and shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under any part of this Contract. The CONTRACTOR shall remove all temporary protection when the work is complete or when so authorized by the ENGINEER.

B. The CONTRACTOR shall carefully consider all bearing loads and capacities for placement of equipment and material on site. In the event of any questions as to whether an area to

be loaded has adequate bearing capacity, the CONTRACTOR shall consult with the ENGINEER prior to the placement of such equipment or material.

1.7 BURNING

A. The use of burning at the project site for the disposal of refuse, debris, and waste materials resulting from demolition and site clearing operations will not be permitted.

1.8 ELECTRICAL DEMOLITION

A. All electrical demolition work shall at all times be conducted by the CONTRACTOR in a safe and proper manner to avoid injury from electrical shock to the OWNER's and CONTRACTOR's personnel. Electrical equipment to be shut off for a period of time shall be tagged, locked out, and sealed with a crimped wire and lead seal and made inoperable. At no time shall live electrical wiring or connections or those which can become energized be accessible to CONTRACTOR, OWNER, or other personnel without suitable protection or warning signs.

1.9 JOB CONDITIONS

A. The OWNER assumes no responsibility for actual condition of the facilities to be demolished. The CONTRACTOR shall visit the site, inspect all facilities, to get familiarized with all existing conditions and utilities.

PART 2 – NOT USED

PART 3 – EXECUTION

3.1 DEMOLITION

A. Disposal of all materials shall be performed in compliance with applicable local, state, and federal codes and requirements. Structures and equipment to be demolished shall be cleaned prior to demolition and the wash water returned to the plant flow. No trace of these structures shall remain prior to placing of backfill in the areas from which structures were removed.

B. The CONTRACTOR shall note that the Drawings used in this Contract to indicate demolition are based on record drawings of the existing facilities. The plans and sections have been reproduced to clarify the scope of work as much as possible. Prior to the submittal of bids, the CONTRACTOR shall conduct a comprehensive survey of the facilities to verify the correctness and exactness of the record drawings, the scope of work, the extent of auxiliary utilities, and the physical and sequencing constraints.

C. The demolition drawings identify the major equipment and structures to be demolished. Auxiliary utilities such as water, air, chemicals, drainage, lubrication oil, hydraulic power fluid, electrical wiring, controls, and instrumentation are not necessarily shown. In association with the major equipment demolition, the following work shall also be performed at no additional cost to the OWNER:

1. All equipment supports, including concrete pads, baseplates, mounting bolts, and support hangers, shall be removed. Any damage to the existing structure shall be repaired as specified.

2. All exposed piping (including vents and drains) and valves shall be removed. Pipe hangers and other supports shall also be removed. Where exposed piping penetrates existing floors and walls, the piping, including wall thimbles, shall be removed to a minimum depth of 2 inches. Holes in the structure shall be repaired as specified.

3. All electrical control panels, junction boxes, motor control centers, and local switches and pushbuttons shall be removed.

4. All exposed electrical conduits and cables shall be removed. All hangers, supports, etc., associated with removal of electrical conduits shall also be removed. All resulting holes in structures shall be repaired as specified.

5. Connections to buried electrical conduits shall be cut a minimum of 2 inches from the finished surface of the existing structure. All wiring shall be removed and the conduits shall be repaired as specified.

6. All associated instrumentation devices shall be removed.

7. All auxiliary utility support systems shall be removed.

8. The area shall be thoroughly cleaned such that little or no evidence of the previous equipment installation will remain.

D. Some of the operating systems or equipment that would be affected by specific demolition work are shown. The CONTRACTOR shall note that this equipment is not all inclusive and is shown for his information only. The CONTRACTOR shall verify the completeness of the equipment affected; coordinate its replacement, relocation, or shutdown, and submit an outage plan in accordance with Section 01300, "Contractor Submittals."

E. Pavement, curbs and gutters shall be removed as necessary to perform the specified work. The limits of removal shall be sawcut. When the required improvements have been constructed, new pavement, curbs and gutters shall be constructed as specified and shown.

F. When existing pipe is removed, the CONTRACTOR shall plug all resulting abandoned connections whether or not shown. Where removed piping is exposed, the remaining piping shall be blind-flanged or fitted with a removable cap or plug.

G. When existing piping is removed from existing structures, the CONTRACTOR shall fill all resulting holes in the structures and repair any damage such that the finished rehabilitated structure shall appear as a new homogeneous unit with little or no indication of where the new and old materials join. The holes in water-bearing structures shall be filled with non-shrink grout to be watertight and reinforced as required, or as shown. In all locations where the surface of the grout will be exposed to view, the non-shrink grout shall be recessed to approximately 1/2-inch back of the exposed surface and the recessed area filled with cement mortar grout.

H. Where existing yard piping is to be abandoned, the CONTRACTOR shall cut back the abandoned pipe for a distance of 5 feet from any connecting structures. All holes at the existing structures shall be repaired. The abandoned pipe shall be capped at both ends prior to backfill.

3.2 STRUCTURE AND PIPING REHABILITATION

A. Certain areas of existing structures, piping, conduits, and the like will be affected by work necessary to complete modifications under this Contract. The CONTRACTOR shall be responsible to rehabilitate those areas affected by his construction activities.

B. Where new rectangular openings are to be installed in concrete or concrete masonry walls or floors, the CONTRACTOR shall score the edges of each opening (both sides of wall or floor slab) by saw cutting clean straight lines to a minimum depth of 1 inch and then chipping out the concrete. Alternately, the sides of the opening (not the corners) can be formed by saw cutting completely through the slab or wall. Saw cuts deeper than 1 inch (or the depth of cover over existing reinforcing steel, whichever is less) shall not be allowed to extend beyond the limits of the opening. Corners shall be made square and true by a combination of core drilling and chipping or grinding. All necessary precautions shall be taken during removal of concrete to prevent debris from falling into or entering adjacent tanks in service or from damaging adjacent equipment or piping. Saw cuts allowed to extend beyond the opening shall be repaired by filling with non-shrink grout. The concrete around any exposed reinforcement steel shall be chipped back and exposed reinforcement steel cut a minimum of 2 inches from the finished face of the new opening and painted with epoxy paint. The inside face of the new opening shall be grouted with an epoxy cement grout to fill any voids and cover the exposed aggregate and shall be trowel-finished to provide a plumb and square opening.

C. When new piping is installed in existing structures, the CONTRACTOR shall accurately position core-drilled openings in the concrete as shown or otherwise required. Openings shall be of sufficient size to permit a final alignment of pipelines and fittings without deflection of any part and to allow adequate space for satisfactory packing where pipe passes through the wall to ensure watertightness around openings so formed. The boxes or cores shall be provided with continuous keyways to hold the filling material in place, and they shall have a slight flare to facilitate grouting and the escape of entrained air during grouting. Before placing the non-shrink grout, concrete surfaces shall be sandblasted, thoroughly cleaned of sand and any other foreign matter, and coated with epoxy bonding compound.

The pipes, castings, or conduits, as specified, shall be grouted in place by pouring in grout under a head of at least 4 inches. The grout shall be poured or rammed or vibrated into place to fill completely the space between the pipes, castings, or conduits, and the sides of the openings so as to obtain the same watertightness as through the wall itself. The grouted casings shall then be water cured.

In all locations where the surface of the grout will be exposed to view, the non-shrink grout shall be recessed to 1/2-inch back of the exposed surface and the recessed area filled with cement mortar grout.

D. When new piping is to be connected to existing piping, the existing piping shall be cut square and ends properly prepared for the connection shown. Any damage to the lining and coating of the existing piping shall be repaired by the CONTRACTOR. Dielectric insulating joints shall be installed at interconnections between new and existing piping.

E. Where existing equipment, equipment pads and bases, piping, piping supports, electrical panels and devices, conduits, and associated appurtenances are removed, the CONTRACTOR shall rehabilitate the affected area such that little or no evidence of the previous installation remains. Openings in concrete floors, walls, and ceilings from piping,

conduit, and fastener penetrations shall be filled with non-shrink grout and finished to match the adjacent area. Concrete pads and bases for equipment and supports shall be removed by chipping away concrete and cutting any exposed reinforced steel and anchor bolts a minimum of 2 inches below finished grade and painted with epoxy paint. The area of concrete to be rehabilitated shall be scored by saw cutting clean, straight lines to a minimum depth of 1-1/2 inches, and all concrete within the scored lines removed to a depth of 1-1/2 inches (or the depth of cover over reinforcing steel, whichever is less). The area within the scored lines shall be patched with non-shrink grout to match the adjacent grade and finish. Abandoned connections to piping and conduits shall be terminated with blind flanges, caps, and plugs suited for the material, type, and service of the pipe or conduit.

F. Existing reinforcement to remain in place shall be protected, cleaned and extended into new concrete. Existing reinforcement not to be retained shall be cut-off as follows:

1. Where new concrete joins existing concrete at the removal line, reinforcement shall be cut-off flush with the concrete surface at the removal line.

2. Where the concrete surface at the removal line is the finished surface, the reinforcement shall be cut back 2 inches below the finished concrete surface, the ends painted with epoxy paint and the remaining holes patched with a cement mortar grout.

G. Where existing handrailing is removed, post embedments and anchors shall be removed and post holes shall be filled with non-shrink grout flush to the floor surface. At the point of continuation of existing handrailing, a new post with rail connections matching the existing handrailing system shall be installed. New posts in existing concrete floors shall be installed in core-drilled socket holes and the annular space between the post and hole filled with non-shrink grout.

H. Where reconstruction activities damage the painting and coating of adjacent or nearby facilities, the damaged areas shall be surface prepared and coated in accordance with Section 09800 - Protective Coating to match the original painting and coating with a compatible system. Surfaces of equipment items that are to be relocated shall be prepared and be coated in accordance with Section 09800 - Protective Coating.

3.3 BELOW-GRADE DEMOLITION

A. Footings, foundation walls, below-grade construction and concrete slabs on grade shall be demolished and removed to a depth which will not interfere with new construction, but not less than 36 inches below existing ground surface or future ground surface, whichever is lower.

B. Below-grade areas and voids resulting from demolition of structures shall be completely filled.

C. All fill and compaction shall be in accordance with Section 02200, "Earthwork."

D. After fill and compaction, surfaces shall be graded to meet adjacent contours and to provide flow to surface drainage structures, or as shown.

3.4 DISPOSAL OF DEMOLISHED MATERIALS

A. Demolition and removal of debris shall be conducted to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities which shall not be closed or obstructed without permission from the OWNER. Alternate routes shall be provided around closed or obstructed traffic ways.

B. Site debris, rubbish, and other materials resulting from demolition operations shall be legally removed from the site and disposed of at the CONTRACTOR's expense. There will be no disposal areas on site.

3.5 SALVAGE

A. Unless specifically identified, when existing equipment and associated electrical control panels or other facilities are removed, they shall be the property of the CONTRACTOR. Materials to be salvaged shall be transported by the CONTRACTOR at the CONTRACTOR's cost to an on-site storage area as designated by the OWNER.

The following list of items shall be carefully removed by the CONTRACTOR and stored as directed by the WATER COMPANY:

1. Vertical Turbine Pumps (2) from Existing Wash Water Waste Holding Tank No. 1

2. Vertical Turbine Pumps (1) from Existing Wash Water Waste Holding Tank No. 2 (other 2 shall be modified and reused.)

3.6 OCCUPANCY AND POLLUTION CONTROL

A. Water sprinkling, temporary enclosures, chutes, and other suitable methods shall be used to limit dust and dirt rising and scattering in the area. Comply with government regulations pertaining to environmental protection in well traveled areas or where it will impede plant operations.

B. Water shall not be used when it creates hazardous or objectionable conditions such as ice, flooding, or pollution.

3.7 PROTECTION

A. Safe passage of persons around area of demolition shall be ensured. Operations shall be conducted to prevent damage to adjacent buildings, structures, or other facilities, and people.

B. Interior and exterior shoring, bracing, or supports shall be provided to prevent movement, settlement or collapse of structures to be demolished, and to adjacent facilities to remain.

C. Existing landscaping materials, structures, and appurtenances, which are not to be demolished shall be protected and maintained as necessary and in accordance with Section 01530, "Protection of Existing Facilities."

3.8 CLEANING

A. During and upon completion of work, the CONTRACTOR shall promptly remove unused tools and equipment, surplus materials, rubbish, debris, and dust and shall leave areas affected by work in a clean, approved condition.

B. Adjacent structures shall be cleaned of dust, dirt, and debris caused by demolition, as directed by the ENGINEER or governing authorities, and adjacent areas returned to condition existing prior to start of work.

- END OF SECTION -

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The WORK of this Section includes measures required during the CONTRACTOR's initial move onto the Site to protect existing fences, houses and associated improvements, streets, and utilities downslope of construction areas from damage due to boulders, trees or other objects dislodged during the construction process; clearing, grubbing and stripping; and regrading of certain areas to receive embankment fill.

1.2 SITE INSPECTION

A. Prior to moving onto the Site, the CONTRACTOR shall inspect the Site conditions and review maps of the existing plant site and off-site pipeline routes and facilities delineating the OWNER's property and right-of-way lines.

PART 2 – PRODUCTS - NOT USED

PART 3 – EXECUTION

3.1 PRIMARY PLANT SITE ACCESS

A. The CONTRACTOR shall develop any necessary access to the Site, including access barriers to prohibit entry of unauthorized persons.

B. **Utility Interference:** Where existing utilities interfere with the WORK, notify the utility owner and the ENGINEER before proceeding in accordance with the General Conditions.

3.2 CLEARING, GRUBBING, AND STRIPPING

A. Construction areas shall be cleared of grass and weeds to at least a depth of six inches and cleared of structures, pavement, sidewalks, concrete or masonry debris, trees, logs, upturned stumps, loose boulders, and any other objectionable material of any kind which would interfere with the performance or completion of the WORK, create a hazard to safety, or impair the subsequent usefulness of the WORK, or obstruct its operation. Loose boulders within 10 feet of the top of cut lines shall be incorporated in landscaping or removed from the Site. Trees and other natural vegetation outside the actual lines of construction shall be protected from damage during construction, as directed by the ENGINEER.

B. Within the limits of clearing, the areas below the natural ground surface shall be grubbed to a depth necessary to remove all stumps, roots, buried logs, and all other objectionable material. Septic tanks, drain fields, and connection lines and any other underground structures, debris or waste shall be removed if found on the Site. All objectionable material from the clearing and grubbing process shall be removed from the Site and wasted in approved safe locations.

C. The entire area to be affected by construction shall be stripped to a depth of 2.5 feet below

the existing ground contours. The stripped materials shall be stockpiled and incorporated into landscaped areas or other non-structural embankments.

D. Unless otherwise indicated, native trees larger than three inches in diameter at the base shall not be removed without the ENGINEER's approval. The removal of any trees, shrubs, fences, or other improvements outside of rights-of-way, if necessary for the CONTRACTOR's choice of means and methods, shall be arranged with the owner of the property, and shall be removed and replaced, at no additional cost to the OWNER.

3.3 OVEREXCAVATION, REGRADING, AND BACKFILL UNDER FILL AREAS

A. After the fill areas have been cleared, grubbed, and excavated, the areas to receive fill will require overexcavation, regrading, and backfill, consisting of the removal and/or stockpiling of undesirable soils. The ground surface shall be recontoured for keying the fill and removing severe or abrupt changes in the topography of the Site. The overexcavated volumes to a level 2.5 feet below the existing ground contours shall be backfilled.

B. Any undesirable topsoil and colluvium shall be removed to the level designated by the ENGINEER and stockpiled for subsequent use as the first material to be placed in the compacted fill.

C. Any steep, very abrupt rock faces and irregularly shaped rock outcrops of bedrock shall be regraded as directed by the ENGINEER.

- END OF SECTION -

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall perform all earthwork indicated and required for construction of the WORK, complete and in place, in accordance with the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

A. The CONTRACTOR shall submit samples of all materials proposed to be used in the work in accordance with the requirements in Section 01300 - Contractor Submittals. Sample sizes shall be as determined by the testing laboratory.

PART 2 – PRODUCTS

2.1 SUITABLE FILL AND BACKFILL MATERIAL REQUIREMENTS

A. **General:** Fill, backfill, and embankment materials shall be suitable selected or processed clean, fine earth, rock, or sand, free from grass, roots, brush, or other vegetation.

B. Fill and backfill materials to be placed within 6 inches of any structure or pipe shall be free of rocks or unbroken masses of earth materials having a maximum dimension larger than 3 inches.

C. **Suitable Materials:** Materials not defined as unsuitable below are defined as suitable materials and may be used in fills, backfilling, and embankment construction subject to the indicated limitations. In addition, when acceptable to the ENGINEER, some of the material listed as unsuitable may be used when thoroughly mixed with suitable material to form a stable composite.

D. Suitable materials may be obtained from on-site excavations, may be processed on-site materials, or may be imported. If imported materials are required by this Section or to meet the quantity requirements of the project the CONTRACTOR shall provide the imported materials at no additional expense to the OWNER, unless a unit price item is included for imported materials in the bidding schedule.

E. The following types of suitable materials are defined:

1. Type A (three-quarters inch minus granular backfill): Crushed rock or gravel, and sand with the gradation requirements below. The material shall have a minimum sand equivalent value of 28 and a minimum R-value of 78. If the sand equivalent value exceeds 35 the R-value requirement is waived.

Sieve Size	Percentage Passing
3/4-inch	100
No. 4	30 - 50
No. 200	0 - 12

2. Type B (Class I crushed stone): Manufactured angular, crushed stone, crushed rock, or crushed slag with the following gradation requirements. The material shall have a minimum sand equivalent value of 75.

Sieve Size	Percentage Passing
3/4-inch	100
No. 4	30 - 50
No. 200	0 - 5

3. Type C (sand backfill): Sand with 100 percent passing a 3/8-inch sieve, at least 90 percent passing a Number 4 sieve, and a sand equivalent value not less than 30.

4. Type D: Not used

5. Type E (pea gravel backfill): Crushed rock or gravel with 100 percent passing a 1/2-inch sieve and not more than 10 percent passing a Number 4 sieve.

6. Type F (coarse drainrock): Crushed rock or gravel meeting the following gradation requirements:

Sieve Size	Percentage Passing
2-inch	100
1-1/2-inch	90 - 100
1-inch	20 - 55
3/4-inch	0 - 15
No. 200	0 - 3

7. Type G (aggregate base): Crushed rock aggregate base material of such nature that it can be compacted readily by watering and rolling to form a firm, stable base for pavements. At the option of the CONTRACTOR, the grading for either the 1-1/2-inch maximum size or 3/4-inch maximum size gradation shall be used. The sand equivalent value shall be not less than 22, and the material shall meet the following gradation requirements:

	Percentage Passing	
Sieve Size	1-1/2-inch Max. Gradation	3/4-inch Max. Gradation
2-inch	100	-
1-1/2-inch	90 - 100	-
1-inch	-	100
3/4-inch	50 - 85	90 - 100
No. 4	25 - 45	35 - 55
No. 30	10 - 25	10 - 30
No. 200	2 - 9	2 - 9

8. Type H (graded drainrock): Drainrock shall be crushed rock or gravel, durable and free from slaking or decomposition under the action of alternate wetting or drying. The material shall be uniformly graded and shall meet the following gradation requirements:

Sieve Size	Percentage Passing
1-inch	100
3/4-inch	90 - 100
3/8-inch	40 - 100
No. 4	25 - 40
No. 8	18 - 33
No. 30	5 - 15
No. 50	0 - 7
No. 200	0 - 3

The drainrock shall have a sand equivalent value not less than 75. The finish graded surface of the drainrock immediately beneath hydraulic structures shall be stabilized to provide a firm, smooth surface upon which to construct reinforced concrete floor slabs. The CONTRACTOR shall use, at its option, one of the asphalt types listed below:

	Type 1	Type 2	Type 3
Designation	SC-800	SC-250	RS-1
Spray Temperature (°F)	175-255	165-200	70-120
Coverage (gal/sq yd)	0.50	0.50	0.50

If the surface remains tacky, sufficient sand shall be applied to absorb the excess asphalt.

9. Type I: Any other suitable material as defined herein.

10. Type J (cement-treated backfill): Material which consists of Type H material, or any mixture of Types B, C, G, and H materials which has been cement-treated so that the cement content of the material is not less than 5 percent by weight when tested in accordance with ASTM D 2901 - Standard Test Method for Cement Content of Freshly Mixed Soil Cement. The ultimate compressive strength at 28 days shall be not less than 400 psi when tested in accordance with ASTM D 1633 - Standard Test Method for Compressive Strength of Molded Soil - Cement Cylinders.

11. Type K (topsoil): Stockpiled topsoil material which has been obtained at the site by removing soil to a depth not exceeding 2 feet. Removal of the topsoil shall be done after the area has been stripped of vegetation and debris.

12. Type L (controlled low strength material): Controlled low strength material shall be in accordance with Section 02210 - Controlled Low Strength Material.

13. Type M (aggregate subbase): Crushed rock aggregate subbase material that can be compacted readily by watering and rolling to form a firm stable base. The sand equivalent value shall be not less than 18 and the material shall meet the following gradation requirements:

Sieve Size	Percentage Passing
3-inch	100
2-1/2 inch	87 - 100
No. 4	35 - 95

14. Type N (trench plug): Low permeable fill material, a non-dispersible clay material having a minimum plasticity index of 10.

2.2 UNSUITABLE MATERIAL

A. Unsuitable materials include the materials listed below.

1. Soils which, when classified under ASTM D 2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System), fall in the classifications of Pt, OH, CH, MH, or OL.

2. Soils which cannot be compacted sufficiently to achieve the density specified for the intended use.

3. Materials that contain hazardous or designated waste materials including petroleum hydrocarbons, pesticides, heavy metals, and any material which may be classified as hazardous or toxic according to applicable regulations.

4. Soils that contain greater concentrations of chloride or sulfate ions, or have a soil resistivity or pH less than the existing on-site soils.

5. Topsoil, except as allowed below.

2.3 SPECIAL BACKFILL

A. All sand, crushed stone or gravel shall be clean, free from dust, loam, clay, perishable matter or any other unsuitable material in quantities which would render the special backfill unsuitable.

1. Special Backfill as Pipe Bedding under, around and 12-inches above pipe shall be as follows:

Ductile Iron, Steel and Concrete Pipe - Crushed Stone (AASHTO Size No. 57) or gravel.

PVC and Copper Pipe - Crushed Stone (Size No. 8) or sand.

2. Special Backfill as Backfill from 12-inches above pipe to subgrade of roadways and to underside of structures; or where indicated on the Contract Drawings shall be as follows:

Gravel or crushed stone such as limestone screenings (Size No. 10) or Aggregate Base meeting the requirements of the Kentucky Transportation Cabinet, Division of Highway's Design Manual, Chapter 61-06.

3. Special Backfill as Foundation Cushion under footings and floor slab; under flexible asphalt concrete pavement - roadways; or where indicated on the Contract Drawings.

B. The use of other types of backfill materials will not be allowed without prior approval by the ENGINEER. The use of slag products is prohibited.

2.4 USE OF FILL, BACKFILL, AND EMBANKMENT MATERIAL TYPES

A. The CONTRACTOR shall use the types of materials as designated herein for all required fill, backfill, and embankment construction hereunder.

B. Where these Specifications conflict with the requirements of any local agency having jurisdiction or with the requirements of a pipe material manufacturer, the ENGINEER shall be immediately notified. In case of conflict between types of pipe embedment backfills, the CONTRACTOR shall use the agency-specified backfill material if that material provides a greater degree of structural support to the pipe, as determined by the ENGINEER. In case of conflict between types of trench or final backfill types, the CONTRACTOR shall use the agency-specified backfill material if that material provides the greater in-place density after compaction.

C. Fill and backfill types shall be used in accordance with the following provisions:

1. Embankment fills shall be constructed of Type I material, as defined herein, or any mixture of Type I and Type A through Type H materials.

2. Pipe zone backfill, as defined under "Pipe and Utility Trench Backfill" below, shall consist of the following materials for each pipe material listed below.

a. Mortar coated pipe, concrete pipe, and un-coated ductile iron pipe shall be provided Type A or B pipe bedding and embedment backfill material.

b. Coal tar enamel coated pipe, polyethylene encased pipe, tape wrapped pipe, and other non-mortar coated pipe shall be backfilled with Type C bedding and embedment zone backfill material.

c. Plastic pipe and vitrified clay pipe shall be backfilled with Type B bedding and embedment zone backfill material. Vitrified clay pipe shall be backfilled with Type B material to the top of the pipe zone.

d. Where pipelines are installed on grades exceeding 4 percent, and where backfill materials are graded such that there is less than 10 percent passing a Number 4 sieve, trench plugs of Type J, L, or N material shall be provided at maximum intervals of 200 feet unless indicated otherwise.

3. Trench zone backfill for pipelines as defined under "Pipe and Utility Trench Backfill" shall be Type I backfill material or any of Types A through H backfill materials or any mixture thereof, except:

a. Type K material may be used for trench zone backfill in agricultural areas unless otherwise shown or specified.

4. Final backfill material for pipelines under paved areas, as defined under "Pipe and Utility Trench Backfill" shall be Type G backfill material. Final backfill under areas not paved shall be the same material as that used for trench backfill, except that Type K material shall be used for final backfill in agricultural areas unless otherwise indicated.

5. Trench backfill and final backfill for pipelines under structures shall be the same material as used in the pipe zone, except where concrete encasement is required by the Contract Documents.

6. Aggregate base materials under pavements shall be Type G material constructed to the thicknesses indicated. Aggregate subbase shall be Type M material.

7. Backfill around structures shall be Type I material, or Types A through Type H materials, or any mixture thereof, except as shown.

8. Backfill materials beneath structures shall be as follows:

   a. Drainrock materials under hydraulic structures or other water retaining structures with underdrain systems shall be Type H material.

   b. Under concrete hydraulic structures or other water retaining structures without underdrain systems, Types G or H materials shall be used.

   c. Under structures where groundwater must be removed to allow placement of concrete, Type F material shall be used. Before the Type F material is placed, filter fabric shall be placed over the exposed foundation.

   d. Under all other structures, Type G or H material shall be used.

9. Backfill used to replace pipeline trench over-excavation shall be a layer of Type F material with a 6-inch top filter layer of Type E material or filter fabric to prevent migration of fines for wet trench conditions or the same material as used for the pipe zone backfill if the trench conditions are not wet.

10. The top 6 inches of fill on reservoir roofs, embankment fills around hydraulic structures, and all other embankment fills shall consist of Type K material, topsoil.

11. Filter fabric shall be **Mirafi 140 N or Mirafi 700X.**

2.5 MATERIALS TESTING

A. All soils testing of samples submitted by the CONTRACTOR will be done by a testing laboratory of the OWNER'S choice and at the OWNER'S expense. At its discretion, the ENGINEER may request that the CONTRACTOR supply samples for testing of any material used in the work.

B. Particle size analysis of soils and aggregates will be performed using ASTM D 422 - Standard Test Method for Particle-Size Analysis of Soils.

C. Determination of sand equivalent value will be performed using ASTM D 2419 - Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.

D. **Unified Soil Classification System:** References in this Section to soil classification types and standards shall have the meanings and definitions indicated in ASTM D 2487. The CONTRACTOR shall be bound by all applicable provisions of said ASTM D 2487 in the interpretation of soil classifications.

PART 3 – EXECUTION

3.1 EXCAVATION - GENERAL

A. **General:** Except when specifically provided to the contrary, excavation shall include the removal of all materials of whatever nature encountered, including all obstructions of any nature that would interfere with the proper execution and completion of the WORK. The removal of said materials shall conform to the lines and grades indicated or ordered. Unless otherwise indicated, the entire construction site shall be stripped of all vegetation and debris, and such material shall be removed from the site prior to performing any excavation or placing any fill. The CONTRACTOR shall furnish, place, and maintain all supports and shoring that may be required for the sides of the excavations. Excavations shall be sloped or otherwise supported in a safe manner in accordance with applicable State safety requirements and the requirements of OSHA Safety and Health Standards for Construction (29CFR1926).

B. Removal and Exclusion of Water: The CONTRACTOR shall remove and exclude water, including stormwater, groundwater, irrigation water, and wastewater, from all excavations. Dewatering wells, wellpoints, sump pumps, or other means shall be used to remove water and continuously maintain groundwater at a level at least two feet below the bottom of excavations before the excavation work begins at each location. Water shall be removed and excluded until backfilling is complete and all field soils testing has been completed.

C. There shall be no onsite waste disposal area and all excess excavation shall be removed from the site and disposed of in a legal manner. This removal of extra excavation shall be at no extra cost to the OWNER.

3.2 STRUCTURE, ROADWAY, AND EMBANKMENT EXCAVATION

A. **Excavation Beneath Structures and Embankments:** Except where otherwise indicated for a particular structure or ordered by the ENGINEER, excavation shall be carried to the grade of the bottom of the footing or slab. Where indicated or ordered, areas beneath structures or fills shall be over-excavated. The subgrade areas beneath embankments shall be excavated to remove not less than the top 6 inches of native material and where such subgrade is sloped, the native material shall be benched. When such over-excavation is indicated, both over-excavation and subsequent backfill to the required grade shall be performed by the CONTRACTOR. When such over-excavation is not indicated but is ordered by the ENGINEER, such over-excavation and any resulting backfill will be paid for under a separate unit price bid item if such bid item has been established; otherwise payment will be made in accordance with a negotiated price. After the required excavation or over-excavation has been completed, the exposed surface shall be scarified to a depth of 6 inches, brought to optimum moisture content, and rolled with heavy compaction equipment to obtain 95 percent of maximum density.

B. **Excavation Beneath Concrete Reservoirs:** Excavation under reservoirs shall extend to the bottom of the drainrock layer. After such excavation has been completed, the exposed surface shall be rolled with heavy compaction equipment to 95 percent of maximum density and then graded to provide a reasonably smooth surface for placement of the drainrock. Areas under the reservoir upon which fill is to be placed shall be scarified to a depth of 6 inches, brought to optimum moisture content, and compacted to obtain 95 percent of maximum density.

C. **Excavation Beneath Paved Areas:** Excavation under areas to be paved shall extend to the bottom of the aggregate base or subbase, if such base is called for; otherwise it shall extend to the paving thickness. After the required excavation has been completed, the top 12 inches of exposed surface shall be scarified, brought to optimum moisture content, and rolled with heavy compaction equipment to obtain 95 percent of maximum density. The finished subgrade shall be even, self-draining, and in conformance with the slope of the finished pavement. Areas that could accumulate standing water shall be regraded to provide a self-draining subgrade.

D. **Notification of ENGINEER:** The CONTRACTOR shall notify the ENGINEER at least 3 days in advance of completion of any structure excavation and shall allow the ENGINEER a review period of at least one day before the exposed foundation is scarified and compacted or is covered with backfill or with any construction materials.

3.3 PIPELINE AND UTILITY TRENCH EXCAVATION

A. Exploratory Excavation

1. The CONTRACTOR shall excavate and expose buried points of connection to existing utilities where indicated on the Drawings. Excavation shall be performed prior to preparation of Shop Drawings for connections and before fabrication of pipe, and the data obtained shall be used in preparing Shop Drawings.

2. Data, including dates, locations excavated, and sketches, shall be submitted to the ENGINEER within one week of excavation.

3. Damage to utilities from excavation activities shall be repaired by the CONTRACTOR at no additional cost to the OWNER.

B. **General:** Unless otherwise indicated or ordered, excavation for pipelines and utilities shall be open-cut trenches with widths as indicated.

C. **Trench Bottom:** Except when pipe bedding is required, the bottom of the trench shall be excavated uniformly to the grade of the bottom of the pipe bedding. Excavations for pipe bells and welding shall be made as required.

D. **Open Trench:** The maximum amount of open trench permitted in any one location shall be 500 feet, or the length necessary to accommodate the amount of pipe installed in a single day, whichever is greater. All trenches shall be fully backfilled at the end of each day or, in lieu thereof, shall be covered by heavy steel plates adequately braced and capable of supporting vehicular traffic in those locations where it is impractical to backfill at the end of each day. The above requirements for backfilling or use of steel plate will be waived in cases where the trench is located further than 100 feet from any travelled roadway or occupied structure. In such cases, however, barricades and warning lights meeting safety requirements shall be provided and maintained.

E. **Trench Over-Excavation:** Where trenches are indicated to be over-excavated, excavation shall be to the depth indicated, and backfill shall be installed to the grade of the bottom of the pipe bedding.

F. **Over-Excavation:** When ordered by the ENGINEER, whether indicated on the Drawings or not, trenches shall be over-excavated beyond the depth and/or width shown. Such

over-excavation shall be to the dimensions ordered. The trench shall then be backfilled to the grade of the bottom of the pipe bedding. Over-excavation less than 6 inches below the limits on the Drawings shall be done at no increase in cost to the OWNER. When the over-excavation ordered by the ENGINEER is 6 inches or greater below the limits shown, or wider, additional payment will be made to the CONTRACTOR. Said additional payment will be made under separate unit price bid items for over-excavation if such bid items have been established; otherwise payment will be made in accordance with a negotiated price.

G. Where pipelines are to be installed in embankments, fills, or structure backfills, the fill shall be constructed to a level at least one foot above the top of the pipe before the trench is excavated.

H. If a moveable trench shield is used during excavation operations, the trench width shall be wider than the shield so that the shield is free to be lifted and then moved horizontally without binding against the trench sidewalls. If the trench walls cave in or slough, the trench shall be excavated as an open excavation with sloped sidewalls or with trench shoring, as indicated and as required by the pipe structural design.

3.4 OVER-EXCAVATION NOT ORDERED OR INDICATED

A. Any over-excavation carried below the grade ordered or indicated, shall be backfilled to the required grade with the indicated material and compaction. Such work shall be performed by the CONTRACTOR at no additional cost to the OWNER.

3.5 EXCAVATION IN LAWN AREAS

A. Where excavation occurs in lawn areas, the sod shall be carefully removed, dampened, and stockpiled to preserve it for replacement. Excavated material may be placed on the lawn; provided, that a drop cloth or other suitable method is employed to protect the lawn from damage. The lawn shall not remain covered for more than 72 hours. Immediately after completion of backfilling and testing of the pipeline, the sod shall be replaced and lightly rolled in a manner so as to restore the lawn as near as possible to its original condition. CONTRACTOR shall provide new sod if stockpiled sod has not been replaced within 72 hours.

3.6 EXCAVATION IN VICINITY OF TREES

A. Except where trees are indicated to be removed, trees shall be protected from injury during construction operations. No tree roots over 2 inches in diameter shall be cut without express permission of the ENGINEER. Trees shall be supported during excavation by any means previously reviewed by the ENGINEER.

3.7 ROCK EXCAVATION

A. Explosives and Blasting

1. Blasting will not be permitted.

3.8 BACKFILL - GENERAL

A. Backfill shall not be dropped directly upon any structure or pipe. Backfill shall not be placed around or upon any structure until the concrete has attained sufficient strength to withstand the loads imposed. Backfill around water retaining structures shall not be placed until the structures have been tested, and the structures shall be full of water while backfill is being placed.

B. Except for drainrock materials being placed in over-excavated areas or trenches, backfill shall be placed after all water is removed from the excavation, and the trench sidewalls and bottom have been dried to a moisture content suitable for compaction.

C. If a moveable trench shield is used during excavation, pipe installation, and backfill operations, the shield shall be moved by lifting the shield free of the trench bottom or backfill and then moving the shield horizontally, The CONTRACTOR shall not drag trench shields along the trench causing damage or displacement to the trench sidewalls, the pipe, or the bedding and backfill.

D. Immediately prior to placement of backfill materials, the bottoms and sidewalls of trenches and structure excavations shall have all loose sloughing, or caving soil and rock materials removed. Trench sidewalls shall consist of excavated surfaces that are in a relatively undisturbed condition before placement of backfill materials.

E. Special backfill as backfill shall be placed moistened and compacted in layers. The compacted density shall be not less than 95% of the maximum dry density of the material being placed.

F. Compacted special backfill as foundation cushion shall be placed, moistened and compacted in 6" layers until the density is not less than 95% of the maximum dry density of the material being placed. The placing of this material shall be continued until the required depth is placed, and the top of the cushion shall be finished to the lines and grades shown on the Contract Drawings. No foundation material shall be placed on frozen subbase.

G. The CONTRACTOR shall supply backfill material in the event that the onsite material is not suitable. This backfill material shall be supplied by the CONTRACTOR to the OWNER at no extra cost to the OWNER.

3.9 PLACING AND SPREADING OF BACKFILL MATERIALS

A. Backfill materials shall be placed and spread evenly in layers. When compaction is achieved using mechanical equipment, the layers shall be evenly spread so that when compacted each layer shall not exceed 6 inches in thickness.

B. During spreading, each layer shall be thoroughly mixed as necessary to promote uniformity of material in each layer. Pipe zone backfill materials shall be manually spread around the pipe so that when compacted the pipe zone backfill will provide uniform bearing and side support.

C. Where the backfill material moisture content is below the optimum moisture content, water shall be added before or during spreading until the proper moisture content is achieved.

D. Where the backfill material moisture content is too high to permit the specified degree of

compaction the material shall be dried until the moisture content is satisfactory.

3.10 COMPACTION OF FILL, BACKFILL, AND EMBANKMENT MATERIALS

A. Each layer of Types A, B, C, G, H, I, and K backfill materials as defined herein, where the material is graded such that at least 10 percent passes a No. 4 sieve, shall be mechanically compacted to the indicated percentage of density. Equipment that is consistently capable of achieving the required degree of compaction shall be used and each layer shall be compacted over its entire area while the material is at the required moisture content.

B. Each layer of Type E, F, and J backfill materials shall be compacted by means of at least 2 passes from a flat plate vibratory compactor. When such materials are used for pipe zone backfill, vibratory compaction shall be used at the top of the pipe zone or at vertical intervals of 24 inches, whichever is the least distance from the subgrade.

C. Fill on reservoir and structure roofs shall be deposited at least 30 days after the concrete roof slab has been placed. Equipment weighing more than 10,000 pounds when loaded shall not be used on a roof. A roller weighing not more than 8,000 pounds shall be used to compact fill on a roof.

D. Flooding, ponding, or jetting shall not be used for fill on roofs, backfill around structures, backfill around reservoir walls, for final backfill materials, or aggregate base materials.

E. Equipment weighing more than 10,000 pounds shall not be used closer to walls than a horizontal distance equal to the depth of the fill at that time. Hand operated power compaction equipment shall be used where use of heavier equipment is impractical or restricted due to weight limitations.

F. Backfill around and over pipelines that is mechanically compacted shall be compacted using light, hand operated, vibratory compactors and rollers. After completion of at least two feet of compacted backfill over the top of pipeline, compaction equipment weighing no more than 8,000 pounds may be used to complete the trench backfill.

G. **Compaction Requirements:** The following compaction test requirements shall be in accordance with ASTM D 1557 - Test Method for Laboratory Compaction Characteristics of Soils Using Modified Effort (56,000 ft - lbf/ft^3) (2,700 kN-m/m^3) for Type A, B, C, G, H, I, K, M, and N materials and in accordance with ASTM D 4253 - Standard Test Method for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table, and D 4254 - Standard Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density, for Type B, E, F, and J materials. Where agency or utility company requirements govern, the highest compaction standards shall apply.

Location or Use of Fill	Percentage of Maximum Density	Percentage of Relative Density
Pipe embedment backfill for flexible pipe.	95	70
Pipe bedding and over-excavated zones under bedding for flexible pipe, including trench plugs.	95	70
Pipe embedment backfill for Steel Yard Piping	---	70

Pipe embedment backfill for rigid pipe	90	55
Pipe zone backfill portion above embedment for rigid pipe.	95	70
Pipe bedding and over-excavated zones under bedding for rigid pipe.	95	70
Final backfill, beneath paved areas or structures.	95	70
Final backfill, not beneath paved areas or structures.	90	55
Trench zone backfill, beneath paved areas and structures, including trench plugs.	95	70
Trench zone backfill, not beneath paved areas or structures, including trench plugs.	95	70
Embankments and fills.	90	55
Embankments and fills beneath paved areas or structures.	95	70
Backfill beneath structures and hydraulic structures.	95	70
Backfill and fill around structures on reservoir or structure roof.	90	55
Topsoil (Type K material)	80	N.A.

Location or Use of Fill	Percentage of Maximum Density	Percentage of Relative Density
Aggregate base or subbase (Type G or M material)	95	N.A.

3.11 PIPE AND UTILITY TRENCH BACKFILL

A. Pipe Zone Backfill

2. The pipe zone is defined as that portion of the vertical trench cross-section lying between a plane below the bottom surface of the pipe and a plane at a point above the top surface of the pipe as indicated. The bedding is defined as that portion of pipe zone backfill material between the trench subgrade and the bottom of the pipe. The embedment is defined as that portion of the pipe zone backfill material between

the bedding and a level line as indicated.

3. After compacting the bedding the CONTRACTOR shall perform a final trim using a stringline for establishing grade, such that each pipe section when first laid will be continually in contact with the bedding along the extreme bottom of the pipe. Excavation for pipe bells and welding shall be made as required.

4. The pipe zone shall be backfilled with the indicated backfill material. The CONTRACTOR shall exercise care to prevent damage to the pipeline coating, cathodic bonds, and the pipe itself during the installation and backfill operations.

5. If a moveable trench shield is used during backfill operations the shield shall be lifted to a location above each layer of backfill material prior to compaction of the layer. The CONTRACTOR shall not displace the pipe or backfill while the shield is being moved.

B. **Trench Zone Backfill:** After the pipe zone backfills have been placed, backfilling of the trench zone may proceed. The trench zone is defined as that portion of the vertical trench cross-section lying as indicated between a plane above the top surface of the pipe and a plane at a point 18 inches below the finished surface grade, or if the trench is under pavement, 18 inches below the roadway subgrade.

C. **Final Backfill:** Final backfill is all backfill in the trench cross-sectional area within 18 inches of finished grade, or if the trench is under pavement, all backfill within 18 inches of the roadway subgrade.

3.12 FILL AND EMBANKMENT CONSTRUCTION

A. The area where a fill or embankment is to be constructed shall be cleared of all vegetation, roots and foreign material. Following this, the surface shall be moistened, scarified to a depth of 6 inches, and rolled or otherwise mechanically compacted. Embankment and fill material shall be placed and spread evenly in approximately horizontal layers. Each layer shall be moistened or aerated, as necessary. Unless otherwise approved by the ENGINEER, each layer shall not exceed 6 inches of compacted thickness. The embankment, fill, and the scarified layer of underlying ground shall be compacted to 95 percent of maximum density under structures and paved areas, and 90 percent of maximum density elsewhere.

B. When an embankment or fill is to be made and compacted against hillsides or fill slopes steeper than 4:1, the slopes of hillsides or fills shall be horizontally benched to key the embankment or fill to the underlying ground. A minimum of 12 inches normal to the slope of the hillside or fill shall be removed and re-compacted as the embankment or fill is brought up in layers. Material thus cut shall be re-compacted along with the new material at no additional cost to the OWNER. Hillside or fill slopes 4:1 or flatter shall be prepared in accordance with Paragraph A, above.

C. Where embankment or structure fills are constructed over pipelines, the first 4 feet of fill over the pipe shall be constructed using light placement and compaction equipment that does not damage the pipe. Heavy construction equipment shall maintain a minimum distance from the edge of the trench equal to the depth of the trench until at least 4 feet of fill over the pipe has been completed.

3.13 FIELD TESTING

A. **General:** All field soils testing will be done by a testing laboratory of the OWNER's choice at the OWNER's expense except as indicated below.

B. Where soil material is required to be compacted to a percentage of maximum density, the maximum density at optimum moisture content will be determined in accordance with Method C of ASTM D 1557. Where cohesionless, free draining soil material is required to be compacted to a percentage of relative density, the calculation of relative density will be determined in accordance with ASTM D 4253 and D 4254. Field density in-place tests will be performed in accordance with ASTM D 1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method, ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place By Nuclear Methods (Shallow Depth), or by such other means acceptable to the ENGINEER.

C. In case the test of the fill or backfill show non-compliance with the required density, the CONTRACTOR shall accomplish such remedy as may be required to insure compliance. Subsequent testing to show compliance shall be by a testing laboratory selected by the OWNER and shall be at no additional cost to the OWNER.

D. The CONTRACTOR shall provide test trenches and excavations including excavation, trench support, and groundwater removal for the OWNER'S field soils testing operations. The trenches and excavations shall be provided at the locations and to the depths required by the OWNER. All WORK for test trenches and excavations shall be provided at no additional cost to the OWNER.

- END OF SECTION -

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide erosion control barriers, complete and in place, in accordance with the Contract Documents

1.2 CONTRACTOR SUBMITTALS

A. Submittals shall be in accordance with Section 01300 - Contractor Submittals:

B. **Product Data:** Manufacturer's catalog sheets on geotextile fabrics.

PART 2 – PRODUCTS

2.1 FABRIC

A. Fabric may be woven or non-woven, made from polypropylene, polyethylene, or polyamid, and shall contain sufficient UV inhibitors so that it will last for 2 years in outdoor exposure.

B. Fabric shall have the following properties:

Parameter	Standard Method	Value
Grab tensile strength	ASTM D 4632	100 lb
Burst strength	ASTM D 3786	200 psi
Apparent opening size	ASTM D 4751	Between 200 and 70 sieve size

C. Fabric Manufacturer:

Mirafi

2.2 POSTS

A. Posts shall be wood, at least 2 inches by 2 inches, at least 6 feet long.

2.3 FENCING

A. Woven wire fabric fencing shall be galvanized, mesh spacing of 6 inches, maximum 14-gauge, at least 30 inches tall.

2.4 FASTENERS

A. Fasteners to wood posts shall be steel, at least 1 1/2 inches long.

PART 3 – EXECUTION

3.1 PREPARATION

A. Provide erosion control barriers at the indicated locations and as required to prevent erosion and silt loss from the Site.

B. CONTRACTOR shall not commence clearing, grubbing, earthwork, or other activities which may cause erosion until barriers are in place.

3.2 INSTALLATION

A. Barrier systems shall be installed in such a manner that surface runoff will percolate through the system in sheet flow fashion and allow sediment to be retained and accumulated.

B. Attach the woven wire fencing to the posts that are spaced a maximum of 6 feet apart and embedded a minimum of 12 inches. Install posts at a slight angle toward the source of the anticipated runoff.

C. Trench in the toe of the filter fabric barrier with a spade or mechanical trencher so that the downward face of the trench is flat and perpendicular to the direction of flow. Lay fabric along the edges of the trench. Backfill and compact.

D. Securely fasten the fabric materials to the woven wire fencing with tie wires.

E. Reinforced fabric barrier shall have a height of 18 inches.

F. Provide the filter fabric in continuous rolls and cut to the length of the fence to minimize the use of joints. When joints are necessary, splice the fabric together only at a support post with a minimum 6-inch overlap and seal securely.

3.3 MAINTENANCE

A. Regularly inspect and repair or replace damaged components of the barrier. Unless otherwise directed, maintain the erosion control system until final acceptance; then remove erosion and sediment control systems promptly.

B. Remove sediment deposits when silt reaches a depth of 6 inches or 1/2 the height of the barrier, whichever is less. Dispose of sediments on the Site, if a location is indicated on the Drawings, or at a site arranged by the CONTRACTOR which is not in or adjacent to a stream or floodplain.

- END OF SECTION -

PART 1 — GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall furnish materials for and install all drilled, cast-in-place concrete piers, where required by the Contract Documents, including all dowels and other appurtenances necessary to make a complete installation.

1.2 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of other requirements of these Specifications, all work specified herein shall conform to or exceed the requirements of he Building Code and the applicable requirements of the following documents to the extent that the provisions of such documents are not in conflict with the requirements of this Section.

B. References herein to "Building Code" or BOCA shall mean the, BOCA National Building Code 1996. The latest edition of the codes, as adopted as of the date of award by the agency having jurisdiction, shall apply to the work herein.

C. All work specified herein shall conform to Report of Geotechnical Exploration Section 5.2.1 Drilled Shafts (Caissons) by Fuller, Mossbarger, Scott and May Engineers, Inc. (FMSM).

D. **Commercial Standards:**

1. Industry Guidelines for Specification and Inspection of Drilled Shafts by a Committee of ADSC.

2. Standards and Specifications of the Foundation Drilling Industry, by the ADSC: An International Association of Drilling Contractors.

3. Standard Specification for the Construction of End Bearing Drilled Piers (AC1 336.1-79).

4. AWS Structural Welding Code D1.1-1994 and "Standard Qualification Procedure."

1.3 CONTRACTOR SUBMITTALS

A. The CONTRACTOR shall submit shop drawings for all items needed to install the piers in accordance with these Specifications, including, but not limited to, concrete mix design, rebar, and casings.

B. The CONTRACTOR shall submit a detailed description of procedures and equipment intended to be employed, including details of excavation, dewatering (if needed), soil removal, placement of reinforcement, and placement of concrete.

C. If welding of steel casings is needed, the CONTRACTOR shall submit welding procedures and qualifications of welders, in accordance with AWS D1.1-1994 for structural steel.

1.4 DEFINITIONS

A. In the Contract Documents, where the terms "pier" (in reference to items below grade), "drilled pier," and "foundation pier" are used, they shall have equivalent meaning.

PART 2 — PRODUCTS

2.1 MATERIALS

A. **Concrete:** Concrete shall be structural concrete in accordance with Section 03310, "Cast-in-Place concrete," provided the requirements of Part 3 of this Section are satisfied.

B. **Reinforcement Steel:** All reinforcement steel shall be in accordance with Section 03200, "Reinforcement Steel."

C. **Structural Steel Casing:** Structural steel casing, where needed, shall be a minimum of 3/16-inch thick, ASTM A36 steel. Casings shall be smooth. No corrugated casing shall be permitted.

D. **Fiber Form Casing:** Fiber form casings shall be **Sono-tube.**

PART 3 — EXECUTION

3.1 SEQUENCING AND SCHEDULING

A. The CONTRACTOR shall schedule the drilling, placement of reinforcement steel, and placement of concrete, so that each excavated shaft is poured immediately after drilling is complete, and reinforcement steel has been placed and approved. All drilled holes shall be filled with concrete within 48 hours of drilling, unless a structural steel casing is provided for the full depth of the shaft.

B. Drilled holes shall be protected against any entrance of water or other debris by sandbagging, covering, or other means proposed by the CONTRACTOR. No drilling shall be permitted during periods of rainfall.

C. Excessive wheel loads and surface vibration shall not be allowed within the immediate vicinity of any drilled hole or freshly placed concrete.

D. As-built drawings shall be furnished by the contractor to verify the location of the piers before the placements of the slabs.

E. The CONTRACTOR shall pay for the inspection and the verification of sound bedrock by an inspector. The inspector shall produce reports of all findings and verifications.

3.2 EXCAVATION

A. Pier excavation shall be made by drilling. Required depths of piers shown on drawings are approximate. Piers shall extend a minimum of 2 pier diameters into weathered shale bedrock. Adequate depth of excavation shall be determined by the ENGINEER.

B. During foundation construction, a 2.0-inch diameter percussion test hole shall be drilled to a depth of 5 feet or two shaft diameters (whichever is greater) below proposed

bearing elevation to verify the soundness of the underlying rock and to identify any weathered shale zones, clay seams and voids that might have and adverse affect upon the foundation support. Each hole shall be inspected be the inspector. Prior to the placement of concrete, the bottom of the drilled holes shall be clean and free of debris. Bottom surfaces shall be flat and level.

C. The maximum variation in the center of any drilled pier from plumb shall be 6 inches. The maximum variation in location of any drilled pier at the ground surface shall be 3 inches. If the actual pier location does not allow a minimum of 4 inches between the edge of the pier and the edge of the concrete foundation element at the top of the pier, the CONTRACTOR shall be responsible for modifying the foundation element to provide a minimum 4-inch edge distance.

D. Prior to drilling, the design center of each pier shall be located by survey, the use of off-set stakes and intersecting string lines. Stake locations shall be preserved until pier construction has been inspected and completed.

E. In the event that any caving in of the drilled holes should occur over any portion of the length of the drilled hole, a structural steel casing shall be provided for the entire length of that pier, up to 10 feet from the top of the pier.

F. Drilling mud or chemical stabilizers shall not be used, except as permitted by the ENGINEER.

G. The CONTRACTOR shall provide suitable light for inspecting the drilled holes. Each hole shall be inspected by the ENGINEER prior to placing concrete.

3.3 REINFORCEMENT STEEL ASSEMBLY AND PLACEMENT

A. Reinforcement steel cages may be shop- or field-assembled. If not shop assembled, the cages shall be fully assembled at grade, prior to placement. Care shall be taken in placing the reinforcement cage not to disturb the sides of the excavation.

B. Each reinforcement steel cage shall be secured in place symmetrically about the centerline axis of the pier and blocked to stay clear of the walls of the excavation. Cages shall be securely held in place through the placement of concrete.

3.4 CONCRETE PLACEMENT

A. Concrete may be placed using the following methods.

1. Concrete shall be as specified in Section 03310 "Cast-in-Place Concrete." Placement shall be performed using a tremie tube or pump tube, with a maximum of 4 feet of concrete free fall. The concrete shall be vibrated the entire length of the shaft, in accordance with these Specifications.

B. Concrete tests shall be performed in accordance with Section 03310 "Cast-in-Place Concrete".

C. Curing shall be in accordance with "Method 2" in Section 03310, "Cast-in-Place Concrete."

D. Concrete shall not be placed into the piers under wet conditions

- END OF SECTION -

SECTION 02460 - ROADWAYS, PARKING AREAS, AND SIDEWALKS

PART 1 – GENERAL

1.1 WORK INCLUDED

A. The CONTRACTOR shall furnish and install, at the locations shown on the Contract Drawings, as specified or as directed, all asphalt concrete roadways and parking areas, asphalt resurfacing and concrete sidewalks required for the proper completion of the work included under this CONTRACT.

B. In general, this work shall include furnishing all materials and constructing the asphalt concrete roadways and parking areas, asphalt resurfacing and concrete sidewalks, together with all subgrade preparation, stone fill as permitted, all materials, rolling, tamping, filling and binding of materials, roadway underdrains, placing of reinforcing, placing and finishing the concrete walks and all necessary labor, tools, materials and appurtenances.

C. It is the intent of this CONTRACT that the installation shall be complete in all respects and ready for use and operation. The CONTRACTOR will be responsible for all incidental details, and for any special construction necessary to complete the work in an acceptable manner.

D. In order to minimize erosion and sediment runoff, roadways, parking areas, and sidewalks shall be paved or otherwise stabilized as soon as possible.

E. All paving is to be done at the end of the project. Any damaged areas prior to acceptance are to be restored including clean-up, all at no additional cost to the OWNER.

F. The requirements of Section 02200 – Earthwork and 03200 – Reinforcing Steel Bars, apply to the WORK of this section.

1.2 CONTRACTOR SUBMITTALS

A. The CONTRACTOR shall submit, in writing, materials testing reports, job-mix formulas, and other pertinent information satisfactory to the ENGINEER demonstrating that materials and methods CONTRACTOR proposes to utilize will comply with the provisions of this Section. Submittals shall be in accordance with Section 01300, "Contractor Submittals."

B. **Suitability Tests of Proposed Materials:** Tests for conformance with the Specifications shall be performed prior to start of the WORK. The samples shall be identified to show the name of the material, aggregate source, name of the supplier, contract number, and the segment of the WORK where the material represented by the sample is to be used. Results of all tests shall be submitted to the ENGINEER for approval. Materials to be tested shall include aggregate base, coarse and fine aggregate for paving mixtures, mineral filler, and asphalt cement.

C. **Trial Batch:** Before placing any paving material, a testing laboratory acceptable to the ENGINEER shall prepare a trial batch of asphalt concrete for each job-mix formula to be used by the CONTRACTOR for the work. The trial batch shall be prepared using the aggregates and asphalt cement proposed by the CONTRACTOR, and approved by the

ENGINEER. The compacted trial batch shall provide a basis for computing the voids ratio, provide an indication of the optimum asphalt content, and establish a basis for controlling compaction during construction. The cost of not more than two laboratory trial batch tests will be borne by the OWNER but the CONTRACTOR shall furnish the materials at no cost. Any additional trial batch testing required shall be performed at the expense of the CONTRACTOR.

PART 2 – PRODUCTS

2.1 Construction and materials shall meet the requirements of the referenced items of the Kentucky Transportation Cabinet, Division of Highway's Design Manual, Chapter 61-06.

PART 3 – EXECUTION

3.1 The CONTRACTOR shall construct flexible asphalt concrete pavement according to the table below. The CONTRACTOR shall submit for approval the Job Mix Formula (JMF) for the asphalt concrete pavement in accordance with the requirements of the Kentucky Transportation Cabinet.

A. **Asphalt Concrete Pavement:**

Material	Minimum Thickness
Aggregate Base	12"
Bituminous Aggregate Base (No. 57 stone)	6"
Bituminous Prime Coat	0.4 Gal./Sq. Yd.
Asphalt Wearing Surface	3"

B. **Subgrade:** The entire area to be occupied by the roadway shall be cleared, and the excavation or compacted fill made as required and brought to the proper cross-sections, as shown on the Contract Drawings. Pipe trenches and other excavations shall be backfilled to the top of the subgrade as required with special backfill material, and thoroughly compacted within the limits of the roadways and parking areas. After the surface of the subgrade has been properly shaped, and before any stone is placed, the entire subgrade shall be thoroughly rolled and compacted. Rolling shall be done with an approved type of self-propelled roller, weighing not less than ten (10) tons. All hollows and depressions which develop during the rolling shall be filled with acceptable material, and the subgrade rerolled. The process of filling and rolling shall be repeated until no depressions develop, and the entire subgrade has been brought to a uniform condition of stability. All places which, in the opinion of the ENGINEER, cannot be properly rolled, shall be tamped with hand tampers weighing not less than eighty (80) pounds per square foot of tamping surface. In making the compacted fill and in doing the final subgrade rolling, the CONTRACTOR shall see that the material to be compacted and/or rolled has the proper moisture content to secure maximum compaction. The subgrade shall be compacted to 95% standard proctor. During the process of construction, the road bed shall be maintained in such condition that it will be well-drained at all times.

C. Gradation of the aggregate base should be the same or coarser than the lower gradation limits of Kentucky Transportation Cabinet Division of Highway's Design Manual. In addition, the granular base should contain less than five (5) percent by weight passing the U.S. No. 200 sieve. For the aggregate base course and the bituminous aggregate base course slag will not be permitted.

D. **Asphalt Concrete:** At the time of delivery to the Work site, the temperature of mixture shall not be lower than 260 degrees F or higher than 320 degrees F, the lower limit to be approached in warm weather and the higher in cold weather.

1. Asphalt concrete shall not be placed when the atmospheric temperature is below 40 degrees F or during unsuitable weather.

2. The asphalt concrete shall be evenly spread upon the subgrade or base to such a depth that, after rolling, it will be of the specified cross section and grade of the course being constructed.

3. The depositing, distributing, and spreading of the asphalt concrete shall be accomplished in a single, continuous operation by means of a self-propelled mechanical spreading and finishing machine designed specially for that purpose. The machine shall be equipped with a screed or strike-off assembly capable of being accurately regulated and adjusted to distribute a layer of the material to a definite pre-determined thickness. When paving is of a size or in a location that use of a self-propelled machine is impractical the ENGINEER may waive the self-propelled requirement. Spreading, once commenced, must be continued without interruption.

4. The mix shall be compacted immediately after placing. Initial rolling with a steel-wheeled tandem roller, steel three-wheeled roller, vibratory roller, or a pneumatic-tired roller shall follow the paver as closely as possible. If needed, intermediate rolling with a pneumatic-tired roller shall be done immediately behind the initial rolling. Final rolling shall eliminate marks from previous rolling. In areas too small for the roller a vibrating plate compactor or a hand tamper shall be used to achieve thorough compaction.

5. Upon completion the pavement shall be true to grade and cross-section. When a 10-ft straightedge is laid on the finished surface parallel to the center of the roadway, the surface shall not vary from the edge of the straightedge more than 1/8-in except at intersections or changes of grade. In the transverse direction, the surface shall not vary from the edge of the straightedge more than 1/4-in.

6. The relative density after compaction shall be 95 percent of the density obtained by using ASTM D 1188 or D 2726. A properly calibrated nuclear asphalt testing device shall be used for determining the field density of compacted asphalt concrete, or slabs or cores may be laboratory tested in accordance with ASTM D 1188.

3.2 CONCRETE WALKS

A. The CONTRACTOR shall construct all the concrete walks, as shown on the Contract Drawings, including reinforcing, foundation materials and joint fillers.

B. The excavation or embankment for the walks shall be brought to a point slightly above the required subgrade, after which the earth shall be thoroughly compacted, by rolling with a roller, not less than three (3) feet long and weighing at least two hundred (200) pounds per

lineal foot. The foundation shall be trimmed smoothly and evenly to the exact subgrade. In case soft or spongy earth or other unsuitable materials are encountered in the foundation, they shall be removed and the space filled in with suitable material, placed in layers not over eight (8) inches in thickness, each layer being thoroughly compacted by rolling or ramming.

C. The concrete walks shall be not less than six (6) inches thick, placed on a two (2) inch minimum course of gravel, and of cross sections indicated on the Contract Drawings. The two (2) inch course shall be thoroughly rolled, as specified for subgrade. Concrete walks shall be reinforced with wire mesh, as detailed on the Contract Drawings. Wire mesh shall conform to all of the requirements of Section 03200, but shall be furnished and installed under this Section.

D. The top of the concrete walk shall have a crown or slope, as shown on the Contract Drawings, and shall be hand tamped and finished with a wood float. The concrete walk shall be laid by means of metal forms at least three-sixteenths (3/16) inch in thickness, and all edges shall be finished with a one-quarter (1/4) inch rounding tool. Surface shall be scored at intervals equal to the walk width.

E. A one-half (1/2) inch joint, of elastic expansion joint filler shall be provided at least once every fifty (50) feet in length of the walk, where the walk abuts a building or structure, and wherever else shown or required.

3.2 PAVEMENT MARKING

A. Pavement marking paint shall be applied where shown only when the pavement surface is dry and clear, and when the air temperature is above 40 degrees F. All equipment used in the application of pavement marking shall produce stripes and markings of uniform quality with clean and well-defined edges that conform to the details and dimensions shown. Drips, overspray, improper markings and paint material tracked by traffic shall be immediately removed from the pavement surface by methods previously reviewed by the ENGINEER.

- END OF SECTION -

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide double cement lined ductile iron pipe and all appurtenant work, complete in place, in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **Commercial Standards:**

ANSI/AWWA C104/A21.4	Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
ANSI/AWWA C105/A21.5	Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids
ANSI/AWWA C110/A21.10	Ductile-Iron and Gray-Iron Fittings, 3 in Through 48 in for Water and Other Liquids
ANSI/AWWA C111/A21.11	Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings
ANSI/AWWA C115/A21.15	Flanged Ductile-Iron and Gray-Iron Pipe with Threaded Flanges
ANSI/AWWA C150/A21.50	Thickness Design of Ductile-Iron Pipe
ANSI/AWWA C151/A21.51	Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids
ANSI/AWWA C153/A21.53	Ductile-Iron Compact Fittings, 3 in. Through 12 in. for Water and Other Liquids
AWWA C209	Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines
AWWA C214	Tape Coating Systems for the Exterior of Steel Water Pipelines
AWWA C600	Installation of Ductile Iron Water Mains and Their Appurtenances
ASTM C 150	Specification for Portland Cement

1.3 CONTRACTOR SUBMITTALS

A. **Shop Drawings:** The CONTRACTOR shall submit shop drawings of pipe and fittings in accordance with the requirements in Section 01300, "Contractor Submittals," the

requirements of the referenced standards and the following supplemental requirements as applicable:

1. Certified dimensional drawings of all valves, fittings, and appurtenances.

2. For pipe 24 inches in diameter and larger, line layout and marking diagrams which indicate the specific number of each fitting and the location and the direction of each fitting in the completed line. In addition, the line layouts shall include: the pipe station and invert elevation at all changes in grade or horizontal alignment; all elements of curves and bends, both in horizontal and vertical alignment; and the limits of each reach of restrained joints, or of concrete encasement.

B. **Certifications:** The CONTRACTOR shall furnish a certified affidavit of compliance for all pipe and other products or materials furnished under this Section of the Specifications, as specified in the referenced standards and the following supplemental requirements:

1. Physical and chemical properties.

2. Hydrostatic test reports.

C. All expenses incurred in making samples for certification of tests shall be borne by the CONTRACTOR.

1.4 QUALITY ASSURANCE

A. **Inspection:** All pipe shall be subject to inspection at the place of manufacture in accordance with the provisions of the referenced standards, as supplemented by the requirements herein. The CONTRACTOR shall notify the ENGINEER in writing of the manufacturing starting date not less than 14 calendar days prior to the start of any phase of the pipe manufacture.

B. During the manufacture of the pipe, the ENGINEER shall be given access to all areas where manufacturing is in process and shall be permitted to make all inspections necessary to confirm compliance with the Specifications.

C. **Tests:** Except as modified herein, all materials used in the manufacture of the pipe shall be tested in accordance with the requirements of the referenced standards as applicable.

D. The CONTRACTOR shall perform said material tests at no additional cost to the OWNER. The ENGINEER shall have the right to witness all testing conducted by the CONTRACTOR; provided, that the CONTRACTOR'S schedule is not delayed for the convenience of the ENGINEER.

E. In addition to those tests specifically required, the ENGINEER may request additional samples of any material including lining and coating samples for testing by the OWNER. The additional samples shall be furnished at no additional cost to the OWNER.

PART 2 – PRODUCTS

2.1 GENERAL

A. Double cement lined ductile iron pipe shall conform to ANSI/AWWA C151 and C214,

subject to the following supplemental requirements. The pipe shall be of the diameter and class shown, shall be furnished complete with rubber gaskets as indicated in the Contract Documents, and all specials and fittings shall be provided as required under the Contract Documents.

B. **Markings:** The CONTRACTOR shall legibly mark specials 24 inches in diameter and larger in accordance with the laying schedule and marking diagram. All fittings shall be marked at each end with top field centerline.

C. **Handling and Storage:** The pipe shall be handled by devices acceptable to the ENGINEER, designed and constructed to prevent damage to the pipe coating/exterior. The use of equipment which might injure the pipe coating/exterior will not be permitted. Stockpiled pipe shall be suitably supported and shall be secured to prevent accidental rolling. All other pipe handling equipment and methods shall be acceptable to the ENGINEER.

D. **Laying Lengths:** Maximum pipe laying lengths shall be 20 ft with shorter lengths provided as required by the Drawings.

E. **Finish:** The pipe shall have smooth dense interior surfaces and shall be free from fractures, excessive interior surface crazing and roughness.

F. **Closures and Correction Pieces:** Closures and correction pieces shall be provided as required so that closures may be made due to different headings in the pipe laying operation and so that correction may be made to adjust the pipe laying to conform to pipe stationing shown on the Drawings. The locations of correction pieces and closure assemblies are shown on the Drawings. Any change in location or number of said items shall be acceptable to the ENGINEER.

2.2 PIPE DESIGN CRITERIA

A. **General:** Ductile iron pipe shall be designed in accordance with the requirements of ANSI/AWWA C150 as applicable and as modified in this Section.

B. **Pipe Wall Thickness for Internal Pressure:** The pipe shall be designed with a net thickness to withstand the design pressure in accordance with the hoop stress formula.

C. **Pipe Wall Thickness for External Load:** The pipe shall also be designed with a net thickness to withstand internal loads using ANSI/AWWA C150 Design Equation (2) with the appropriate bending moment and deflection coefficients for Laying Condition Types 4 and 5 as applicable.

D. The pipe deflection shall be checked using ANSI/AWWA C150 Design Equation (3) and the coefficients stated above. The allowable deflection shall not exceed 0.0225 times the nominal diameter.

E. In lieu of ANSI/AWWA C150 Design Equation (4), the earth loads will be computed using the following 2 equations for trench or embankment loading as applicable:

1. Trench Condition:

$$W_d = C_d w B_d^2$$

Where: W_d = Earth Load in pounds per linear foot
C_d = Calculation Coefficient
Ku' = [0.13]
w = [120] lb/ft^3
B_d = Trench width at top of pipe, feet

2. Positive Projecting Embankment Condition:

$$W_c = C_c w B_c^2$$

Where: W_c = Earth Load in pounds per linear foot
C_c = Calculation Coefficient (based on $r_{sd}P$ of 0.25)
Ku = [0.19]
w = [120] lb/ft^3
B_c = Outside diameter of pipe, feet

F. The above 2 formulas are based on a depth of cover of 10 feet or greater. For depths of cover of less than 10 feet, HS-20 live load shall be included. For depths of cover of 3 feet or less, HS-20 live load plus impact shall be included. The determination of live load and impact factors shall be as recommended by AASHTO in "Standard Specifications for Highway Bridges."

G. If the calculated deflection, $Defl_x$, exceeds 0.0225 times the nominal diameter, the pipe class shall be increased.

H. **Minimum Pipe Wall Thickness:** In addition to the requirements of this Section, the minimum wall thickness shall be in accordance with Table 50.5 of ANSI/AWWA C150.

2.3 MATERIALS

A. **Ductile Iron Pipe:** Pipe materials shall conform to the requirements of ANSI/AWWA C151.

B. **Cement:** Cement for mortar lining shall conform to the requirements of ANSI/AWWA C104; provided, that cement for mortar lining shall be Type II or V. Cement shall not originate from kilns which burn metal-rich hazardous waste fuel, nor shall a fly ash or pozzolan be used as a cement replacement.

2.4 SPECIALS AND FITTINGS

A. Fittings for ductile iron pipe shall conform to the requirements of ANSI/AWWA C153/A21.53 or ANSI/AWWA C110/A21.10 for diameters 3-inch through 48-inch and shall have a minimum pressure rating of 250 psi. Ductile iron fittings larger than 48-inch shall conform to the above referenced standard with the necessary modifications for the larger size.

2.5 DESIGN OF PIPE

A. **General:** The pipe furnished shall be ductile iron pipe, mortar-lined.

B. The pipe shall be designed, manufactured, tested, inspected, and marked according to applicable requirements previously stated and except as hereinafter modified, shall conform to ANSI/AWWA C151.

C. **Pipe Dimensions:** The pipe shall be of the diameter and class shown. The minimum wall thickness for each pipe size shall be as specified or shown.

D. **Fitting Dimensions:** The fittings shall be of the diameter and class shown.

E. **Joint Design:** Ductile iron pipe and fittings shall be furnished with mechanical joints, push-on joints, flanged joints, and restrained joints as required. Restrained joints shall be used on all buried yard piping except gravity drain piping.

1. Mechanical and push-on joints shall conform to ANSI/AWWA C111/A21.11.

2. Flanged joints shall conform to ANSI/AWWA C115/A21.15.

3. Restrained joints shall be **"Flex-Ring" Restrained Joint by American Ductile Iron Pipe or "TR FLEX" Restrained Joint by U.S. Pipe, or Clow Super Lock Joint by Clow Water Systems Company.** The use of restrained joints utilizing a friction type connection shall be prohibited.

F. For bell-and-spigot ends with rubber gaskets, the clearance between the bells and spigots shall be such that when combined with the gasket groove configuration and the gasket itself, will provide watertight joints under all operating conditions when properly installed. The CONTRACTOR shall require the pipe manufacturer to submit details complete with significant dimensions and tolerances and also to submit performance data indicating that the proposed joint has performed satisfactorily under similar conditions. In the absence of a history of field performance, the results of a test program shall be submitted.

G. Shop-applied interior linings and exterior coatings shall be held back from the ends of the pipe as shown or as otherwise acceptable to the ENGINEER.

2.6 CEMENT-MORTAR LINING

A. **Cement-Mortar Lining for Shop Application:** Except as otherwise provided herein, interior surfaces of all ductile iron pipe, fittings, and specials shall be cleaned and double lined in the shop with cement-mortar lining applied centrifugally in conformity with ANSI/AWWA C104. During the lining operation and thereafter, the pipe shall be maintained in a round condition by suitable bracing or strutting. The lining machines shall be of a type that has been used successfully for similar work. Every precaution shall be taken to prevent damage to the lining. If lining is damaged or found faulty at delivery site, the damaged or unsatisfactory portions shall be replaced with lining conforming to these Specifications.

B. The minimum lining thickness shall be as follows:

Nominal Pipe Diameter (in)	Minimum Lining Thickness (in)
3-12	1/4
14-24	3/8
30-54	1/2

C. **Protection of Pipe Lining/Interior:** All shop-applied cement mortar lining shall be given a seal coat of asphaltic material in conformance with ANSI/AWWA C104.

2.7 EXTERIOR COATING OF PIPE

A. **Exterior Coating of Exposed Piping:** The exterior surfaces of pipe which will be exposed to the atmosphere inside structures or above ground shall be thoroughly cleaned and then given a shop coat of rust-inhibitive primer conforming to the requirements of Section 09800, "Protective Coating."

B. **Exterior Coating of Buried Piping:** The exterior coating shall be an asphaltic coating approximately 1 mil thick.

PART 3 – EXECUTION

3.1 INSTALLATION OF PIPE

A. **Handling and Storage:** All pipe, fittings, etc., shall be carefully handled and protected against damage, impact shocks, and free fall. All pipe handling equipment shall be acceptable to the ENGINEER. Pipe shall not be placed directly on rough ground but shall be supported in a manner which will protect the pipe against injury whenever stored at the trench site or elsewhere. No pipe shall be installed where the lining or coating show defects that may be harmful as determined by the ENGINEER. Such damaged lining or coating shall be repaired, or a new undamaged pipe shall be furnished and installed.

B. All pipe damaged prior to Substantial Completion shall be repaired or replaced by the CONTRACTOR.

C. The CONTRACTOR shall inspect each pipe and fitting prior to installation to insure that there are no damaged portions of the pipe.

D. Before placement of pipe in the trench, each pipe or fitting shall be thoroughly cleaned of any foreign substance, which may have collected thereon and shall be kept clean at all times thereafter. For this purpose, the openings of all pipes and fittings in the trench shall be closed during any interruption to the WORK.

E. **Pipe Laying:** The pipe shall be installed in accordance with ANSI/AWWA C600.

F. Pipe shall be laid directly on the bedding material. No blocking will be permitted, and the bedding shall be such that it forms a continuous, solid bearing for the full length of the pipe. Excavations shall be made as needed to facilitate removal of handling devices after the pipe is laid. Bell holes shall be formed at the ends of the pipe to prevent point loading at the bells or couplings. Excavation shall be made as needed outside the normal trench section at field joints to permit adequate access to the joints for field connection operations and for application of coating on field joints.

G. Each section of pipe 24 inches in diameter and larger shall be laid in the order and position shown on the laying schedule. In laying pipe, it shall be laid to the set line and grade, within approximately one inch plus or minus. On grades of zero slope, the intent is to lay to grade.

H. Where necessary to raise or lower the pipe due to unforeseen obstructions or other causes, the ENGINEER may change the alignment and/or the grades. Such change shall be made by the deflection of joints, by the use of bevel adapters, or by the use of additional fittings. However, in no case shall the deflection in the joint exceed the

maximum deflection recommended by the pipe manufacturer. No joint shall be misfit any amount which will be detrimental to the strength and water tightness of the finished joint.

I. Except for short runs which may be permitted by the ENGINEER, pipes shall be laid uphill on grades exceeding 10 percent. Pipe which is laid on a downhill grade shall be blocked and held in place until sufficient support is furnished by the following pipe to prevent movement. All bends shall be properly installed as shown.

J. **Cold Weather Protection:** No pipe shall be installed upon a foundation into which frost has penetrated or at any time that there is a danger of the formation of ice or penetration of frost at the bottom of the excavation. No pipe shall be laid unless it can be established that the trench will be backfilled before the formation of ice and frost occurs.

K. **Pipe and Specials Protection:** The openings of all pipe and specials shall be protected with suitable bulkheads to prevent unauthorized access by persons, animals, water or any undesirable substance. At all times, means shall be provided to prevent the pipe from floating.

L. **Pipe Cleanup:** As pipe laying progresses, the CONTRACTOR shall keep the pipe interior free of all debris. The CONTRACTOR shall completely clean the interior of the pipe of all sand, dirt, mortar splatter and any other debris following completion of pipe laying, pointing of joints and any necessary interior repairs prior to testing and disinfecting the completed pipeline.

3.2 RUBBER GASKETED JOINTS

A. **Rubber Gasketed Joints:** Immediately before jointing pipe, the bell end of the pipe shall be thoroughly cleaned, and a clean rubber gasket lubricated with an approved vegetable-based lubricant shall be placed in the bell groove. The spigot end of the pipe shall be carefully cleaned and lubricated with a vegetable-based lubricant. The spigot end of the pipe section shall then be inserted into the bell of the previously laid joint and telescoped into its proper position. Tilting of the pipe to insert the spigot into the bell will not be permitted.

3.3 POLYETHYLENE SLEEVE UNBONDED COATING

A. Buried ductile iron pipe shall be polyethylene encased in accordance with the requirements of ANSI/AWWA C105/A21.5.

3.4 INSTALLATION OF PIPE APPURTENANCES

A. **Protection of Appurtenances:** Where the joining pipe is tape-coated, buried appurtenances shall be coated with cold-applied tape in accordance with ANSI/AWWA C209, Type II. Where pipe is encased in polyethylene sleeves, buried appurtenances shall also be encased in polyethylene.

B. **Installation of Valves:** All valves shall be handled in a manner to prevent any injury or damage to any part of the valve. All joints shall be thoroughly cleaned and prepared prior to installation. The CONTRACTOR shall adjust all stem packing and operate each valve prior to installation to insure proper operation. All valves shall be installed so that the valve stems are plumb and in the location shown.

- END OF SECTION -

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall perform flushing and testing of all pipelines and appurtenant piping and disinfection of all pipelines and appurtenant piping for potable water, complete, in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **Commercial Standards:**

ANSI/AWWA B300	Hypochlorites.
ANSI/AWWA B301	Liquid Chlorine.
ANSI/AWWA C651	Disinfecting Water Mains.

1.3 CONTRACTOR SUBMITTALS

A. A proposed plan and schedule for water conveyance, cleaning, pressure testing, disinfection, and water disposal shall be submitted in writing for approval a minimum of 48 hours before testing is to start. The plan shall demonstrate that personnel are experienced and prepared to resolve problems which may arise.

PART 2 – PRODUCTS

2.1 MATERIALS REQUIREMENTS

A. All test equipment, chemicals for chlorination, temporary valves, bulkheads, or other water control equipment and materials shall be selected and furnished by the CONTRACTOR subject to the ENGINEER's review. No materials shall be used which would be injurious to the construction or its future function.

B. Chlorine for disinfection may be in the form of liquid chlorine, sodium hypochlorite solution, or calcium hypochlorite granules or tablets.

C. Liquid chlorine shall be in accordance with the requirements of ANSI/AWWA B301. Liquid chlorine shall be used only:

1. In combination with appropriate gas flow chlorinators and ejectors;

2. Under the direct supervision of an experienced technician;

3. When appropriate safety practices are observed.

D. Sodium hypochlorite and calcium hypochlorite shall be in accordance with the

requirements of ANSI/AWWA B300.

PART 3 – EXECUTION

3.1 GENERAL

A. Unless otherwise indicated, water for testing and disinfecting water pipelines will be furnished by the OWNER; however, the CONTRACTOR shall make all necessary provisions for conveying the water from the OWNER-designated source to the points of use.

B. All pressure pipelines shall be tested.

C. Disinfection shall be accomplished by chlorination. All chlorinating and testing operations shall be performed in the presence of the ENGINEER.

D. Disinfection operations shall be scheduled by the CONTRACTOR as late as possible during the contract time period so as to assure the maximum degree of sterility of the facilities at the time the WORK is accepted by the OWNER. Bacteriological testing shall be performed by a certified testing laboratory approved by the OWNER and at the expense of the CONTRACTOR. Results of the bacteriological testing shall be satisfactory to the State Department of Health or other appropriate regulatory agency.

3.2 PIGGING

A. The CONTRACTOR shall clean the system thoroughly by pigging to remove sand, grit, gravel, stones, fluids, construction waste, and all material which would not be found in a properly cleaned pipeline. Pigging shall obtain a smooth interior pipe surface free from any material or fluid not used in cleaning.

B. Pigging shall be defined as passage of a sufficient number of pigs through the pipeline to achieve the clean conditions above. Flushing will not be acceptable as a substitute for pigging.

C. Provision for pig access and egress points and disposal of water and materials shall be the CONTRACTOR's responsibility.

D. Pigs shall be individually marked and their location shall be controlled and monitored so that no pigs remain in the system after cleaning.

E. Pigging may be done in conjunction with initial filling for the hydrostatic test.

3.3 HYDROSTATIC TESTING OF PIPELINES

A. Prior to hydrostatic testing, pipelines shall be flushed or blown out as appropriate. The CONTRACTOR shall test all pipelines either in sections or as a unit. No section of the pipeline shall be tested until all field-placed concrete or mortar has attained an age of 14 days. The test shall be made by closing valves when available, or by placing temporary bulkheads in the pipe and filling the line slowly with water. The CONTRACTOR shall be responsible for ascertaining that all test bulkheads are suitably restrained to resist the

thrust of the test pressure without damage to, or movement of, the adjacent pipe. Any unharnessed sleeve-type couplings, expansion joints, or other sliding joints shall be restrained or suitably anchored prior to the test, to avoid movement and damage to piping and equipment. The CONTRACTOR shall provide sufficient temporary air tappings in the pipelines to allow for evacuation of all entrapped air in each pipe segment to be tested. After completion of the tests, such taps shall be permanently plugged. Care shall be taken to see that all air vents are open during filling.

B. The pipeline shall be filled at a rate which will not cause any surges or exceed the rate at which the air can be released through the air valves at a reasonable velocity and all the air within the pipeline shall be properly purged. After the pipeline or section thereof has been filled, it shall be allowed to stand under a slight pressure for at least 24 hours to allow the concrete or mortar lining, as applicable, to absorb what water it will and to allow the escape of air from any air pockets. During this period, bulkheads, valves, and connections shall be examined for leaks. If leaks are found, corrective measures satisfactory to the ENGINEER shall be taken.

C. The hydrostatic test shall consist of holding the test pressure on the pipeline for a period of 4 hours. The test pressure for distribution and transmission pipelines shall be 125 percent of the pipe pressure class indicated, measured at the highest point of the pipeline section being tested. The test pressure for yard piping shall be as indicated on the Piping Schedule measured at the lowest point of the pipeline section being tested. No pressure test will be required for a reservoir overflow line. All visible leaks shall be repaired in a manner acceptable to the ENGINEER.

D. The maximum allowable leakage for distribution and transmission pipelines shall be according to the following formula:

$$L = S \times D \times P^{1/2} / 133{,}200$$

where:
L = leakage (gallons per hour)
S = length (feet), the lessor of the actual length being tested or the maximum length for determining leakage. Maximum length for determining leakage is 2000 feet.
D = pipe diameter (inches)
P = test pressure (psi)

E. The maximum leakage for yard piping shall be as shown on the Piping Schedule. Pipe with welded joints shall have no leakage.

F. Pipelines that fail to pass the prescribed leakage test will be considered defective WORK, and the CONTRACTOR shall determine the cause of the leakage, shall take corrective measures necessary to repair the leaks, and shall retest the pipelines.

3.4 DISINFECTING PIPELINES

A. **General:** All potable water pipelines except those appurtenant to hydraulic structures shall be disinfected in accordance with the requirements of ANSI/AWWA C651 using the Continuous-Feed Method as modified herein.

B. **Chlorination:** A chlorine-water solution shall be uniformly introduced into the pipeline by means of a solution-feed chlorinating device. The chlorine solution shall be introduced at

one end of the pipeline through a tap in such a manner that as the pipeline is filled with water, the concentration in the water entering the pipe is approximately 50 mg/l. Care shall be taken to prevent the strong chlorine solution in the pipeline being disinfected from flowing back into the line supplying the water.

C. **Retention Period:** Chlorinated water shall be retained in the pipeline long enough to destroy all non-spore-forming bacteria. This period shall be at least 24 hours. After the chlorine-treated water has been retained for the required time, the free chlorine residual at the pipeline extremities and at other representative points shall be at least 25 mg/l.

D. **Chlorinating Valves:** During the process of chlorinating the pipelines, all valves and other appurtenances shall be operated while the pipeline is filled with the heavily-chlorinated water.

E. **Sampling Ports:** The CONTRACTOR shall provide sampling ports along the pipeline as defined on AWWA C651. Taps may be made at manways and air valves to help facilitate the spacing requirement.

F. **Final Flushing:** After the applicable retention period, the heavily chlorinated water shall be flushed from the pipeline until chlorine measurements show that the concentration in the water leaving the pipeline is no higher than that generally prevailing in the system or is acceptable for domestic use. If there is any question that the chlorinated discharge will cause damage to the environment, a reducing agent shall be applied to the water to neutralize thoroughly the chlorine residual remaining in the water.

G. **Bacteriological Testing:** After final flushing and before the pipeline is placed in service, a sample, or samples shall be collected from the end of the line, and shall be tested for bacteriological quality in accordance with the requirements of the State Department of Health or other appropriate regulatory agency. For this purpose the pipe shall be re-filled with fresh potable water and left for a period of 24 hours before any sample is collected. Should the initial disinfection treatment fail to produce satisfactory bacteriological test results, the disinfection procedure shall be repeated until acceptable results are obtained.

3.5 CONNECTIONS TO EXISTING SYSTEM

A. Where connections are to be made to an existing potable water system, the interior surfaces of all pipe and fittings used in making the connections shall be swabbed or sprayed with a one percent hypochlorite solution before they are installed. Thorough flushing shall be started as soon as the connection is completed and shall be continued until discolored water is eliminated.

- END OF SECTION -

PART 1 — GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall perform all the landscaping and all appurtenant work, complete, in accordance with the requirements of the Contract Documents.

B. In general, this work shall include the restoration of grass areas disturbed by construction, but not be limited to the following work: topsoil, soil preparation, planting of seed, fertilizing, weed control, finish grading, furnishing and installing of materials, cleanup, maintenance and guarantee.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **Federal Specifications:**

FS O-F-241D	Fertilizer, Mixed, Commercial

B. **Commercial Standards:**

ANSI/ASTM D 422	Method for Particle-Size Analysis of Soils
ANSI Z60.1	Nursery Stock
American Association of Nurserymen, Inc.	Rules and Grading Provisions

1.3 CONTRACTOR SUBMITTALS

A. **General:** The CONTRACTOR shall furnish a certificate with each delivery or bulk material delivery, stating source, quantity, and type of material. All materials shall conform to specification requirements. All certificates shall be delivered to the ENGINEER at time of each delivery. All bulk delivered materials shall be delivered with level load volume plainly marked on the truck bed.

B. **Topsoil Report:** Topsoil report as well as literature on fertilizers, peat, mulch, "Silva-fiber" and seed mixes, shall be submitted as specified in Section 01300 - Contractor Submittals.

C. **Certificates of Inspection:** Certificates of inspection of plant material, as may be required by Federal, State, or other authorities having jurisdiction, shall be furnished and accompany the shipment.

D. **Samples:** Typical sample of the grass seed shall be submitted for approval at the site.

E. **Certified Report on Topsoil Analysis:** The CONTRACTOR shall submit for approval by the ENGINEER a certified report by an approved analytical laboratory showing analyses of representative samples of topsoil proposed for use. The topsoil shall not be delivered to the site until approval is received from the ENGINEER. Approval of the laboratory report does not constitute final acceptance. Topsoil shall be subject to rejection by the

ENGINEER on or after delivery if it is found not to meet the requirements of the Specifications or does not conform to the laboratory test results.

1.4 CLEANUP

A. Upon completion of all planting operations, the portion of the project site used for a work or storage area by the CONTRACTOR shall be cleaned of all debris, superfluous materials, and equipment. All such materials and equipment shall be entirely removed from the project site.

B. All walks or pavement shall be swept or washed clean upon completion of the WORK of this Section.

1.5 MAINTENANCE OF LANDSCAPING PLANTING PRIOR TO ACCEPTANCE OF PROJECT

A. **General:** The CONTRACTOR shall be responsible for protecting, watering, and maintaining all seeded areas until final acceptance of all work under the contract.

B. At time of acceptance of the complete project, the lawn shall be totally established with no bare spots, mowed a minimum of 4 times, and the grass shall be at least 1-1/4 to 2 inches in height.

C. Upon completion of lawn seeding, the entire area shall be soaked to saturation by a fine spray. The new planting shall be kept watered by the sprinkling system existing on the site during dry weather or whenever necessary for proper establishment of the lawn. Care shall be taken to avoid excessive washing or puddling on the surface and any such damage caused thereby shall be repaired by the CONTRACTOR at its own expense.

D. **Protection:** The CONTRACTOR shall provide adequate protection to all newly seeded areas including the installation of approved temporary fences to prevent trespassing and damage, as well as erosion control, until the end of the one-year correction period.

E. The CONTRACTOR shall replace any materials or equipment it has damaged or which has been damaged by its employees or subcontractors.

F. Partial utilization of the project shall not relieve the CONTRACTOR of any of the requirements contained in the Contract Documents.

G. **Mowing of Lawn Areas:** First mowing of lawn areas shall begin as soon as the grass has reached a height of 3 inches and subsequent mowing shall be at least once a week, or as often as necessary to maintain all lawn areas at a uniform height of 1-1/2 to 2 inches.

H. All lawns shall be fertilized every 3 weeks with 6 lb of 16-16-8 commercial fertilizer per 1000 sq ft for the first 7 weeks and fertilized thereafter once each 5 months prior to acceptance and during maintenance and correction period.

I. Maintenance shall include, in addition to the foregoing, cleaning, edging, repairs to stakes, wire, and wrappings, the repair of erosion, and all other necessary work of maintenance. Sidewalks and other paved areas shall be kept clean while planting and maintenance are in progress.

1.6 FINAL INSPECTION AND GUARANTEE

A. Inspection of work of lawns will be made at conclusion of maintenance.

B. Written notice requesting inspection shall be submitted to the ENGINEER at least 10 days prior to the anticipated inspection date.

C. Final acceptance of the WORK prior to guarantee period of the contract will be accepted upon written approval by the ENGINEER, on the satisfactory completion of all work, including maintenance, but exclusive of the replacement of plant material.

D. Any delay in the completion of any item of work in the planting operation which extends the planting into more than one season shall extend the correction period in accordance with the date of completion given above.

1.7 MAINTENANCE AND GUARANTEE FOLLOWING ACCEPTANCE OF PROJECT

A. **General:** The CONTRACTOR shall be responsible for a period of one year after date of acceptance of all work under the Contract, for maintaining all seeded areas including all weeding and fertilizing. The CONTRACTOR shall provide a written guarantee to the WATER COMPANY from the landscaping subcontractor, embodying the provisions of this Section of the Specifications.

B. The WORK covered by the maintenance and guarantee portions of these specifications consists of providing reseeding, labor, materials, equipment, and supplies and in performing all operations in connection with maintenance and guarantees.

C. The inspection of lawn areas is independent of the final inspection and maintenance period. After the lawn has been accepted and has been mowed 4 or more times, the responsibility for mowing will be turned over to the WATER COMPANY. However, the weeding, fertilizing, and controlling of diseases of the lawn areas shall remain the responsibility of the CONTRACTOR for the remainder of the one-year maintenance and correction period.

D. All water required during the maintenance and correction period will be furnished by the WATER COMPANY.

E. **Maintenance:** Watering and mowing of the lawn during the maintenance and correction period will be performed by the CONTRACTOR in accordance with written instructions which shall be furnished by the SUPPLIER of the grass seed or sod.

F. All lawn and planting areas shall be fertilized during the maintenance and correction period with 16-6-4 chemical fertilizer. Amount of fertilizer applied shall be per fertilizer's written instructions on bag. Fertilizers applied to planting areas shall be cultivated into the top 2 inches of topsoil.

G. The CONTRACTOR shall clean-up and remove unused or waste materials from the site and leave the area in a neat condition (satisfactory to the WATER COMPANY) whenever it performs work during the maintenance period.

H. **Final Inspection:** The WATER COMPANY and CONTRACTOR shall make a final inspection at the end of the one-year correction period. Any seeded areas found defective at time of final inspection shall be reseeded within a time agreed upon by both parties. If it

is too late in the planting season for replanting, the replacements shall be made during the next planting season even though such planting may run beyond the maintenance and correction period.

PART 2 — PRODUCTS

2.1 GENERAL

All landscaping materials for soil conditioning, weed abatement, or planting shall be first-grade, commercial quality and shall have certificates indicating the source of material, analysis, quantity, or weight attached to each sack or container or provided with each delivery. Delivery certificates shall be given to the ENGINEER as each shipment of material is delivered. A list of the materials used, together with typical certificates of each material, shall be submitted to the ENGINEER prior to the final acceptance of the job.

2.2 TOPSOIL

A. Topsoil shall be obtained from naturally drained areas and shall be fertile, friable loam suitable for plant growth. Topsoil shall be subject to inspection and approval at the source of supply and upon delivery.

B. The topsoil shall be of uniform quality, free from subsoil stiff or lumpy clay, hard clods, hardpan, rocks, disintegrated debris, plants, roots, seeds, and any other materials that would be toxic or harmful to plant growth. Topsoil shall contain no noxious weeds or noxious weed seeds.

C. The topsoil shall contain at least 6 percent organic matter as determined by loss of weight after ignition of dried (moisture-free) samples in accordance with current methods of the Association of Official Agricultural Chemists.

D. The acidity range of the topsoil shall be (pH 5.5 to pH 7.5). The salinity level shall be less than 3 millimhos/cm.

E. Clay, as determined by the Bouyoucous hydrometer or by the decantation method, shall not exceed 60 percent of the topsoil material.

F. Mechanical analysis shall be performed and shall conform to ANSI/ASTM D 422.

2.3 FERTILIZER AND ADDITIVES

A. Fertilizer shall be furnished in bags or other standard containers with name, weight, and guaranteed analysis of contents clearly marked thereon.

B. Chemical fertilizers shall be a mixed commercial fertilizer conforming to FS O-F-241D, Type I, with percentages of nitrogen, phosphoric acid, and potash at 6-10-4. The combined N-P-K content shall be following percentages of total weight: 6 percent nitrogen, 10 percent phosphoric acid and 4 percent potash. Fertilizers shall be uniform in composition, dry, and free flowing.

C. Tablets shall be 12 grams each 20-10-5 "Agriform," "Lesslie".

D. Lime shall be dolomitic limestone containing not less than [redacted] percent of total carbonates. Limestone shall be ground to such fineness that 100 percent will pass a No. 200 sieve.

E. Agricultural gypsum shall be approved standard brand agricultural calcium sulfate ($CaSO_4$) as applied to soils and shall contain 19 percent combined sulfur.

2.4 PEAT MOSS

A. Peat shall be a domestic product conforming to FS Q-P-166E and may be reed peat, sedge peat, moss peat, reed muck, or sedge muck. Moss shall be of horticultural grade (fine shreds).

B. Sphagnum peat moss shall be good quality baled peatmoss free from injurious materials.

2.5 SEED MIXTURES

A. All seed shall conform with applicable City, County, State, and Federal regulations. Seed shall be mixed by dealer. The CONTRACTOR shall furnish dealer's guaranteed germination of each variety. Grass seed shall not be delivered to the site until samples have been approved in writing by the ENGINEER or his authorized landscape representative. Approval of samples, however, shall not affect the right of the ENGINEER, or the authorized landscape representative to reject seed upon or after delivery. Seed which has become wet, moldy, or otherwise damaged prior to use will not be accepted.

B. Grass shall be fresh, clean, and new-crop seed, composed of the following varieties mixed in the proportions by weight, as shown, and tested for the minimum percentage of purity and germination specified or approved equal.

	Mixture	Purity	Germination	Weed
CBS II Perenial Rye Grass				
Citation II:	48	100%	95%	0.0
Birdie II	29	100%	98%	0.0
Omega II	20	100%	98%	0.0
Other seed, etc.	3			

PART 3 — EXECUTION

3.1 GENERAL

A. The landscape work shall not be performed at any time when it may be subject to damage by climatic conditions.

B. Delivery of materials may begin only after samples and tests have been approved by the ENGINEER. All materials furnished for the work shall be not less than the approved sample.

C. Waste materials shall be removed and disposed of off the WATER COMPANY 's property, unless otherwise indicated.

D. It shall be the responsibility of the CONTRACTOR to avail itself of any information regarding utilities which are in the area of work and to prevent damage to the same. The CONTRACTOR shall provide protection to the utilities as necessary.

E. Burning of combustible materials on the site shall not be permitted.

F. The CONTRACTOR shall provide protection to structures, sidewalks, pavements, and other facilities in areas of work which are subject to damage during landscape work. Open excavations shall be provided with barricades and warning lights which conform to the requirements of governing authorities and the State's OSHA safety requirements from dusk to dawn each day and when needed for safety.

3.2 SOIL PREPARATION

A. The landscape work shall not begin until all other trades have repaired all areas of settlement, erosion, rutting, etc., and the soils have been re-established, recompacted, and refinished to finish grades. The ENGINEER shall be notified of all areas which prevent the landscape work from being executed.

B. Areas requiring grading by the landscaper including adjacent transition areas shall be uniformly level or sloping between finish elevations to within 0.10-ft above or below required finish elevations.

C. The landscape work shall not proceed until after walks, curbs, pavings, and edging are in place. The contract operations shall be completed to a point where the landscape areas will not be disturbed. The subgrade shall be cleaned free of waste materials of all kinds.

D. During grading waste materials in the planting areas such as weeds, rocks (2 inches and larger) building materials, rubble, wires, cans, glass, lumber, sticks, etc., shall be removed from the site. Weeds shall be dug out by the roots.

E. Fertilizers, additives, seed, peat, etc. subject to moisture damage shall be kept in a weatherproof storage place in such a manner that they will be kept dry.

F. After removal of waste materials the planting areas subgrade shall be scarified and pulverized to a depth of not less than 6 inches and all surface irregularities below the cover of topsoil removed.

G. Finish grading shall consist of:

1. Final contouring of the planting areas.

2. Placing 4 inches of topsoil over all areas to be planted unless shown or specified otherwise.

3. Placing all soil additives and fertilizers.

4. Tilling of planting areas.

5. After tilling, bring areas to uniform grades by floating and/or hand raking.

6. Making minor adjustment of finish grades as directed by the ENGINEER.

7. Removing waste materials such as stones, roots, or other undesirable foreign material and raking, disking, dragging, and smoothing soil ready for planting.

H. Any unusual subsurface condition that will require special treatment shall be reported to the ENGINEER.

I. Topsoil shall be uniformly distributed over all areas where required. Subgrade and topsoil shall be damp and free from frost.

J. Surface drainage shall be provided as shown by molding the surfaces to facilitate the natural run-off of water. Low spots and pockets shall be filled with topsoil and graded to drain properly.

K. Finish grade of all planting areas shall be 1-1/2 inches below finish grades of adjacent pavement of any kind.

L. Jute mesh shall be installed loosely up and down the slope. The installed mesh shall fit the soil surface contour and shall be held in place by 12-inch long, 11-gage (minimum) steel wire staples driven vertically into the soil at approximately 24-inch spacing. Jute mesh strips shall overlap along the sides at least 6 inches. Ends of strips shall be buried into the soil at least 6 inches. Staples shall be driven into side overlap at 2 points per side overlap.

3.3 SEEDING-GENERAL

A. Grass seeds shall be provided for grass area restoration and shall be maintained.

B. The soil shall be prepared and fertilized before seeding or shall be prepared per hydro-seeding instructions. The CONTRACTOR shall prepare only enough ground that can be planted within 24 hours thereafter.

C. Soil preparation shall consist of the following:

1. Preparation of sub-grade grading shall be per Paragraphs entitled "General" and "Soil Preparation," respectively, herein.

2. Finish grading of soil per Paragraph entitled "Soil Preparation", herein. The soil additives and fertilizer for finish grading shall consist of mulch at 5 cu yd/1000 sq.ft and commercial fertilizer at 20 lb/1000 sq ft.

D. Sow seed at the rate of 4 lbs to 1000 sq ft of area. Equal quantities of seed shall be sown in the directions at right angles to each other to produce an even distribution of seed over the entire area.

E. No seeding shall be done when wind velocity exceeds 4 mph, within 24 hours after rain, or if the surface has been compacted, without first loosening the ground.

F. The seed shall then be covered with a fine layer of soil to a depth not greater than 1/4-inch.

G. All lawn areas shall be covered with sphagnum peat moss or clean straw uniformly at a rate of 1-1/2 standard bales per 1000 sq ft.

H. After covering the seeds with soil and peat or straw, the planted area shall be rolled in 2 directions with a 200-lb roller or other roller designed for lawn seeding.

I. All lawn slopes greater than 5 percent, or places where erosion is a problem, shall be mulched with straw at a rate of 2 bales per 1000 sq ft.

J. This seeding method may be utilized between May 1 and September 15.

K. Mechanical application (hydroseeding) is acceptable. The CONTRACTOR shall notify the ENGINEER of proposed method, mulch, and type of equipment to be used and shall receive approval before beginning this operation.

3.4 HYDRO-SEEDING

A. One-step hydro-seeding may be utilized between May 1 and September 15. This method consists of preparing the seed bed as specified; combining specified seed mixture at the rate of 6 lb per 1000 sq ft for LAWN MIX; fertilizer at the rate of 15 lb per 1000 sq ft; "Silva-fiber" or approved equal at the rate of 1400 lb per acre of area and water in tanks; agitating these compounds into a well-mixed slurry suspension; and spraying the mixture under pressure onto the prepared areas to be seeded.

— END OF SECTION —

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall furnish all materials for concrete formwork, bracing, shoring, and supports and shall design and construct all falsework, all in accordance with the provisions of the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **Codes:** All codes, as referenced herein, are specified in Section 01090 - Reference Standards.

B. **Government Standards:**

PS 1	Construction and Industrial Plywood
PS 20	American Softwood Lumber Standard

C. **Commercial Standards:**

ACI 117	Standard Tolerances for Concrete Construction and Materials
ACI 347	Guide to Formwork for Concrete

1.3 CONTRACTOR SUBMITTALS

A. **Falsework Calculations and Drawings:** The CONTRACTOR's attention is directed to the provisions of Section 1717 of the Division of Industrial Safety, Construction Safety Orders, as revised November 1973, which requires that all falsework or vertical shoring installations where the height of the falsework or vertical shoring, as measured from the top of the sills to the soffit of the superstructure, exceeds 14 feet, or where individual horizontal span lengths exceed 16 feet, or provision for vehicular or railroad traffic through falsework or vertical shoring is made, shall be approved and signed by a civil engineer, registered in the State of West Virginia; provided further, that a copy of the falsework plan or shoring layout shall be available on the job site at all times.

B. The CONTRACTOR shall, in accordance with the requirements in Section 1300 - Submittals, submit detailed plans of the falsework proposed to be used. Such plans shall be in sufficient detail to indicate the general layout, sizes of members, anticipated stresses, grade of materials to be used in the falsework, means of protecting existing construction which supports falsework, and typical soil conditions.

C. The CONTRACTOR shall, in accordance with the requirements in Section 1300 - Submittals, submit the following.

1. Form ties and all related accessories, including taper tie plugs, if taper ties are used.

2. Form gaskets.

1.4 QUALITY ASSURANCE

A. **Tolerances:** The variation from established grade or lines shall not exceed 1/4-inch in 10 feet and there shall be no offsets or visible waviness in the finished surface. All other tolerances shall be within the tolerances of ACI 117.

PART 2 – PRODUCTS

2.1 GENERAL

A. Except as otherwise expressly accepted by the ENGINEER, all lumber brought on the job site for use as forms, shoring, or bracing shall be new material. All forms shall be smooth surface forms and shall be of the following materials:

Walls	-	Steel or plywood panel
Columns	-	Steel, plywood or fiber glass
Roof and floor	-	Plywood
All other work	-	Steel panels, plywood or tongue and groove lumber

B. Form materials which may remain or leave residues on or in the concrete shall be classified as acceptable for potable water use by the Environmental Protection Agency within 30 days of application or use.

2.2 FORM AND FALSEWORK MATERIALS

A. Materials for concrete forms, formwork, and falsework shall conform to the following requirements:

1. Lumber shall be Douglas Fir or Southern Yellow Pine, construction grade or better, in conformance with U.S. Product Standard PS 20.

2. Plywood for concrete formwork shall be new, waterproof, synthetic resin bonded, exterior type Douglas Fir or Southern Yellow Pine plywood manufactured especially for concrete formwork and shall conform to the requirements of PS 1 for Concrete Forms, Class I, and shall be edge sealed.

3. Form materials shall be metal, wood, plywood, or other approved material that will not adversely affect the concrete and will facilitate placement of concrete to the shape, form, line, and grade shown. Metal forms shall be an approved type that will accomplish such results. Wood forms for surfaces to be painted shall be Medium Density Overlaid plywood, MDO Ext. Grade.

B. Unless otherwise shown, exterior corners in concrete members shall be provided with 3/4-inch chamfers. Re-entrant corners in concrete members shall not have fillets unless otherwise shown.

C. Forms and falsework to support the roof and floor slabs shall be designed for the total dead load, plus a live load of 50 psf (minimum). The minimum design load for combined dead and live loads shall be 100 psf.

2.3 FORM TIES

A. Form ties shall be provided with a plastic cone or other suitable means for forming a conical hole to insure that the form tie may be broken off back of the face of the concrete. The maximum diameter of removable cones for rod ties, or of other removable form-tie fasteners having a circular cross-section, shall not exceed 1-1/2 inches; and all such fasteners shall be such as to leave holes of regular shape for reaming. Form ties for water-retaining structures shall have integral waterstops. Integral waterstops shall tightly fit the form tie so that they cannot be moved from mid-point of the tie. Form ties shall be **Burke Penta-Tie System by The Burke Company or Richmond Snap-Tys by the Richmond Screw Anchor Company.**

B. Removable taper ties may be used when approved by the ENGINEER. A preformed neoprene or polyurethane tapered plug sized to seat at the center of the wall shall be inserted in the hole left by the removal of the taper tie. **Use Burke Taper-Tie System by The Burke Company or Taper-Ty by the Richmond Screw Anchor Company.**

PART 3 – EXECUTION

3.1 GENERAL

A. Forms to confine the concrete and shape it to the required lines shall be used wherever necessary. The CONTRACTOR shall assume full responsibility for the adequate design of all forms, and any forms which are unsafe or inadequate in any respect shall promptly be removed from the WORK and replaced at the CONTRACTOR's expense. Provide worker protection from protruding reinforcement bars in accordance with applicable safety codes. A sufficient number of forms of each kind shall be provided to permit the required rate of progress to be maintained. The design and inspection of concrete forms, falsework, and shoring shall comply with applicable local, state and Federal regulations. Plumb and string lines shall be installed before concrete placement and shall be maintained during placement. Such lines shall be used by CONTRACTOR's personnel and by the ENGINEER and shall be in sufficient number and properly installed. During concrete placement, the CONTRACTOR shall continually monitor plumb and string line form positions and immediately correct deficiencies.

B. Concrete forms shall conform to the shape, lines, and dimensions of members as called for on the Drawings, and shall be substantial, free from surface defects, and sufficiently tight to prevent leakage. Forms shall be properly braced or tied together to maintain their position and shape under a load of freshly-placed concrete. If adequate foundation for shores cannot be secured, trussed supports shall be provided.

3.2 FORM DESIGN

A. All forms shall be true in every respect to the required shape and size, shall conform to the established alignment and grade, and shall be of sufficient strength and rigidity to maintain their position and shape under the loads and operations incident to placing and vibrating the concrete. Suitable and effective means shall be provided on all forms for holding adjacent edges and ends of panels and sections tightly together and in accurate alignment so as to prevent the formation of ridges, fins, offsets, or similar surface defects in the finished concrete. Plywood, 5/8-inch and greater in thickness, may be fastened directly to studding if the studs are spaced close enough to prevent visible deflection marks in the concrete. The forms shall be tight so as to prevent the loss of

water, cement and fines during placing and vibrating of the concrete. Specifically, the bottom of wall forms that rest on concrete footings or slabs shall be provided with a gasket to prevent loss of fines and paste during placement and vibration of concrete. Such gasket may be a 1- to 1-1/2-inch diameter polyethylene rod held in position to the underside of the wall form. Adequate clean-out holes shall be provided at the bottom of each lift of forms. The size, number, and location of such clean-outs shall be as acceptable to the ENGINEER. Whenever concrete cannot be placed from the top of a wall form in a manner that meets the requirements of the Contract Documents, form windows shall be provided in the size and spacing needed to allow placement of concrete to the requirements of Section 03300, Cast-in-Place Concrete. The size, number, and location of such form windows shall be as acceptable to the ENGINEER.

3.3 CONSTRUCTION

A. **Vertical Surfaces:** All vertical surfaces of concrete members shall be formed, except where placement of the concrete against the ground is shown. Not less than 1-inch of concrete shall be added to the thickness of the concrete member as shown where concrete is permitted to be placed against trimmed ground in lieu of forms. Such permission will be granted only for members of comparatively limited height and where the character of the ground is such that it can be trimmed to the required lines and will stand securely without caving or sloughing until the concrete has been placed.

B. **Construction Joints:** Concrete construction joints will not be permitted at locations other than those shown or specified, except as may be acceptable to the ENGINEER. When a second lift is placed on hardened concrete, special precautions shall be taken in the way of the number, location, and tightening of ties at the top of the old lift and bottom of the new to prevent any unsatisfactory effect whatsoever on the concrete. Pipe stubs and anchor bolts shall be set in the forms where required.

C. **Form Ties:**

1. Embedded Ties: Holes left by the removal of form tie cones shall be reamed with suitable toothed reamers so as to leave the surface of the holes clean and rough before being filled with mortar as specified for "Finish of Concrete Surfaces" in Section 03300 - Cast-in-Place Concrete. Wire ties for holding forms will not be permitted. No form-tying device or part thereof, other than metal, shall be left embedded in the concrete. Ties shall not be removed in such manner as to leave a hole extending through the interior of the concrete members. The use of snap-ties which cause spalling of the concrete upon form stripping or tie removal will not be permitted. If steel panel forms are used, rubber grommets shall be provided where the ties pass through the form in order to prevent loss of cement paste. Where metal rods extending through the concrete are used to support or to strengthen forms, the rods shall remain embedded and shall terminate not less than 1-inch back from the formed face or faces of the concrete.

2. Removable Ties: Where taper ties are approved for use, the larger end of the taper tie shall be on the wet side of walls in water retaining structures. After the taper tie is removed, the hole shall be thoroughly cleaned and roughened for bond. A precast neoprene or polyurethane tapered plug shall be located at the wall centerline. The hole shall be completely filled with non-shrink grout for water bearing and below-grade walls. The hole shall be completely filled with non-shrink or regular cement grout for above-grade walls which are dry on both sides. Exposed faces of walls shall have the outer 2 inches of the exposed face filled with

a cement grout which shall match the color and texture of the surrounding wall surface.

3.4 REUSE OF FORMS

A. Forms may be reused only if in good condition and only if acceptable to the ENGINEER. Light sanding between uses will be required wherever necessary to obtain uniform surface texture on all exposed concrete surfaces. Exposed concrete surfaces are defined as surfaces which are permanently exposed to view. In the case of forms for the inside wall surfaces of hydraulic/water retaining structures, unused tie rod holes in forms shall be covered with metal caps or shall be filled by other methods acceptable to the ENGINEER.

3.5 REMOVAL OF FORMS

A. Careful procedures for the removal of forms shall be strictly followed, and this work shall be done with care so as to avoid injury to the concrete. No heavy loading on green concrete will be permitted. In the case of roof slabs and above-ground floor slabs, forms shall remain in place until test cylinders for the roof concrete attain a minimum compressive strength of 75 percent of the 28-day strength specified in Section 03300 - Cast-in-Place Concrete; provided, that no forms shall be disturbed or removed under an individual panel or unit before the concrete in the adjacent panel or unit has attained 75 percent of the specified 28-day strength and has been in place for a minimum of 7 days. The time required to establish said strength shall be as determined by the ENGINEER who will make several test cylinders for this purpose from concrete used in the first group of roof panels placed. If the time so determined is more than the 7-day minimum, then that time shall be used as the minimum length of time. Forms for all vertical walls of waterholding structures shall remain in place at least 36 hours after the concrete has been placed. Forms for all vertical walls of non water holding structures shall remain in place at least 12 hours after the concrete has been placed. Forms for all parts of the WORK not specifically mentioned herein shall remain in place for periods of time as recommended in ACI 347.

3.6 MAINTENANCE OF FORMS

A. Forms shall be maintained at all times in good condition, particularly as to size, shape, strength, rigidity, tightness, and smoothness of surface. Forms, when in place, shall conform to the established alignment and grades. Before concrete is placed, the forms shall be thoroughly cleaned. The form surfaces shall be treated with a nonstaining mineral oil or other lubricant acceptable to the ENGINEER. Any excess lubricant shall be satisfactorily removed before placing the concrete. Where field oiling of forms is required, the CONTRACTOR shall perform the oiling at least two weeks in advance of their use. Care shall be exercised to keep oil off the surfaces of steel reinforcement and other metal items to be embedded in concrete.

3.7 FALSEWORK

A. The CONTRACTOR shall be responsible for the design, engineering, construction, maintenance, and safety of all falsework, including staging, walkways, forms, ladders, and similar appurtenances, which shall equal or exceed the applicable requirements of the provisions of the OSHA Safety and Health Standards for Construction, and the requirements specified herein.

B. All falsework shall be designed and constructed to provide the necessary rigidity and to support the loads. Falsework for the support of a superstructure shall be designed to support the loads that would be imposed if the entire superstructure were placed at one time.

C. Falsework shall be placed upon a solid footing, safe against undermining, and protected from softening. When the falsework is supported on timber piles, the maximum calculated pile loading shall not exceed 20 tons. When falsework is supported on any portion of the structure which is already constructed, the load imposed by the falsework shall be spread, distributed, and braced in such a way as to avoid any possibility of damage to the structure.

- END OF SECTION -

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall furnish, fabricate, and place all concrete reinforcement steel, welded wire fabric, couplers, and concrete inserts for use in reinforced concrete and masonry construction and shall perform all appurtenant work, including all the wires, clips, supports, chairs, spacers, and other accessories, all in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards

ACI 315	Details and Detailing of Concrete Reinforcement
ACI 318	Building Code Requirements for Reinforced Concrete
CRSI MSP-1	Concrete Reinforcing Steel Institute Manual of Standard Practice
WRI	Manual of Standard Practice for Welded Wire Fabric
AWS D1.4	Structural Welding Code - Reinforcing Steel
ASTM A 82	Specification for Steel Wire, Plain, for Concrete Reinforcement
ASTM A 185	Specification for Welded Steel Wire Fabric, Plain, for Concrete Reinforcement
ASTM A 615	Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 775	Specification for Epoxy-Coated Reinforcing Steel Bars

1.3 CONTRACTOR SUBMITTALS

A. The CONTRACTOR shall furnish shop bending diagrams, placing lists, and drawings of all reinforcement steel prior to fabrication in accordance with the requirements of Section 01300, "Contractor Submittals."

B. Details of the concrete reinforcement steel and concrete inserts shall be submitted by the CONTRACTOR at the earliest possible date after receipt by the CONTRACTOR of the Notice to Proceed. Said details of reinforcement steel for fabrication and erection shall conform to ACI 315 and the requirements specified and shown. The shop bending diagrams shall show the actual lengths of bars, to the nearest inch measured to the intersection of the extensions (tangents for bars of circular cross section) of the outside surface. The shop drawings shall include bar placement diagrams which clearly indicate the dimensions of each bar splice.

C. Where mechanical couplers are required or permitted to be used to splice reinforcement steel, the CONTRACTOR shall submit manufacturer's literature which contains instructions and recommendations for installation for each type of coupler used; certified test reports which verify the load capacity of each type and size of coupler used; and shop drawings which show the location of each coupler with details of how they are to be installed in the formwork.

D. If reinforcement steel is spliced by welding at any location, the CONTRACTOR shall submit mill test reports which shall contain the information necessary for the determination of the carbon equivalent as specified in AWS D1.4. The CONTRACTOR shall submit a written welding procedure for each type of weld for each size of bar which is to be spliced by welding; merely a statement that AWS procedures will be followed is not acceptable.

1.4 QUALITY ASSURANCE

A. If requested by the ENGINEER, the CONTRACTOR shall provide samples from each heat of reinforcement steel delivered in a quantity adequate for testing. Costs of initial tests will be paid by the OWNER. Costs of additional tests due to material failing initial tests shall be paid by the CONTRACTOR.

B. If reinforcement steel is spliced by welding at any location, the CONTRACTOR shall submit certifications of procedure qualifications for each welding procedure used and certification of welder qualifications, for each welding procedure, and for each welder performing the work. Such qualifications shall be as specified in AWS D1.4.

C. If requested by the ENGINEER, the CONTRACTOR shall provide samples of each type of welded splice used in the work in a quantity and of dimensions adequate for testing. At the discretion of the ENGINEER, radiographic testing of direct butt welded splices will be performed. The CONTRACTOR shall provide assistance necessary to facilitate testing. The CONTRACTOR shall repair any weld which fails to meet the requirements of AWS D1.4. The costs of testing will be paid by the OWNER; except, the costs of all tests which fail to meet specified requirements shall be paid by the CONTRACTOR.

PART 2 – PRODUCTS

2.1 MATERIAL REQUIREMENTS

A. Materials specified in this Section which may remain or leave residues on or within the concrete shall be classified as acceptable for potable water use by the Environmental Protection Agency within 30 days of application or use.

2.2 REINFORCEMENT STEEL

A. Reinforcement Steel for all cast-in-place reinforced concrete construction shall conform to the following requirements:

1. Bar reinforcement shall conform to the requirements of ASTM A 615 for Grade 60 Billet Steel Reinforcement or as otherwise shown.

2. Welded wire fabric reinforcement shall conform to the requirements of ASTM A 185 and the details shown; provided, that welded wire fabric with longitudinal wire of W4

size wire and smaller shall be either furnished in flat sheets or in rolls with a core diameter of not less than 10 inches; and provided further, that welded wire fabric with longitudinal wires larger than W4 size shall be furnished in flat sheets only.

3. Spiral reinforcement shall be cold-drawn steel wire conforming to the requirements of ASTM A 82.

B. Accessories

1. Accessories shall include all necessary chairs, slab bolsters, concrete blocks, tie wires, dips, supports, spacers, and other devices to position reinforcement during concrete placement. All bar supports shall meet the requirements of the CRSI Manual of Standard Practice including special requirements for supporting epoxy coated reinforcing bars. Wire bar supports shall be CRSI Class 1 for maximum protection with a 1/8-inch minimum thickness of plastic coating which extends at least 1/2-inch from the concrete surface. Plastic shall be gray in color.

2. Concrete blocks (dobies), used to support and position reinforcement steel, shall have the same or higher compressive strength as specified for the concrete in which it is located. Wire ties shall be embedded in concrete block bar supports.

C. Epoxy coating for reinforcing and accessories, where specified or shown, shall conform to ASTM A 775.

2.3 MECHANICAL COUPLERS

A. Mechanical couplers shall be provided where shown and where approved by the ENGINEER. The couplers shall develop a tensile strength which exceeds 125 percent of the yield strength of the reinforcement bars being spliced at each splice.

B. Where the type of coupler used is composed of more than one component, all components required for a complete splice shall be supplied. This shall apply to all mechanical splices, including those splices intended for future connections.

C. The reinforcement steel and coupler used shall be compatible for obtaining the required strength of the connection. Straight threaded type couplers shall require the use of the next larger size reinforcing bar or shall be used with reinforcing bars with specially forged ends which provide upset threads which do not decrease the basic cross section of the bar.

D. Couplers shall be **Lenton Form Saver as manufactured by Erico Products; Dowel Bar Splicer System as manufactured by Richmond Screw Anchor Company.**

2.4 WELDED SPLICES

A. Welded splices shall be provided where shown and where approved by the ENGINEER. All welded splices of reinforcement steel shall develop a tensile strength which exceeds 125 percent of the yield strength of the reinforcement bars which are connected.

B. All materials required to conform the welded splices to the requirements of AWS D1.4 shall be provided.

2.5 EPOXY GROUT

A. Epoxy for grouting reinforcing bars shall be specifically formulated for such application, for the moisture condition, application temperature, and orientation of the hole to be filled.

PART 3 – EXECUTION

3.1 GENERAL

A. All reinforcement steel, welded wire fabric, couplers, and other appurtenances shall be fabricated, and placed in accordance with the requirements of the Building Code and the supplementary requirements specified herein.

3.2 FABRICATION

A. General

1. Reinforcement steel shall be accurately formed to the dimensions and shapes shown, and the fabricating details shall be prepared in accordance with ACI 315 and ACI 318, except as modified by the Drawings. Stirrups and tie bars shall be bent around a pin having a diameter not less than 1-1/2-inch for No. 3 bars, 2-inch for No. 4 bars, and 2-1/2-inch for No. 5 bars. Bends for other bars shall be made around a pin having a diameter not less than 6 times the bar diameter, except for bars larger than 1 inch, in which case the bends shall be made around a pin of 8 bar diameters. Bars shall be bent cold.

2. The CONTRACTOR shall fabricate reinforcement bars for structures in accordance with bending diagrams, placing lists, and placing drawings. Said drawings, diagrams, and lists shall be prepared by the CONTRACTOR as specified under Section 01300, "Contractor Submittals."

B. **Fabricating Tolerances:** Bars used for concrete reinforcement shall meet the following requirements for fabricating tolerances:

1. Sheared length: $\pm$ 1 inch

2. Depth of truss bars: + 0, - 1/2 inch

3. Stirrups, ties, and spirals: $\pm$ 1/2 inch

4. All other bends: $\pm$ 1 inch

3.3 PLACING

A. Reinforcement steel shall be accurately positioned as shown, and shall be supported and wired together to prevent displacement, using annealed iron wire ties or suitable clips at intersections. All reinforcement steel shall be supported by concrete, plastic or metal supports, spacers or metal hangers which are strong and rigid enough to prevent any displacement of the reinforcement steel. Where concrete is to be placed on the ground, supporting concrete blocks (or dobies) shall be used, in sufficient numbers to support the bars without settlement, but in no case shall such support be continuous. All concrete

blocks used to support reinforcement steel shall be tied to the steel with wire ties which are embedded in the blocks. For concrete over formwork, the CONTRACTOR shall furnish concrete, metal, plastic, or other acceptable bar chairs and spacers.

B. Limitations on the use of bar support materials shall be as follows.

1. Concrete Dobies: permitted at all locations except where architectural finish is required.

2. Wire Bar Supports: permitted only at slabs over dry areas, interior dry wall surfaces, and exterior wall surfaces.

3. Plastic Bar Supports: permitted at all locations except on grade.

C. Tie wires shall be bent away from the forms in order to provide the specified concrete coverage.

D. Bars additional to those shown which may be found necessary or desirable by the CONTRACTOR for the purpose of securing reinforcement in position shall be provided by the CONTRACTOR at its own expense.

E. Unless otherwise specified, reinforcement placing tolerances shall be within the limits specified in Section 7.5 of ACI 318 except where in conflict with the requirements of the Building Code.

F. Bars may be moved as necessary to avoid interference with other reinforcement steel, conduits, or embedded items. If bars are moved more than one bar diameter, or enough to exceed the above tolerances, the resulting arrangement of bars shall be as acceptable to the ENGINEER.

G. Welded wire fabric reinforcement placed over horizontal forms shall be supported on slab bolsters. Slab bolsters shall be spaced not more than 30 inches on centers, shall extend continuously across the entire width of the reinforcement mat, and shall support the reinforcement mat in the plane shown.

H. Welded wire fabric placed over the ground shall be supported on wired concrete blocks (dobies) spaced not more than 3 feet on centers in any direction. The construction practice of placing welded wire fabric on the ground and hooking into place in the freshly placed concrete shall not be used.

I. Epoxy coated reinforcing bars shall be stored, transported, and placed in such a manner as to avoid chipping of the epoxy coating. Non-abrasive slings made of nylon and similar materials shall be used. Specially coated bar supports shall be used. All chips or cracks in the epoxy coating shall be repaired with a compatible epoxy repair material prior to placing concrete.

J. Accessories supporting reinforcing bars shall be spaced such that there is no deflection of the accessory from the weight of the supported bars. When used to space the reinforcing bars from wall forms, the forms and bars shall be located so that there is no deflection of the accessory when the forms are tightened into position.

3.4 SPACING OF BARS

A. The clear distance between parallel bars (except in columns and between multiple layers of bars in beams) shall be not less than the nominal diameter of the bars nor less than 1-1/3 times the maximum size of the coarse aggregate, nor less than one inch.

B. Where reinforcement in beams or girders is placed in 2 or more layers, the clear distance between layers shall be not less than one inch.

C. In columns, the clear distance between longitudinal bars shall be not less than 1-1/2 times the bar diameter, nor less than 1-1/2 times the maximum size of the coarse aggregate, nor less than 1-1/2 inches.

D. The clear distance between bars shall also apply to the distance between a contact splice and adjacent splices or bars.

3.5 SPLICING

A. General

1. Reinforcement bar splices shall only be used at locations shown. When it is necessary to splice reinforcement at points other than where shown, the character of the splice shall be as acceptable to the ENGINEER.

2. Unless otherwise indicated, dowels shall match the size and spacing of the spliced bar.

B. Splices of Reinforcement

1. The length of lap for reinforcement bars, unless otherwise shown shall be in accordance with ACI 318-89, Section 12.15.1 for a Class B splice.

2. Laps of welded wire fabric shall be in accordance with the ACI 318. Adjoining sheets shall be securely tied together with No. 14 tie wire, one tie for each 2 running feet. Wires shall be staggered and tied in such a manner that they cannot slip.

3. Splices in column spiral reinforcement, when necessary, shall be made by welding or by a lap of 1-1/2 turns.

C. Bending or Straightening

1. Reinforcement shall not be straightened or rebent in a manner which will injure the material. Bars with kinks or bends not shown shall not be used. All bars shall be bent cold, unless otherwise permitted by the ENGINEER. No bars partially embedded in concrete shall be field-bent except as shown or specifically permitted by the ENGINEER.

D. Couplers which are located at a joint face shall be a type which can be set either flush or recessed from the face as shown. The couplers shall be sealed during concrete placement to completely eliminate concrete or cement paste from entering. Couplers intended for future connections shall be recessed a minimum of 1/2 inch from the concrete surface. After the concrete is placed, the coupler shall be plugged with plastic plugs which have an O-ring seal and the recess filled with sealant to prevent any contact with water or other corrosive materials. Threaded couplers shall be plugged .

E. Unless noted otherwise, mechanical coupler spacing and capacity shall match the spacing and capacity of the reinforcing shown for the adjacent section.

3.6 CLEANING AND PROTECTION

A. Reinforcement steel shall at all times be protected from conditions conducive to corrosion until concrete is placed around it.

B. The surfaces of all reinforcement steel and other metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar and other foreign substances immediately before the concrete is placed. Where there is delay in depositing concrete, reinforcement shall be reinspected and, if necessary recleaned.

3.7 EMBEDMENT OF DRILLED REINFORCING STEEL DOWELS

A. Hole Preparation

1. The hole diameter shall be as recommended by the epoxy manufacturer but shall be no larger than 0.25 inch greater than the diameter of the outer surface of the reinforcing bar deformations.

2. The depth of the hole shall be as recommended by the epoxy manufacturer to fully develop the bar but shall not be less than 12 bar diameters, unless noted otherwise.

3. The hole shall be drilled by methods which do not interfere with the proper bonding of epoxy.

4. Existing reinforcing steel in the vicinity of proposed holes shall be located prior to drilling. The location of holes to be drilled shall be adjusted to avoid drilling through or nicking any existing reinforcing bars.

5. The hole shall be blown clean with clean, dry compressed air to remove all dust and loose particles.

6. Epoxy shall be injected into the hole through a tube placed to the bottom of the hole. The tube shall be withdrawn as epoxy is placed but kept immersed to prevent formation of air pockets. The hole shall be filled to a depth that insures that excess material will be expelled from the hole during dowel placement.

7. Dowels shall be twisted during insertion into the partially filled hole so as to guarantee full wetting of the bar surface with epoxy. The bar shall be inserted slowly enough to avoid developing air pockets.

- END OF SECTION -

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide joints in concrete, complete and in place, in accordance with the Contract Documents.

B. Joints in concrete structures shall be the types defined below and will be permitted only where indicated, unless specifically accepted by the ENGINEER.

REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

C. **Federal Specifications:**

TT-S-0227E(3)	Sealing Compound, elastomeric type, Multi-component for Calking, Sealing, and Glazing Buildings and Other Structures).

D. **U.S. Army Corps of Engineers Specifications:**

CRD-C572	PVC Waterstop.

E. **Commercial Standards:**

ASTM A 775	Epoxy-Coated Reinforcing Steel Bars
ASTM C 920	Elastomeric Joint Sealants
ASTM D 412	Standard Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers Tension
ASTM D 624	Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
ASTM D 638	Standard Test Method for Tensile Properties of Plastics
ASTM D 746	Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
ASTM D 747	Standard Test Method for Apparent Bending Modulus of Plastics by Means of a Cantilever Beam
ASTM D 1056	Flexible Cellular Materials -- Sponge or Expanded Rubber
ASTM D 1752	Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D 2240	Standard Test Method for Rubber Property -- Durometer

Hardness

ASTM D 2241 (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)

1.2 TYPES OF JOINTS

A. **Construction Joints:** When fresh concrete is placed against a hardened concrete surface, the joint between the two pours is called a construction joint. Unless otherwise indicated, joints in water bearing members shall be provided with a waterstop and/or sealant groove of the shape indicated. The surface of the first pour may also be required to receive a coating of bond breaker as indicated.

B. **Contraction Joints:** Contraction joints are similar to construction joints except that the fresh concrete shall not bond to the hardened surface of the earlier pour, which shall be coated with a bond breaker. The slab reinforcement shall be stopped 4-1/2 inches from the joint; which is provided with a sleeve-type dowel, to allow shrinkage of the concrete of the later pour. Waterstop and/or sealant groove shall also be provided when indicated.

C. **Expansion Joints:** To allow the concrete to expand freely, a space is provided between the two pours, and the joint shall be formed as indicated. The space is obtained by placing a filler joint material against the earlier pour, to act as a form for the later pour. Unless otherwise indicated, expansion joints in water bearing members shall be provided with a center-bulb type waterstop as indicated.

D. Premolded expansion joint material shall be installed with the edge at the indicated distance below or back from finished concrete surface, and shall have a slightly tapered, dressed, and oiled wood strip secured to or placed at the edge thereof during concrete placement, which shall later be removed to form space for sealing material.

E. The space so formed shall be filled with a joint sealant material as indicated below. In order to keep the two wall or slab elements in line the joint shall also be provided with a sleeve-type dowel as indicated.

F. **Control Joints:** The function of the control joint is to provide a weaker plane in the concrete, where shrinkage cracks will probably occur. A groove, of the shape and dimensions indicated, is formed or saw-cut in the concrete. This groove is afterward filled with a joint sealant material.

1.3 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01300 - Contractor Submittals.

B. Shop Drawings

1. Placement drawings showing the location and type of all joints for each structure.

2. Certified test reports from the sealant manufacturer on the actual batch of material being supplied indicating compliance with requirements shall be furnished before the sealant is used on the job.

3. Sufficient data to show general compliance with the requirements of the Contract Documents prior to ordering the sealant material.

4. Copies of Waterstop Welding Certification to be provided by manufacturer or authorized agent of manufacturer. Every person who is to be involved with waterstop installation is required to have individual Certification on file with ENGINEER, which states said individuals are certified and trained to install waterstop per manufacturer's recommendations and specifications.

C. Samples

1. Prior to production of the material required under this contract, qualification samples of waterstops shall be submitted. Such samples shall consist of extruded or molded sections of each size or shape to be used. The balance of the material to be used under this contract shall not be produced until after the ENGINEER has reviewed the qualification samples.

D. **Certificates:** Written certification from the manufacturer as an integral part of the shipping form, to show that all of the material shipped to this project meets or exceeds the physical property requirements of the Contract Documents. Supplier certificates are not acceptable.

1.4 QUALITY ASSURANCE

A. **Waterstop Inspection:** It is required that all waterstop field joints shall be subject to rigid inspection, and no such work shall be scheduled or started without having made prior arrangements with the ENGINEER for the required inspections. Not less than 24 hours notice shall be given for scheduling such inspections.

B. Field joints in waterstops shall be subject to rigid inspection for misalignment, bubbles, inadequate bond, porosity, cracks, offsets, and other defects which would reduce the potential resistance of the material to water pressure at any point. Defective joints shall be replaced with material which passes inspection; faulty material shall be removed from the Site and disposed of at no increase in cost to the OWNER.

C. The following waterstop defects represent a partial list of defects which shall be grounds for rejection:

1. Offsets at joints greater than 1/16-inch or 15 percent of material thickness, at any point, whichever is less.

2. Exterior crack at joint, due to incomplete bond, which is deeper than 1/16-inch or 15 percent of material thickness, at any point, whichever is less.

3. Any combination of offset or exterior crack which will result in a net reduction in the cross section of the waterstop in excess of 1/16-inch or 15 percent of material thickness at any point, whichever is less.

4. Misalignment of joint which results in misalignment of the waterstop in excess of 1/2-inch in 10 feet.

5. Porosity in the welded joint as evidenced by visual inspection.

6. Bubbles or inadequate bonding which can be detected with a penknife test. (If, while prodding the entire joint with the point of a pen knife, the knife breaks through the outer portion of the weld into a bubble, the joint shall be considered defective.)

7. Visible signs of separation when the cooled splice is bent by hand at any sharp angle.

D. **Waterstop Samples:** Prior to use of the waterstop material in the field, a sample of a prefabricated (shop made fitting) mitered cross and a tee constructed of each size or shape of material to be used shall be submitted. These samples shall be prefabricated (shop made fitting) so that the material and workmanship represent in all respects the fittings to be provided. Field samples of prefabricated (shop made fitting) fittings (crosses, tees, etc.) will also be selected at random by the ENGINEER for testing by a laboratory at the OWNER's expense. When tested, they shall have a tensile strength across the joints equal to at least 1400 psi.

E. **Construction Joint Sealant:** The CONTRACTOR shall prepare adhesion and cohesion test specimens as required herein, at intervals of 5 working days while sealants are being installed.

F. The sealant material shall show no signs of adhesive or cohesive failure when tested in accordance with the following procedure in laboratory and field tests:

1. Sealant specimen shall be prepared between 2 concrete blocks (1-inch by 2-inch by 3-inch). Spacing between the blocks shall be 1-inch. Coated spacers (2-inch by 1-1/2-inch by 1/2-inch) shall be used to insure sealant cross-sections of 1/2-inch by 2 inches with a width of 1-inch.

2. Sealant shall be cast and cured according to manufacturer's recommendations except that curing period shall be not less than 24 hours.

3. Following curing period, the gap between blocks shall be widened to 1-1/2-inch. Spacers shall be used to maintain this gap for 24 hours prior to inspection for failure.

1.5 SPECIAL WARRANTY REQUIREMENTS

A. The CONTRACTOR shall furnish a 5-year written warranty of the entire sealant installation against faulty and/or incompatible materials and workmanship, together with a statement that it agrees to repair or replace, to the satisfaction of the OWNER, at no additional cost to the OWNER, any such defective areas which become evident within said 5-year guarantee period.

PART 2 – PRODUCTS

2.1 GENERAL

A. Joint materials herein shall be classified as acceptable for potable water use by the Environmental Protection Agency within 30 days of application.

2.2 PVC WATERSTOPS

A. **General:** Waterstops shall be extruded from an elastomeric polyvinyl chloride compound containing the plasticizers, resins, stabilizers, and other materials necessary to meet the requirements of this Section. No reclaimed or scrap material shall be used. The CONTRACTOR shall obtain from the waterstop manufacturer and shall furnish to the

ENGINEER for review, current test reports and a written certification of the manufacturer that the material to be shipped to the job meets the physical requirements as outlined in the U.S. Army Corps of Engineers Specification CRD-C572 and those listed herein.

B. **Flatstrip and Center-Bulb Waterstops:** Flatstrip and center-bulb waterstops shall be as manufactured by: **JP Specialties, Inc.,** Lake Elsinore, California or **Greenstreak Plastic Products Co.,** St. Louis, Missouri, provided, that at no place shall the thickness of flat strip waterstops, including the center bulb type, be less than 3/8-inch.

C. **Multi-Rib Waterstops:** Multi-rib waterstops, where required, shall be as manufactured by **JP Specialties, Inc.,** Lake Elsinore, California or **Greenstreak Plastic Products Co.,** St. Louis, Missouri. Prefabricated (shop made fitting) joint fittings shall be used at all intersections of the ribbed-type waterstops.

D. **Retrofit Waterstops:** Retrofit waterstops and batten bars shall be as manufactured by **JP Specialties, Inc.,** Lake Elsinore, California or **Greenstreak Plastic Products Co.,** St. Louis, Missouri; **Style #609.**

E. **Pre-formed Hydrophyllic Waterstop:** Hydrophyllic (bentonite-free) waterstops and shall be **Hydrotite CJ10202k** as manufactured by **JP Specialties, Inc.,** Lake Elsinore, California; **Greenstreak Plastic Products Co.,** St. Louis, Missouri; or **Adeka MC2010** as manufactured by **Asahi Denka Kogyo K. K., Tokyo, Japan (03) 5255-9016.**

F. **Other Types of Waterstops:** When types of waterstops not listed above are indicated, they shall be subjected to the same requirements as those listed herein.

G. **Waterstop Testing Requirements:** When tested in accordance with the test standards, the waterstop material shall meet or exceed the following requirements:

Physical Property, Sheet Material	Value	ASTM Std.
Tensile Strength-min (psi)	1750	D 638, Type IV
Ultimate Elongation-min (percent)	350	D 638, Type IV
Low Temp Brittleness-max (degrees F)	-35	D 746
Stiffness in Flexure-min (psi)	400	D 747
Accelerated Extraction (CRD-C572)		
Tensile Strength-min (psi)	1500	D 638, Type IV
Ultimate Elongation-min (percent)	300	D 638, Type IV
Effect of Alkalies (CRD-C572)		
Change in Weight (percent)	+0.25/-0.10	------
Change in Durometer, Shore A	+5	D 2240
Finish Waterstop		
Tensile Strength-min (psi)	1400	D 638, Type IV
Ultimate Elongation-min (percent)	280	D 638, Type IV

2.3 JOINT SEALANT

A. Joint sealant shall be polyurethane polymer designed for bonding to concrete which is continuously submerged in water. No material will be acceptable which has an unsatisfactory history as to bond or durability when used in the joints of water retaining structures.

B. Joint sealant material shall meet the following requirements (73 degrees F and 50 percent R.H.):

Work Life	45 - 180 minutes
Time to Reach 20 Shore "A" Hardness (at 77 degrees F, 200 gr quantity)	24 hours, maximum
Ultimate Hardness (ASTM D 2240)	20 - 45 Shore "A"
Tensile Strength (ASTM D 412)	175 psi, minimum
Ultimate Elongation (ASTM D 412)	400 percent, minimum
Tear Resistance (Die C, ASTM D 624)	75 pounds per inch of thickness, minimum
Color	Light Gray

C. Polyurethane sealants for waterstop joints in concrete shall conform to the following requirements:

1. Sealant shall be 2-part polyurethane with the physical properties of the cured sealant conforming to or exceeding the requirements of ANSI/ASTM C 920 or Federal Specification TT-S-0227 E(3) for 2-part material, as applicable.

2. For vertical joints and overhead horizontal joints, only "non-sag" compounds shall be used; all such compounds shall conform to the requirements of ANSI/ASTM C 920 Class 25, Grade NS, or Federal Specification TT-S-0227 E(3), Type II, Class A.

3. For plane horizontal joints, the self-leveling compounds which meet the requirements of ANSI/ASTM C 920 Class 25, Grade P, or Federal Specification TT-S-0227 E(3), Type I shall be used. For joints subject to either pedestrian or vehicular traffic, a compound providing non-tracking characteristics, and having a Shore "A" hardness range of 35 to 45, shall be used.

4. Primer materials, if recommended by the sealant manufacturer, shall conform to the printed recommendations of the manufacturer.

D. Sealants, indicated, shall be **PSI-270** as manufactured by **Polymeric Systems Inc.; Elastothane 227R** as manufactured by **Pacific Polymers or Sikaflex 2C,** as manufactured by **Sika Corporation.**

E. Sealants for non-waterstop joints in concrete shall conform to Section 07920 - Sealants and Caulking.

2.4 JOINT MATERIALS

A. **Bearing Pad:** Bearing pad to be neoprene conforming ASTM D 2000, BC 420, 40 durometer hardness unless otherwise indicated.

B. **Neoprene Sponge:** Sponge shall be neoprene, closed-cell, expanded, conforming to ASTM D 1056, type 2C3-E1.

C. **Joint Filler:**

1. Joint filler for expansion joints in waterholding structures shall be neoprene conforming to ASTM D1056, type 2C5-E1.

2. Joint filler material in other locations shall be of the preformed non-extruding type joint filler constructed of cellular neoprene sponge rubber or polyurethane of firm texture. Bituminous fiber type will not be permitted. All non-extruding and resilient-type preformed expansion joint fillers shall conform to the requirements and tests set forth in ASTM D 1752 for Type I, except as otherwise indicated.

2.5 BACKING ROD

A. Backing rod shall be an extruded closed-cell, polyethylene foam rod. The material shall be compatible with the joint sealant material and shall have a tensile strength of not less than 40 psi and a compression deflection of approximately 25 percent at 8 psi. The rod shall be 1/8-inch larger in diameter than the joint width except that a one-inch diameter rod shall be used for a 3/4-inch wide joint.

2.6 BOND BREAKER

A. Bond breaker shall be **Super Bond Breaker** as manufactured by **Burke Company,** San Mateo, California or **Select Cure CRB** as manufactured by **Select Products Co.**, Upland, California. It shall contain a fugitive dye so that areas of application will be readily distinguishable.

2.7 HYDROPHILLIC WATERSTOP

A. Hydrophillic waterstop shall be the type which expands in the presence of water to form a watertight joint seal without damaging the concrete in which it is cast.

B. Hydrophillic waterstop shall be manufactured from chloroprene and modified chloroprene with hydrophillic properties; with delay coating to inhibit initial expansion due to moisture present in fresh concrete. The minimum expansion ratio of modified chloroprene shall be not less than 3 to 1 volumetric change in distilled water at 70 degrees F (21 degrees C).

Physical Property, Chloroprene	Value	ASTM Std.
Tensile Strength-min (psi)	1275	D 412
Ultimate Elongation-min (percent)	350	D 412
Hardness, Shore A	55□5	D 2240

Physical Property, Modified Chloroprene	Value	ASTM Std.
Tensile Strength-min (psi)	300	D 412
Ultimate Elongation-min (percent)	600	D 412

2.8 RETROFIT WATERSTOP

A. Bonding agent for retrofit waterstop shall be **Propoxy 300** as manufactured by **UNITEX**, Kansas City, MO; **Greenstreak 7300** as manufactured by **JP Specialties, Inc.**, Lake Elsinore, California or **Greenstreak Plastic Products Co.**, St. Louis, Missouri, and as recommended by the waterstop manufacturer.

2.9 SLIP DOWELS

A. Slip dowels in joints shall be smooth epoxy-coated bars, conforming to ASTM A 775.

2.10 PVC TUBING

A. PVC tubing in joints shall be Sch. SDR 13.5, conforming to ASTM D 2241.

PART 3 – EXECUTION

3.1 GENERAL

A. Waterstops shall be embedded in the concrete across joints as indicated. Waterstops shall be fully continuous for the extent of the joint. Splices necessary to provide such continuity shall be accomplished in conformance to printed instructions of manufacturer of the waterstops. The CONTRACTOR shall take suitable precautions and means to support and protect the waterstops during the progress of the work and shall repair or replace at its own expense any waterstops damaged during the progress of the work. All waterstops shall be stored so as to permit free circulation of air around the waterstop material.

B. When any waterstop is installed in the concrete on one side of a joint, while the other half or portion of the waterstop remains exposed to the atmosphere for more than 2 days, suitable precautions shall be taken to shade and protect the exposed waterstop from direct rays of the sun during the entire exposure and until the exposed portion of the waterstop is embedded in concrete.

3.2 SPLICES IN WATERSTOPS

A. Splices in waterstops shall be performed by heat sealing the adjacent waterstop sections in accordance with the manufacturer's printed recommendations. It is essential that:

1. The material not be damaged by heat sealing.

2. The splices have a tensile strength of not less than 80 percent of the unspliced material tensile strength.

3. The continuity of the waterstop ribs and of its tubular center axis be maintained. No edge welding is allowed.

B. Butt joints of the ends of 2 identical waterstop sections may be made while the material is in the forms.

C. All joints with waterstops involving more than 2 ends to be jointed together, and all joints

which involve an angle cut, alignment change, or the joining of 2 dissimilar waterstop sections shall be prefabricated (shop made fitting) prior to placement in the forms, allowing not less than 24-inch long strips of waterstop material beyond the joint. Upon being inspected and approved, such prefabricated (shop made fitting) waterstop joint assemblies shall be installed in the forms and the ends of the 24-inch strips shall be butt welded to the straight run portions of waterstop in place in the forms.

D. Where a centerbulb waterstop intersects and is jointed with a non-centerbulb waterstop, care shall be taken to seal the end of the centerbulb, using additional PVC material if needed.

3.3 JOINT CONSTRUCTION

A. **Setting Waterstops:** In order to eliminate faulty installation that may result in joint leakage, particular care shall be taken of the correct positioning of the waterstops during installation. Adequate provisions must be made to support and anchor the waterstops during the progress of the WORK and to insure the proper embedment in the concrete. The symmetrical halves of the waterstops shall be equally divided between the concrete pours at the joints. The center axis of the waterstops shall be coincident with the joint openings. Maximum density and imperviousness of the concrete shall be insured by thoroughly working it in the vicinity of all joints.

B. In placing flat-strip waterstops in the forms, means shall be provided to prevent them from being folded over by the concrete as it is placed. Unless otherwise indicated, waterstops shall be held in place with light wire ties on 12-inch centers which shall be passed through the edge of the waterstop and tied to the curtain of reinforcing steel. Horizontal waterstops, with their flat face in a vertical plane, shall be held in place with continuous supports to which the top edge of the waterstop shall be tacked. In placing concrete around horizontal waterstops, with their flat face in a horizontal plane, concrete shall be worked under the waterstops by hand so as to avoid the formation of air and rock pockets.

C. In placing centerbulb waterstops in expansion joints, the centerbulb shall be centered on the joint filler material.

D. Waterstop in vertical wall joints shall stop 6 inches from the top of the wall where such waterstop does not connect with any other waterstop and is not to be connected to a future concrete placement.

E. **Joint Location:** Construction joints and other types of joints shall be provided where indicated. When not indicated, construction joints shall be provided at 25-foot maximum spacing for all concrete construction. Where joints are indicated spaced greater than 40 feet apart, additional joints shall be provided to maintain the 25-foot maximum spacing. The location of all joints, of any type, shall be submitted for acceptance by the ENGINEER.

F. **Joint Preparation:** Special care shall be used in preparing concrete surfaces at joints where bonding between 2 sections of concrete is required. Unless otherwise indicated, such bonding will be required at all horizontal joints in walls. Surfaces shall be prepared in accordance with the requirements of Section 03300 - Cast-in-Place Concrete. Except on horizontal wall construction joints, wall to slab joints, or where otherwise indicated, at all joints where waterstops are required, the joint face of the first pour shall be coated with a bond breaker as indicated herein.

G. **Retrofit Joint Preparation:** Existing surfaces to receive a retrofit waterstop shall be clean and free from any loose or foreign material. Surface shall be given a light sandblast or hydroblast finish to 1/8-inch amplitude prior to application of epoxy and waterstop.

H. **Construction Joint Sealant:** Construction joints in water-bearing floor slabs, and elsewhere as indicated, shall be provided with tapered grooves which shall be filled with a construction joint sealant. The material used for forming the tapered grooves shall be left in the grooves until just before the grooves are cleaned and filled with joint sealant. After removing the forms from the grooves, all laitance and fins shall be removed, and the grooves shall be sand-blasted. The grooves shall be allowed to become thoroughly dry, after which they shall be blown out; immediately thereafter, they shall be primed, bond breaker tape placed in the bottom of the groove, and filled with the construction joint sealant. The primer shall be furnished by the sealant manufacturer. No sealant will be permitted to be used without a primer. Care shall be used to completely fill the sealant grooves. Areas designated to receive a sealant fillet shall be thoroughly cleaned, as outlined for the tapered grooves, prior to application of the sealant.

I. The primer and sealant shall be placed strictly in accordance with the printed recommendations of the manufacturer, taking special care to properly mix the sealant prior to application. The sides of the sealant groove shall not be coated with bond breaker, curing compound, or any other substance which would interfere with proper bonding of the sealant. Sealant shall achieve final cure at least 7 days before the structure is filled with water.

J. Sealant shall be installed by a competent waterproofing specialty contractor who has a successful record of performance in similar installations. Before work is commenced, the crew doing the WORK shall be instructed on the proper method of application by a representative of the sealant manufacturer.

K. Thorough, uniform mixing of 2-part, catalyst-cured materials is essential; special care shall be taken to properly mix the sealer before its application. Before any sealer is placed, the CONTRACTOR shall arrange to have the crew doing the WORK carefully instructed on the proper method of mixing and application by a representative of the sealant manufacturer.

L. Any joint sealant which fails to fully and properly cure after the manufacturer's recommended curing time for the conditions of the WORK hereunder, shall be completely removed; the groove shall be thoroughly sandblasted to remove all traces of the uncured or partially cured sealant and primer, and shall be re-sealed with the indicated joint sealant. All costs of such removal, joint treatment, re-sealing, and appurtenant work shall be at no increased cost to the OWNER.

M. **Hydrophillic Waterstop**

1. Where a hydrophillic waterstop is called for in the Contract Documents, it shall be installed with the manufacturer's instructions and recommendations except as modified herein.

2. When requested by the ENGINEER, the CONTRACTOR shall arrange for the manufacturer to furnish technical assistance in the field.

3. Hydrophillic waterstop shall only be used where complete confinement by concrete is provided. Hydrophillic waterstop shall not be used in expansion or contraction joints

nor in the first [redacted] inches of any intersecting joint.

4. The hydrophillic waterstop shall be located as near as possible to the center of the joint and it shall be continuous around the entire joint. The minimum distance from the edge of the waterstop to the face of the member shall be 5 inches.

5. Where the thickness of the concrete member to be placed on the hydrophillic waterstop is less than 12 inches, the waterstop shall be placed in grooves formed or ground into the concrete. The groove shall be at least 3/4 inch deep and 1-1/4 inches wide. When placed in the groove, the minimum distance from the edge of the waterstop to the face of the member shall be 2.5 inches.

6. Where a hydrophillic waterstop is used in combination with PVC waterstop, the hydrophillic waterstop shall overlap the PVC waterstop for a minimum of 6 inches and shall be adhered to PVC waterstop with single component water-swelling sealant as recommended by manufacturer.

7. The hydrophillic waterstop shall not be installed where the air temperature falls outside the manufacturer's recommended range.

8. The concrete surface under the hydrophillic waterstop shall be smooth and uniform. The concrete shall be ground smooth if needed. Alternately, the hydrophillic waterstop shall be bonded to the surface using an epoxy grout which completely fills all voids and irregularities beneath the waterstop material. Prior to installation, the concrete surface shall be wire brushed to remove any laitance or other materials that may interfere with the bonding of epoxy.

9. The hydrophillic waterstop shall be secured in place with concrete nails and washers at 12-inch maximum spacing. This shall be in addition to the adhesive recommended by the manufacturer.

N. **Retrofit Waterstop:**

1. Retrofit waterstops shall be set in a bed of epoxy over a sandblasted surface with stainless steel batten bars and 1/4-inch diameter stainless steel anchors at 6 inches on center, staggered, and in accordance with the manufacturer's written recommendations.

- END OF SECTION -

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide cast-in-place concrete, complete and in place, in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Federal Specifications and Standards

UU-B-790A (1) (2)	Building Paper, Vegetable Fiber (Kraft, Waterproofed, Water Repellant and Fire Resistant)
PS 1	Construction and Industrial Plywood
PS 20	American Softwood Lumber Standard

B. Commercial Standards

ACI 214	Recommended Practice for Evaluation of Strength Test Results of Concrete
ACI 301	Structural Concrete for Buildings
ACI 315	Details and Detailing of Concrete Reinforcement
ACI 318	Building Code Requirements for Reinforced Concrete
ACI 347	Guide to Formwork for Concrete
ASTM A 82	Steel Wire, Plain, for Concrete Reinforcement
ASTM A 185	Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A 615	Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM C 31	Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C 33	Concrete Aggregates
ASTM C 39	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C 94	Ready-Mixed Concrete

ASTM C 114	Test Methods for Chemical Analysis of Hydraulic Cement
ASTM C 136	Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C 143	Standard Test Method for Slump of Hydraulic Cement Concrete
ASTM C 150	Portland Cement
ASTM C 156	Standard Test Method for Water Retention by Concrete Curing Materials
ASTM C 192	Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 260	Air-Entraining Admixtures for Concrete
ASTM C 309	Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 494	Chemical Admixtures for Concrete
ASTM C 1077	Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM D 1751	Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-Extruding and Resilient Bituminous Types)
ASTM E 119	Standard Test Methods for Fire Tests of Building Construction and Materials
AWS D 1.4	Structural Welding Code - Reinforcing Steel
WRI	Manual of Standard Practice for Welded Wire Fabric

1.3 CONTRACTOR SUBMITTALS

A. **General:** Furnish submittals in accordance with Section 01300 - Contractor Submittals.

B. Shop Drawings

1. Detailed plans of the false work proposed to be used. Such plans shall be in sufficient detail to indicate the general layout, sizes of members, anticipated stresses, grade of materials to be used in the false work, and typical soil conditions.

2. Shop bending diagrams, placing lists, and drawings of all reinforcing steel prior to fabrication.

3. Details of the concrete reinforcing steel and concrete inserts shall be submitted at the

earliest possible date after receipt of the Notice to Proceed. Details of reinforcing steel for fabrication and erection shall conform to ACI 315 and the requirements indicated. The shop bending diagrams shall show the actual lengths of bars, to the nearest inch measured to the intersection of the extensions (tangents for bars of circular cross section) of the outside surface. The Shop Drawings shall include bar placement diagrams which clearly indicate the dimensions of each bar splice.

4. Where mechanical couplers are required or permitted to be used to splice reinforcing steel, submit manufacturer's literature which contains instructions and recommendations for installation for each type of coupler used; certified test reports which verify the load capacity of each type and size of coupler used; and Shop Drawings which show the location of each coupler with details of how they are to be installed in the formwork.

5. Submit a written welding procedure for each type of weld for each size of bar which is to be spliced by welding; merely a statement that AWS procedures will be followed is not acceptable. Certify procedure qualifications for each welding procedure used and welder qualifications, for each welding procedure, and for each welder performing the work. Such qualifications shall be as specified in AWS D1.4.

C. **Mix Designs:** Prior to beginning the WORK, submit preliminary concrete mix designs which shall show the proportions and gradations of all materials proposed for each class and type of concrete herein. The mix designs shall be checked by an independent testing laboratory acceptable to the ENGINEER. All costs related to such checking shall be borne by the CONTRACTOR. When a water reducing admixture is to be used, the CONTRACTOR shall furnish mix designs for concrete both with and without the admixture.

D. **Delivery Tickets:** Where ready-mix concrete is used, furnish certified delivery tickets at the time of delivery of each load of concrete. Each ticket shall show the state certified equipment used for measuring, and the total quantities, by weight, of cement, sand, each class of aggregate, admixtures, and the amounts of water in the aggregate, added at the batching plant, and the amount allowed to be added at the site for the specific design mix. In addition, each certificate shall state the mix number, total yield in cubic yards, and the time of day, to the nearest minute, corresponding to the time when the batch was dispatched, when it left the plant, when it arrived at the Site, when unloading began, and when unloading was finished.

1.4 QUALITY ASSURANCE

A. Testing of Reinforcing Steel

1. If requested by the ENGINEER, the CONTRACTOR shall furnish samples from each heat of reinforcing steel in a quantity adequate for testing. Costs of initial tests will be paid by the OWNER. Costs of additional tests of non-compliant steel shall be paid by the CONTRACTOR at no increased cost to the OWNER.

2. If requested by the ENGINEER, the CONTRACTOR shall provide samples of each type of welded splice used in the work in a quantity and of dimensions adequate for testing. At the discretion of the ENGINEER, radiographic testing of direct butt welded splices will be performed. The CONTRACTOR shall provide assistance necessary to facilitate testing. The CONTRACTOR shall repair any weld which fails to meet the requirements of AWS D1.4. The costs of testing will be paid by the OWNER; except,

the costs of all tests which fail to meet specified requirements shall be paid by the CONTRACTOR at no increased cost to the OWNER.

B. Testing of Materials

1. Tests on component materials and for compressive strength of concrete will be performed as indicated herein. Test for determining slump will be in accordance with the requirements of ASTM C 143.

2. The cost of laboratory tests on cement, aggregates, and concrete, will be paid by the OWNER. However, the CONTRACTOR will be charged for the cost of any additional tests and investigations on WORK which does not meet the Specifications. The laboratory will meet or exceed the requirements of ASTM C 1077.

3. Concrete for testing shall be supplied by the CONTRACTOR at no cost to the OWNER, and the CONTRACTOR shall assist the ENGINEER in obtaining samples and disposal and cleanup of excess material.

C. Field Compression Tests

1. Compression test specimens will be taken from the first placement of each class of concrete herein and at intervals thereafter as selected by the ENGINEER to insure continued compliance. Each set of test specimens will be a minimum of 4 cylinders.

2. Compression test specimens for concrete will be made in accordance with section 9.2 of ASTM C 31. Specimens will be 6-inch diameter by 12-inch high cylinders.

3. Compression tests will be performed in accordance with ASTM C 39. One test cylinder will be tested at 7 days and 2 at 28 days. The remaining cylinder will be held to verify test results, if needed.

D. Evaluation and Acceptance of Concrete

1. Evaluation and acceptance of the compressive strength of concrete will be according to the requirements of ACI 318, Chapter 5 "Concrete Quality", and as indicated herein.

2. If any concrete fails to meet these requirements, immediate corrective action shall be taken to increase the compressive strength for all subsequent batches of the type of concrete affected.

3. All concrete which fails to meet the ACI requirements and these Specifications, is subject to removal and replacement at no additional cost to the OWNER.

E. **Construction Tolerances:** The CONTRACTOR shall set and maintain concrete forms and perform finishing operations so as to ensure that the concrete is within the tolerances herein. Surface defects and irregularities are defined as finishes and are to be distinguished from tolerances. Tolerance is the permissible variation from lines, grades, or dimensions indicated. Where tolerances are not stated in the Specifications, permissible deviations will be in accordance with ACI 117.

PART 2 – PRODUCTS

2.1 FORM AND FALSE WORK MATERIALS

A. Except as otherwise specifically accepted by the ENGINEER, all lumber brought on the Site for use as forms, shoring, or bracing shall be new material.

B. Materials for concrete forms, formwork, and false work shall conform to the following requirements:

1. Lumber shall be Douglas Fir or Southern Yellow Pine, construction grade or better, in conformance with U.S. Product Standard PS 20.

2. Plywood for concrete formwork shall be new, waterproof, synthetic resin bonded, exterior type Douglas Fir or Southern Yellow Pine plywood manufactured especially for concrete formwork and shall conform to the requirements of PS 1 for Concrete Forms, Class I, and shall be edge sealed.

3. Form materials shall be metal, wood, plywood, or other material that will not adversely affect the concrete and will facilitate placement of concrete to the shape, form, line, and grade required. Metal forms shall be an approved type that will accomplish such results. Wood forms for surfaces to be painted shall be Medium Density Overlaid plywood, MDO Ext. Grade.

C. Unless otherwise indicated, exterior corners in concrete members shall be provided with 3/4-inch chamfers or tooled to a 3/4-inch radius. Re-entrant corners in concrete members shall not have fillets unless otherwise indicated.

D. Forms and false work to support the roof and floor slabs shall be designed for the total dead load, plus a live load of 30 psf (minimum).

2.2 FORM TIES

A. Form ties shall be provided with a plastic cone or other suitable means for forming a conical hole to insure that the form tie may be broken off back of the face of the concrete. The maximum diameter of removable cones for rod ties or other removable form-tie fasteners having a circular cross-section shall not exceed 1-1/2 inches; and all such fasteners shall be such as to leave holes of regular shape for reaming. Form ties shall be **Burke Penta-Tie System by The Burke Company.**

B. Removable taper ties may be used when approved by the ENGINEER. Taper Ties shall be **Taper-Tie System by The Burke Company.**

2.3 REINFORCEMENT STEEL

A. **General:** Reinforcement steel for cast-in-place reinforced concrete construction shall conform to the requirements of Section 03200 – Reinforcement Steel.

2.4 MECHANICAL COUPLERS

A. Mechanical couplers shall be in accordance with Section 03200 – Reinforcement Steel.

2.5 WELDED SPLICES

A. Welded splices shall be in accordance with Section 03200 – Reinforcement Steel.

2.6 CONCRETE MATERIALS

A. Materials shall be delivered, stored, and handled so as to prevent damage by water or breakage. Only one brand of cement shall be used. Cement reclaimed from cleaning bags or leaking containers shall not be used. All cement shall be used in the sequence of receipt of shipments.

B. All materials furnished for the work shall comply with the requirements of Sections 201, 203, and 204 of ACI 301, as applicable.

C. Storage of materials shall conform to the requirements of Section 205 of ACI 301.

D. Materials for concrete shall conform to the following requirements:

1. Cement shall be standard brand portland cement conforming to ASTM C 150 for Type II or Type V.

2. Water shall be potable, clean, and free from objectionable quantities of silty organic matter, alkali, salts and other impurities. The water shall be considered potable, for the purposes of this Section only, if it meets the requirements of the local governmental agencies. Agricultural water with high total dissolved solids (over 1000 mg/l TDS) shall not be used.

3. Aggregates shall be obtained from pits acceptable to the ENGINEER, shall be non-reactive, and shall conform to ASTM C 33. Maximum size of coarse aggregate shall be as indicated herein. Lightweight sand for fine aggregate will not be permitted.

4. Ready-mix concrete shall conform to the requirements of ASTM C 94.

5. Air-entraining agent meeting the requirements of ASTM C 260 shall be used. Sufficient air-entraining agent shall be used to provide a total air content of 3 to 5 percent; provided that, when the mean daily temperature in the vicinity of the Site falls below 40 degrees F for more than one day, the total air content provided shall be 5 to 7 percent. The OWNER reserves the right, at any time, to sample and test the air-entraining agent received on the job by the CONTRACTOR. The air-entraining agent shall be added to the batch in a portion of the mixing water. The solution shall be batched by means of a mechanical batcher capable of accurate measurement.

6. Admixtures: Admixtures may be added at the CONTRACTOR's option to control the set, affect water reduction, and increase workability. In either case, the addition of an admixture shall be at the CONTRACTOR's expense. The use of an admixture shall be subject to acceptance by the ENGINEER. Concrete containing an admixture shall be first placed at a location determined by the ENGINEER. If the use of an admixture is producing an inferior end result, the CONTRACTOR shall discontinue use of the admixture. Admixtures shall conform to the requirements of ASTM C 494. The required quantity of cement shall be used in the mix regardless of whether or not an admixture is used. Admixtures shall contain no free chloride ions, shall be

non-toxic after 30 days, and shall be compatible with and made by the same manufacturer as the air entraining admixture.

a. Concrete shall not contain more than one water reducing admixture. Concrete containing an admixture shall be first placed at a location determined by the ENGINEER.

b. Set controlling admixture may be either with or without water-reducing properties. Where the air temperature at the time of placement is expected to be consistently over 80 degrees F, a set retarding admixture such as **Sika Corporation's Plastiment or Master Builder's Pozzolith 440-N** shall be used. Where the air temperature at the time of placement is expected to be consistently under 40 degrees, a set accelerating admixture such as **Sika Corporation's Plastocrete 161FL or Master Builder's Pozzutec 20** shall be used.

c. Low range water reducer shall conform to ASTM C 494, Type A. It shall be **WRDA by Grace Concrete Products or Pozzolith 322-n by Master Builders.** The quantity of admixture used and the method of mixing shall be in accordance with the manufacturer's instructions and recommendations.

7. Calcium Chloride: Calcium chloride will not be permitted in concrete.

2.7 CURING MATERIALS

A. Materials for curing concrete shall conform to the following requirements and ASTM C 309:

1. Concrete curing compound shall be **Select Cure CRB as manufactured by Select Products Co., Upland, CA; Burke Spartan Cote Cure-Seal Hardener (with red fugitive dye)** as manufactured by **The Burke Company, San Mateo, CA or MB-429** as manufactured by **Master Builders.** The curing compound shall contain a fugitive dye so that areas of application will be readily distinguishable.

2. Polyethylene sheet for use as concrete curing blanket shall be white, and shall have a nominal thickness of 6 mils. The loss of moisture when determined in accordance with the requirements of ASTM C 156 shall not exceed 0.055 grams per square centimeter of surface.

3. Evaporation retardant shall be a material such as **Confilm** as manufactured by **Master Builders or Eucobar** as manufactured by **Euclid Chemical Company**.

2.8 JOINT MATERIALS

A. Materials for joints in concrete shall conform to the following requirements:

1. Preformed joint filler shall be a non-extruding, resilient, bituminous type conforming to ASTM D 1751.

2. Elastomeric joint sealer shall conform to the requirements of Section 07920 - Sealants and Caulking.

3. Mastic joint sealer shall be a material that does not contain evaporating solvents; that

will tenaciously adhere to concrete surfaces; that will remain permanently resilient and pliable; that will not be affected by continuous presence of water and will not in any way contaminate potable water; and that will effectively seal the joints against moisture infiltration even when the joints are subject to movement due to expansion and contraction. The sealer shall be composed of special asphalts or similar materials blended with lubricating and plasticizing agents to form a tough, durable mastic substance containing no volatile oils or lubricants and shall be capable of meeting the test requirements set forth hereinafter, if testing is required by the ENGINEER.

2.9 MISCELLANEOUS MATERIALS

A. Epoxy adhesives shall be the following products.

1. For bonding freshly-mixed, plastic concrete to hardened concrete, **Sikadur 32 Hi-Mod Epoxy Adhesive,** as manufactured by **Sika Corporation; Concresive Liquid (LPL), as manufactured by Master Builders or BurkEpoxy MV** as manufactured by **The Burke Company.**

2. For bonding hardened concrete or masonry to steel, **Sikadur 31 Hi-Mod Gel** as manufactured by **Sika Corporation; BurkEpoxy NS** as manufactured by **The Burke Company; Concresive Paste (LPL)** as manufactured by **Master Builders.**

2.10 CONCRETE DESIGN REQUIREMENTS

A. General

1. Concrete shall be composed of cement, admixtures, aggregates and water, all of the qualities indicated. In general, the mix shall be designed to produce a concrete capable of being deposited so as to obtain maximum density and minimum shrinkage and, where deposited in forms, to have good consolidation properties and maximum smoothness of surface. The proportions shall be changed whenever necessary or desirable to meet the required results at no additional cost to the OWNER. All changes shall be subject to review by the ENGINEER.

2. The CONTRACTOR is cautioned that the limiting parameters specified below are **NOT** a mix design. Additional cement or water reducing agent may be required to achieve workability demanded by the CONTRACTOR'S construction methods. The CONTRACTOR is responsible for any costs associated with furnishing concrete with the required workability.

B. **Water-Cement Ratio and Compressive Strength:** The minimum compressive strength and cement content of concrete shall be not less than the following tabulation.

Class of Concrete Min 28-Day Compressive Strength (psi)	Type of Work	Max Size Aggregate (in)	Min Cement Per cu yd (sacks)	Max W/C Ratio (by weight)
4,000	All concrete	1	6.0	0.45
3,000	All concrete	1	5.5	0.50

Note: One sack of cement equals 94 lb.

2.11 CONSISTENCY

A. The consistency of the concrete in successive batches shall be determined by slump tests in accordance with ASTM C 143. The slumps shall be as follows:

Part of Work	Slump (in)
All Concrete, unless indicated otherwise	3 inches plus or minus 1 inch
Footings and slabs	3 inches plus or minus 1 inch
Ductbank	5 inches plus or minus 1inch
Other work	3 inches plus 1 inch

2.12 MEASUREMENT OF CEMENT AND AGGREGATE

A. The amount of cement and of each separate size of aggregate entering into each batch of concrete shall be determined by direct weighing equipment furnished by the CONTRACTOR and acceptable to the ENGINEER; provided that, where batches are so proportioned as to contain an integral number of conventional sacks of cement, and the cement is delivered at the mixer in the original unbroken sacks, the weight of the cement contained in each sack may be taken without weighing as 94 pounds.

2.13 MEASUREMENT OF WATER

A. The quantity of water entering the mixer shall be measured by a suitable water meter or other measuring device of a type acceptable to the ENGINEER and capable of measuring the water in variable amounts within a tolerance of one percent.

2.14 READY-MIXED CONCRETE

A. At the CONTRACTOR'S option, ready-mixed concrete may be used meeting the requirements as to materials, batching, mixing, transporting, placing and the supplementary requirements as required herein and in accordance with ASTM C 94.

B. Ready-mixed concrete shall be delivered to the Site, and discharge shall be completed within one hour after the addition of the cement to the aggregates or before the drum has been revolved 250 revolutions, whichever is first. In hot weather, or under conditions contributing to quick stiffening of the concrete, or when the temperature of the concrete is 85 degrees F or above, the time between the introduction of the cement to the aggregates and discharge shall not exceed 45 minutes.

C. Truck mixers shall be equipped with electrically-actuated counters by which the number of revolutions of the drum or blades may be readily verified. The counter shall be of the resettable, recording type, and shall be mounted in the driver's cab. The counters shall be actuated at the time of starting mixers at mixing speeds.

D. Each batch of concrete shall be mixed in a truck mixer for not less than 70 revolutions of

the drum or blades at the rate of rotation designated by the manufacturer of equipment. Additional mixing, if any, shall be at the speed designated by the manufacturer of the equipment as agitating speed. All materials including mixing water shall be in the mixer drum before actuating the revolution counter for determining the number of revolution of mixing.

E. Each batch of ready-mixed concrete delivered to the Site shall be accompanied by a certified delivery ticket in accordance with the Paragraph in Part 1 entitled "Delivery Tickets."

F. The use of non-agitating equipment for transporting ready-mixed concrete will not be permitted. Combination truck and trailer equipment for transporting ready-mixed concrete will not be permitted. The quality and quantity of materials used in ready-mixed concrete and in batch aggregates shall be subject to continuous inspection at the batching plant by the ENGINEER.

PART 3 – EXECUTION

3.1 GENERAL FORMWORK REQUIREMENTS

A. Forms to confine the concrete and shape it to the required lines shall be used wherever necessary. The CONTRACTOR shall assume full responsibility for the adequate design of all forms, and any forms which are unsafe or inadequate in any respect shall promptly be removed from the WORK and replaced at the CONTRACTOR's expense. A sufficient number of forms of each kind shall be provided to permit the required rate of progress to be maintained. The design and inspection of concrete forms, false work, and shoring shall comply with applicable local, state and federal regulations. All design, construction, maintenance, preparation, and removal of forms shall be in accordance with ACI 347 and the requirements herein.

B. All forms shall be true in every respect to the required shape and size, shall conform to the established alignment and grade, and shall be of sufficient strength and rigidity to maintain their position and shape under the loads and operations incident to placing and vibrating the concrete.

3.2 CONSTRUCTION

A. **Vertical Surfaces:** All vertical surfaces of concrete members shall be formed, except where placement of the concrete against the ground is called for on the Drawings. Not less than 1-inch of concrete shall be added to the thickness of the concrete member as shown where concrete is permitted to be placed against trimmed ground in lieu of forms. Such permission will be granted only for members of comparatively limited height and where the character of the ground is such that it can be trimmed to the required lines and will stand securely without caving or sloughing until the concrete has been placed.

B. **Construction Joints:** Concrete construction joints will not be permitted at locations other than those indicated, except as may be acceptable to the ENGINEER. When a second lift is placed on hardened concrete, special precautions shall be taken in the way of the number, location, and tightening of ties at the top of the old lift and bottom of the new to prevent any unsatisfactory effect whatsoever on the concrete. Pipe stubs and anchor bolts shall be set in the forms where required.

C. Form Ties

1. Embedded Ties: Wire ties for holding forms will not be permitted. No form-tying device or part thereof, other than metal, shall be left embedded in the concrete. Ties shall not be removed in such manner as to leave a hole extending through the interior of the concrete members. The use of snap-ties which cause spalling of the concrete upon form stripping or tie removal will not be permitted. If steel panel forms are used, rubber grommets shall be provided where the ties pass through the form in order to prevent loss of cement paste. Where metal rods extending through the concrete are used to support or to strengthen forms, the rods shall remain embedded and shall terminate not less than 1-inch back from the formed face or faces of the concrete.

2. Removable Ties: Where taper ties are approved for use, after the taper tie is removed, the hole shall be thoroughly cleaned and roughened for bond. A precast neoprene or polyurethane tapered plug shall be located at the wall centerline. The hole shall be completely filled with non-shrink or regular cement grout. Exposed faces of walls shall have at least the outer 2 inches of the exposed face filled with a cement grout which shall match the color and texture of the surrounding wall surface.

3.3 REUSE OF FORMS

A. Forms may be reused only if in good condition and only if acceptable to the ENGINEER. Light sanding between uses will be required wherever necessary to obtain uniform surface texture on all exposed concrete surfaces. Exposed concrete surfaces are defined as surfaces which are permanently exposed to view.

3.4 REMOVAL OF FORMS

A. Careful procedures for the removal of forms shall be strictly followed, and this work shall be done with care so as to avoid injury to the concrete. No heavy loading on green concrete will be permitted. Members which must support their own weight shall not have their forms removed until they have attained at least 75 percent of the 28-day strength of the concrete. Forms for all vertical walls and columns shall remain in place at least 2 days after the concrete has been placed. Forms for all parts of the WORK not specifically mentioned herein shall remain in place for periods of time as determined by the ENGINEER.

3.5 GENERAL REINFORCEMENT REQUIREMENTS

A. All reinforcement steel, welded wire fabric, couplers, and other appurtenances shall be fabricated, and placed in accordance with the requirements of the Building Code and the supplementary requirements indicated herein.

3.6 FABRICATION

A. General

1. Reinforcement steel shall be accurately formed to the dimensions and shapes required, and the fabricating details shall be prepared in accordance with ACI 315 and ACI 318, except as modified by the Drawings.

2. The CONTRACTOR shall fabricate reinforcement bars for structures in accordance

with bending diagrams, placing lists, and placing drawings. Said drawings, diagrams, and lists shall be prepared by the CONTRACTOR.

3. Unless otherwise indicated, dowels shall match the size and spacing of the spliced bar.

B. **Bending or Straightening:** Reinforcement shall not be straightened or rebent in a manner which will injure the material. No bars with kinks or bends not required shall be used. All bars shall be bent cold, unless otherwise permitted by the ENGINEER. No bars partially embedded in concrete shall be field-bent except as shown or specifically permitted by the ENGINEER.

3.7 PLACING

A. Reinforcement steel shall be accurately positioned and shall be supported and wired together to prevent displacement, using annealed iron wire ties or suitable clips at intersections. All reinforcement steel shall be supported by concrete, plastic or metal supports, spacers or metal hangers which are strong and rigid enough to prevent any displacement of the reinforcement steel. Where concrete is to be placed on the ground, supporting concrete blocks (or dobies) shall be used, in sufficient numbers to support the bars without settlement, but in no case shall such support be continuous. All concrete blocks used to support reinforcement steel shall be tied to the steel with wire ties which are embedded in the blocks. For concrete over formwork, the CONTRACTOR shall provide concrete, metal, plastic, or other acceptable bar chairs and spacers.

B. The portions of all accessories in contact with the formwork shall be made of concrete, plastic, or steel coated with a 1/8-inch minimum thickness of plastic which extends at least □-inch from the concrete surface. Plastic shall be gray in color.

C. Tie wires shall be bent away from the forms in order to provide the required concrete coverage.

D. Bars additional to those indicated which may be found necessary or desirable by the CONTRACTOR for the purpose of securing reinforcement in position shall be provided by the CONTRACTOR at its own expense.

E. Unless otherwise specified, reinforcement placing tolerances shall be within the limits specified in Section 7.5 of ACI 318 except where in conflict with the requirements of the Building Code.

F. The minimum spacing requirements of ACI 318 shall be followed for all reinforcing steel.

G. Welded wire fabric reinforcement placed over horizontal forms shall be supported on slab bolsters having gray, plastic-coated standard type legs. Slab bolsters shall be spaced not less than 30 inches on centers, shall extend continuously across the entire width of the reinforcing mat, and shall support the reinforcing mat in the plane indicated.

H. Welded wire fabric placed over the ground shall be supported on wired concrete blocks (dobies) spaced not more than 3 feet on centers in any direction. The construction practice of placing welded wire fabric on the ground and hooking into place in the freshly placed concrete shall not be used.

3.8 SPLICING

A. **General:** Reinforcement bar splices shall be in accordance with Section 03200 Reinforcement Steel.

3.9 CLEANING AND PROTECTION

A. Reinforcement steel shall be in accordance with Section 03200 – Reinforcement Steel.

3.10 PROPORTIONING AND MIXING

A. **Proportioning:** Proportioning of the concrete mix shall conform to the requirements of Chapter 3 "Proportioning" of ACI 301.

B. **Mixing:** Mixing of concrete shall conform to the requirements of Chapter 7 ACI 301.

C. **Slump:** Maximum slumps shall be as indicated.

D. **Retempering:** Retempering of concrete or mortar which has partially hardened will not be permitted.

3.11 PREPARATION OF SURFACES FOR CONCRETING

A. **General:** Earth surfaces shall be thoroughly wetted by sprinkling, prior to the placing of any concrete, and these surfaces shall be kept moist by frequent sprinkling up to the time of placing concrete thereon. The surface shall be free from standing water, mud, and debris at the time of placing concrete.

B. **Joints in Concrete:** Concrete surfaces upon or against which concrete is to be placed, where the placement of the old concrete has been stopped or interrupted so that, as determined by the ENGINEER, the new concrete cannot be incorporated integrally with that previously placed, are defined as construction joints. The surfaces of horizontal joints shall be given a compacted, roughened surface for good bond. Except where the Drawings call for joint surfaces to be coated, the joint surfaces shall be cleaned of all laitance, loose or defective concrete, and foreign material. Such cleaning shall be accomplished by hydroblasting. All pools of water shall be removed from the surface of construction joints before the new concrete is placed.

C. **Placing Interruptions:** When placing of concrete is to be interrupted long enough for the concrete to take a set, the working face shall be given a shape by the use of forms or other means, that will secure proper union with subsequent WORK; provided that construction joints shall be made only where acceptable to the ENGINEER.

D. Embedded Items

1. No concrete shall be placed until all formwork, installation of parts to be embedded, reinforcement steel, and preparation of surfaces involved in the placing have been completed and accepted by the ENGINEER at least 4 hours before placement of concrete. All surfaces of forms and embedded items that have become encrusted with dried grout from concrete previously placed shall be cleaned of all such grout before the surrounding or adjacent concrete is placed.

2. All reinforcement, anchor bolts, sleeves, inserts, and similar items shall be set and

secured in the forms where shown on the Drawings or by Shop Drawings and shall be accepted by the ENGINEER before any concrete is placed. Accuracy of placement is the responsibility of the CONTRACTOR.

E. **Casting New Concrete Against Old:** Where concrete is to be cast against old concrete (any concrete which is greater than 60 days of age), the surface of the old concrete shall be thoroughly cleaned and roughened by hydro-blasting (exposing aggregate) prior to the application of an epoxy bonding agent. Application shall be according to the bonding agent manufacturer's instructions and recommendations.

F. No concrete shall be placed in any structure until all water entering the space to be filled with concrete has been properly cut off or has been diverted by pipes, or other means, and carried out of the forms, clear of the work. No concrete shall be deposited underwater nor shall the CONTRACTOR allow still water to rise on any concrete until the concrete has attained its initial set. Water shall not be permitted to flow over the surface of any concrete in such manner and at such velocity as will injure the surface finish of the concrete. Pumping or other necessary dewatering operations for removing ground water, if required, will be subject to the review of the ENGINEER.

G. **Corrosion Protection:** Pipe, conduit, dowels, and other ferrous items required to be embedded in concrete construction shall be so positioned and supported prior to placement of concrete that there will be a minimum of 2 inches clearance between said items and any part of the concrete reinforcement. Securing such items in position by wiring or welding them to the reinforcement will not be permitted.

H. Openings for pipes, inserts for pipe hangers and brackets, and the setting of anchors shall, where practicable, be provided for during the placing of concrete.

I. Anchor bolts shall be accurately set, and shall be maintained in position by templates while being embedded in concrete.

J. **Cleaning:** The surfaces of all metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar, and other foreign substances immediately before the concrete is placed.

3.12 HANDLING, TRANSPORTING, AND PLACING

A. **General:** Placing of concrete shall conform to the applicable requirements of Chapter 8 of ACI 301 and the requirements of this Section. No aluminum materials shall be used in conveying any concrete.

B. **Non-Conforming WORK or Materials:** Concrete which upon or before placing is found not to conform to the requirements herein shall be rejected and immediately removed from the WORK. Concrete which is not placed in accordance with these Specifications, or which is of inferior quality, shall be removed and replaced at no increased cost to OWNER.

C. **Unauthorized Placement:** No concrete shall be placed except in the presence of a duly authorized representative of the ENGINEER. The CONTRACTOR shall notify the ENGINEER in writing at least 24 hours in advance of placement of any concrete.

D. Placement in Wall and Column Forms

1. Concrete shall not be dropped through reinforcement steel or into any deep form, whether reinforcement is present or not, causing separation of the coarse aggregate from the mortar on account of repeatedly hitting rods or the sides of the form as it falls, nor shall concrete be placed in any form in such a manner as to leave accumulation of mortar on the form surfaces above the placed concrete. In such cases, some means such as the use of hoppers and, if necessary, vertical ducts of canvas, rubber, or metal shall be used for placing concrete in the forms in a manner that it may reach the place of final deposit without separation. In no case shall the free fall of concrete exceed 4 feet in walls and 8 feet in columns below the ends of ducts, chutes, or buggies. Concrete shall be uniformly distributed during the process of depositing and in no case after depositing shall any portion be displaced in the forms more than 6 feet in horizontal direction. Concrete in forms shall be deposited in uniform horizontal layers not deeper than 2 feet; and care shall be taken to avoid inclined layers or inclined construction joints except where such are required for sloping members. Each layer shall be placed while the previous layer is still soft. The rate of placing concrete in wall forms shall not exceed 5 feet of vertical rise per hour.

2. The surface of the concrete shall be level whenever a run of concrete is stopped. To insure a level, straight joint on the exposed surface of walls, a wood strip at least 3/4-inch thick shall be tacked to the forms on these surfaces. The concrete shall be carried about □-inch above the underside of the strip. About one hour after the concrete is placed, the strip shall be removed and any irregularities in the edge formed by the strip shall be leveled with a trowel and all laitance shall be removed.

E. **Conveyor Belts and Chutes:** Ends of chutes, hopper gates, and all other points of concrete discharge throughout the CONTRACTOR'S conveying, hoisting and placing system shall be so designed and arranged that concrete passing from them will not fall separated into whatever receptacle immediately receives it. Conveyor belts, if used, shall be of a type acceptable to the ENGINEER. Chutes longer than 50 feet will not be permitted. Minimum slopes of chutes shall be such that concrete of the required consistency will readily flow in them. If a conveyor belt is used, it shall be wiped clean by a device operated in such a manner that none of the mortar adhering to the belt will be wasted. All conveyor belts and chutes shall be covered. Sufficient illumination shall be provided in the interior of all forms so that the concrete at the places of deposit is visible from the deck or runway.

F. **Temperature of Concrete:** The temperature of concrete when it is being placed shall be not more than 90 degrees F nor less than 40 degrees F in moderate weather, and not less than 50 degrees F in weather during which the mean daily temperature drops below 40 degrees F. Concrete ingredients shall not be heated to a temperature higher than that necessary to keep the temperature of the mixed concrete, as placed, from falling below the required minimum temperature. If concrete is placed when the weather is such that the temperature of the concrete would exceed 90 degrees F, the CONTRACTOR shall employ effective means, such as precooling of aggregates and mixing water, using ice, or placing at night, as necessary to maintain the temperature of the concrete, as it is placed, below 90 degrees F. The CONTRACTOR shall be entitled to no additional compensation on account of the foregoing requirements.

G. Cold Weather Placement

1. Placement of concrete shall conform to ACI - 306.1 - Cold Weather Concreting, and the following.

2. Earth foundations shall be free from frost or ice when concrete is placed upon or against them.

3. Maintain the concrete temperature above 50 degrees F for at least 3 days after placement.

3.13 PUMPING OF CONCRETE

A. **General:** If the pumped concrete does not produce satisfactory end results, the CONTRACTOR shall discontinue the pumping operation and proceed with the placing of concrete using conventional methods.

B. Pumping Equipment

1. The pumping equipment shall have 2 cylinders and be designed to operate with one cylinder only in case the other one is not functioning. In lieu of this requirement, the CONTRACTOR may have a standby pump on the site during pumping.

2. The minimum diameter of the hose (conduits) shall be 4 inches.

3. Pumping equipment and hoses (conduits) that are not functioning properly, shall be replaced.

4. Aluminum conduits for conveying the concrete shall not be permitted.

C. Proportioning

1. Minimum compressive strength, cement content, and maximum size of aggregates shall be as required in this Section.

2. Gradation of coarse aggregates shall conform to ASTM C 33 and shall be as close to the middle range as possible.

3. Gradation of fine aggregate shall conform to ASTM C 33, with 15 to 30 percent passing the number 50 screen and 5 to 10 percent passing the number 100 screen. The fineness modulus of sand used shall not be over 3.00.

3.14 TAMPING AND VIBRATING

A. As concrete is placed in the forms or in excavations, it shall be thoroughly settled and compacted, throughout the entire depth of the layer which is being consolidated, into a dense, homogeneous mass, filling all corners and angles, thoroughly embedding the reinforcement, eliminating rock pockets, and bringing only a slight excess of water to the exposed surface of concrete during placement. Vibrators shall be high speed power vibrators (8000 to 10,000 rpm) of an immersion type in sufficient number and with (at least one) standby units as required.

B. Concrete in walls shall be internally vibrated and at the same time rammed, stirred, or worked with suitable appliances, tamping bars, shovels, or forked tools until it completely fills the forms or excavations and closes snugly against all surfaces. Subsequent layers of concrete shall not be placed until the layers previously placed have been worked thoroughly. Vibrators shall be provided in sufficient numbers, with standby units as

required, to accomplish the required results within 15 minutes after concrete of the prescribed consistency is placed in the forms. The vibrating head shall be kept from contact with the surfaces of the forms. Care shall be taken not to vibrate concrete excessively or to work it in any manner that causes segregation of its constituents.

3.15 FINISHING CONCRETE SURFACES

A. **General:** Surfaces shall be free from fins, bulges, ridges, offsets, honeycombing, or roughness of any kind, and shall present a finished, smooth, continuous hard surface. Allowable deviations from plumb or level and from the alignment, profiles, and dimensions indicated are defined as tolerances and are indicated in Part 1 above. These tolerances are to be distinguished from irregularities in finish as described herein. Aluminum finishing tools shall not be used.

B. **Formed Surfaces:** No treatment is required after form removal except for curing, repair of defective concrete, and treatment of surface defects.

C. **Unformed Surfaces:** After proper and adequate vibration and tamping, all unformed top surfaces of slabs, floors, walls, and curbs shall be brought to a uniform surface with suitable tools. The classes of finish specified for unformed concrete surfaces are designated and defined as follows:

1. Finish U1 - Sufficient leveling and screeding to produce an even, uniform surface with surface irregularities not to exceed 3/8-inch. No further special finish is required.

2. Finish U2 - After sufficient stiffening of the screeded concrete, surfaces shall be float finished with wood or metal floats or with a finishing machine using float blades. Excessive floating of surfaces while the concrete is plastic and dusting of dry cement and sand on the concrete surface to absorb excess moisture will not be permitted. Floating shall be the minimum necessary to produce a surface that is free from screed marks and is uniform in texture. Surface irregularities shall not exceed 1/4-inch. Joints and edges shall be tooled where indicated or as determined by the ENGINEER.

3. Finish U3 - After the Finish U2 surface has hardened sufficiently to prevent excess of fine material from being drawn to the surface, steel troweling shall be performed with firm pressure such as will flatten the sandy texture of the floated surface and produce a dense, uniform surface free from blemishes, ripples, and trowel marks. The finish shall be smooth and free of all irregularities.

4. Finish U4 - Trowel the Finish U3 surface to remove local depressions or high points. In addition, the surface shall be given a light hairbroom finish with brooming perpendicular to drainage unless otherwise indicated. The resulting surface shall be rough enough to provide a nonskid finish.

D. Unformed surfaces shall be finished according to the following schedule:

UNFORMED SURFACE FINISH SCHEDULE

Area	Finish
Grade slabs and foundations to be covered with concrete or fill material	U1
Floors to be covered with grouted tile or topping grout	U2
Slabs to be covered with built-up roofing	U2
Slabs and floors to receive architectural finish	U3
Slabs	U4

3.16 CURING AND DAMPPROOFING

A. **General:** Concrete shall be cured for not less than 14 days after placing, in accordance with the methods indicated below for the different parts of the WORK.

Surface to be Cured or Dampproofed	Method
Unstripped forms	1
Construction joints between footings and walls, and between floor slab and columns	2
Encasement concrete and thrust blocks	3
All concrete surfaces not specifically provided for elsewhere in this Paragraph	4

B. **Method 1:** Wooden forms shall be wetted immediately after concrete has been placed and shall be kept wet with water until removed. If steel forms are used the exposed concrete surfaces shall be kept continuously wet until the forms are removed. If forms are removed within 14 days of placing the concrete, curing shall be continued in accordance with Method 4.

C. **Method 2:** The surface shall be covered with burlap mats which shall be kept wet with water for the duration of the curing period, until the concrete in the walls has been placed. No curing compound shall be applied to surfaces cured under Method 2.

D. **Method 3:** The surface shall be covered with moist earth not less than 4 hours, nor more than 24 hours, after the concrete is placed. Earthwork operations that may damage the concrete shall not begin until at least 7 days after placement of concrete.

E. **Method 4:** The surface shall be sprayed with a liquid curing compound.

1. It shall be applied in accordance with the manufacturer's printed instructions at a

maximum coverage rate of 200 square feet per gallon and in such a manner as to cover the surface with a uniform film which will seal thoroughly.

2. Where the curing compound method is used, care shall be exercised to avoid damage to the seal during the curing period. Should the seal be damaged or broken before the expiration of the curing period, the break shall be repaired immediately by the application of additional curing compound over the damaged portion.

3. Wherever curing compound may have been applied by mistake to surfaces against which concrete subsequently is to be placed and to which it is to adhere, curing compound shall be entirely removed by wet sandblasting just prior to the placing of new concrete.

4. Where curing compound is required, it shall be applied as soon as the concrete has hardened enough to prevent marring on unformed surfaces, and within 2 hours after removal of forms from contact with formed surfaces. Repairs required to be made to formed surfaces shall be made within the said 2-hour period; provided, however, that any such repairs which cannot be made within the said 2-hour period shall be delayed until after the curing compound has been applied. When repairs are to be made to an area on which curing compound has been applied, the area involved shall first be wet-sandblasted to remove the curing compound.

5. Whenever the air temperature exceeds 85 degrees F or the wind speed exceeds 25 mph at the time of placement, the concrete shall be treated as follows. Immediately after the concrete has been screeded, it shall be treated with a liquid evaporation retardant. The retardant shall be used again after each work operation as necessary to prevent drying shrinkage cracks.

6. During the curing period, no traffic of any nature and no depositing of any materials, temporary or otherwise, shall be permitted on surfaces coated with curing compound. Foot traffic and the depositing of materials may be allowed after three days if the surface is covered with 5/8-inch plywood placed over polyethylene sheets.

F. The CONTRACTOR may submit alternate methods of curing which maintain the concrete in a continuously wet condition for acceptance by the ENGINEER.

3.17 PROTECTION

A. The CONTRACTOR shall protect all concrete against injury until final acceptance by the OWNER. Fresh concrete shall be protected from damage due to rain, hail, sleet, or snow. The CONTRACTOR shall provide such protection while the concrete is still plastic and whenever such precipitation is imminent or occurring. Immediately following the first frost in the fall, the CONTRACTOR shall be prepared to protect all concrete against freezing. After the first frost, and until the mean daily temperature in the vicinity of the Site falls below 40 degrees F for more than one day, the concrete shall be maintained at a temperature not lower than 50 degrees F for at least 72 hours after it is placed.

3.18 CURING IN COLD WEATHER

A. Water curing of concrete may be reduced to 6 days during periods when the mean daily temperature in the vicinity of the Site is less than 40 degrees F; provided that, during the prescribed period of water curing, when temperatures are such that concrete surfaces may freeze, water curing shall be temporarily discontinued.

B. Concrete cured by an application of curing compound will require no additional protection from freezing if the protection at 50 degrees F for 72 hours is obtained by means of approved insulation in contact with the forms or concrete surfaces; otherwise, the concrete shall be protected against freezing temperatures for 72 hours immediately following 72 hours protection at 50 degrees F. Concrete cured by water curing shall be protected against freezing temperatures for 3 days immediately following the 72 hours of protection at 50 degrees F.

C. Discontinuance of protection against freezing temperatures shall be such that the drop in temperature of any portion of the concrete will be gradual and will not exceed 40 degrees F in 24 hours. In the spring, when the mean daily temperature rises above 40 degrees F for more than 3 successive days, 72-hour protection at a temperature not lower than 50 degrees F may be discontinued for as long as the mean daily temperature remains above 40 degrees F; provided, that the concrete shall be protected against freezing temperatures for not less than 48 hours after placement.

D. Where artificial heat is employed, special care shall be taken to prevent the concrete from drying. Use of unvented heaters will be permitted only when unformed surfaces of concrete adjacent to the heaters are protected for the first 24 hours from an excessive carbon dioxide atmosphere by application of curing compound; provided, that the use of curing compound for such surfaces is otherwise permitted by this Section.

3.19 TREATMENT OF SURFACE DEFECTS

A. As soon as forms are removed, exposed concrete surfaces shall be carefully examined and any irregularities shall be immediately rubbed or ground in a satisfactory manner in order to secure a smooth, uniform, and continuous surface. Plastering or coating of surfaces to be smoothed will not be permitted. No repairs shall be made until after inspection by the ENGINEER. In no case will extensive patching of honeycombed concrete be permitted. Concrete containing minor voids, holes, honeycombing, or similar depression defects shall be repaired as required herein. Concrete containing extensive voids, holes, honeycombing, or similar depression defects, shall be completely removed and replaced. Repairs and replacements shall be promptly executed at no increased cost to the OWNER.

B. Defective surfaces to be repaired shall be cut back from true line a minimum depth of □-inch over the entire area. Feathered edges will not be permitted. Where chipping or cutting tools are not required in order to deepen the area properly, the surface shall be prepared for bonding by the removal of all laitance or soft material, and not less than 1/32-inch depth of the surface film from all hard portions, by means of an efficient sandblast. After cutting and sandblasting, the surface shall be wetted sufficiently in advance of shooting with shotcrete or with cement mortar so that while the repair material is being applied, the surfaces under repair will remain moist, but not so wet as to overcome the suction upon which a good bond depends. The material used for repair shall consist of a mixture of one sack of cement to 3 cubic feet of sand. For exposed walls, the cement shall contain such a proportion of Atlas white portland cement as is required to make the color of the patch match the color of the surrounding concrete.

C. Holes left by tie-rod cones shall be reamed with suitable toothed reamers so as to leave the surfaces of the holes clean and rough. These holes then shall be repaired in an approved manner with dry-packed cement grout. Holes left by form-tying devices having a rectangular cross-section, and other imperfections having a depth greater than their least

surface dimension, shall not be reamed but shall be repaired in an approved manner with dry-packed cement grout.

D. All repairs shall be built up and shaped in such a manner that the completed work will conform to the requirements of this Section, using methods which will not disturb the bond, cause sagging, or cause horizontal fractures. Surfaces of said repairs shall receive the same kind and amount of curing treatment as required for the concrete in the repaired section.

3.20 CARE AND REPAIR OF CONCRETE

A. The CONTRACTOR shall protect all concrete against injury or damage from excessive heat, lack of moisture, overstress, or any other cause until final acceptance by the OWNER. Particular care shall be taken to prevent the drying of concrete and to avoid roughening or otherwise damaging the surface. Any concrete found to be damaged, or which may have been originally defective, or which becomes defective at any time prior to the final acceptance of the completed work, or which departs from the established line or grade, or which, for any other reason, does not conform to the requirements of the Contract Documents, shall be satisfactorily repaired or removed and replaced with acceptable concrete at no increased cost to the OWNER.

- END OF SECTION -

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide grout, complete and in place, in accordance with the Contract Documents.

B. The following types of grout are covered in this Section:

1. Non-Shrink Grout: This type of grout is to be used wherever grout is indicated, unless another type is specifically referenced.

2. Cement Grout

3. Epoxy Grout

4. Topping Grout and Concrete Fill

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Specifications, codes, and standards shall be as listed in Section 03310 - Cast-in-Place Concrete, and as indicated herein.

1.3 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01300 - Contractor Submittals

B. **Shop Drawings:** Include certified test results verifying compliance with the compressive strength, shrinkage, and expansion requirements herein; and manufacturer's literature containing instructions and recommendations on the mixing, handling, placement, and appropriate uses for each type of non-shrink and epoxy grout proposed for the WORK.

1.4 QUALITY ASSURANCE

A. **Field Tests:**

1. Compression test specimens will be taken during construction from the first placement of each type of grout, and at intervals thereafter selected by the ENGINEER to insure continued compliance with these specifications. The specimens will be made by the ENGINEER or its representative.

2. Compression tests and fabrication of specimens for cement grout and non-shrink grout will be performed in accordance with ASTM C 109 - Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in or 50-mm Cube Specimens) at intervals during construction selected by the ENGINEER. A set of three specimens will be made for testing at 7 days, 28 days, and each additional time period as appropriate.

3. Compression tests and fabrication of specimens for epoxy grout will be performed in accordance with ASTM C 579 - Test Methods for Compressive Strength of Chemical-

Resistant Mortars and Monolithic Surfacings, Method B, at intervals during construction selected by the ENGINEER. A set of three specimens will be made for testing at 7 days, and each earlier time period as appropriate.

4. All grout which fails to meet requirements is subject to removal and replacement at no increased cost to the OWNER.

5. The cost of all laboratory tests on grout will be borne by the OWNER, but the CONTRACTOR shall assist the ENGINEER in obtaining specimens for testing. The CONTRACTOR shall be responsible for the cost of testing and inspection of Defective Work which has been replaced. The CONTRACTOR shall furnish all materials necessary for fabricating the test specimens.

B. **Construction Tolerances:** Construction tolerances shall be in accordance with Section 03310, unless indicated otherwise.

PART 2 – PRODUCTS

2.1 CEMENT GROUT

A. **Cement Grout:** Cement grout shall be composed of one part cement, three parts sand, and the minimum amount of water necessary to obtain the desired consistency. Where needed to match the color of adjacent concrete, white portland cement shall be blended with regular cement as needed. The minimum compressive strength at 28 days shall be 4000 psi.

B. Cement grout materials shall be as indicated in Section 03310, except that no cement from kilns burning metal-rich hazardous waste fuel shall be used.

2.2 PREPACKAGED GROUTS

A. **Non-Shrink Grout:**

1. Non-shrink grout shall be a prepackaged, inorganic, non-gas-liberating, non-metallic, cement-based grout requiring only the addition of water. Cement from kilns burning metal-rich hazardous waste fuel shall not be used. Manufacturer's instructions shall be printed on each bag or other container in which the materials are packaged. The specific formulation for each class of non-shrink grout herein shall be that recommended by the manufacturer for the particular application.

2. Class A non-shrink grouts shall have a minimum 28 day compressive strength of 5000 psi; shall have no shrinkage (0.0 percent) and a maximum 4.0 percent expansion in the plastic state when tested in accordance with ASTM C 827 - Test Method for Early Volume Change of Cementitious Mixtures; and shall have no shrinkage (0.0 percent) and a maximum of 0.2 percent expansion in the hardened state when tested in accordance with CRD C 621 - Corps of Engineers Specification for Non-shrink Grout.

3. Class B non-shrink grouts shall have a minimum 28 day compressive strength of 5000 psi and shall meet the requirements of CRD C 621.

4. Application:

a. Class A non-shrink grout shall be used for the repair of all holes and defects in concrete members which are water bearing or in contact with soil or other fill material, grouting under all equipment base plates, and at all locations where grout is required by the Contract Documents except where Class B non-shrink grout and epoxy grout are specifically required. Class A non-shrink grout may be used in place of Class B non-shrink grout for all applications.

b. Class B non-shrink grout shall be used for the repair of all holes and defects in concrete members which are not water-bearing and not in contact with soil or other fill material, grouting under all base plates for structural steel members, and grouting railing posts in place.

B. **Epoxy Grout:**

1. Epoxy grout shall be a pourable, non-shrink, 100 percent solids system. The epoxy grout system shall have three components: resin, hardener, and specially blended aggregate, all premeasured and prepackaged. The resin component shall not contain any non-reactive diluents. Resins containing butyl glycidyl ether (BGE) or other highly volatile and hazardous reactive diluents are not acceptable. Variation of component ratios is not permitted unless specifically recommended by the manufacturer. Manufacturer's instructions shall be printed on each container in which the materials are packaged. Epoxy grout shall be **BurkEpoxy Anchoring Grout by The Burke Company.**

2. The chemical formulation of the epoxy grout shall be that recommended by the manufacturer for the particular application.

3. The mixed epoxy grout system shall have a minimum working life of 45 minutes at 75 degrees F.

4. The epoxy grout shall develop a compressive strength of 5000 psi in 24 hours and 10,000 psi in seven days when tested in accordance with ASTM C 579, Method B. There shall be no shrinkage (0.0 percent) and a maximum 4.0 percent expansion when tested in accordance with ASTM C 827.

5. The epoxy grout shall exhibit a minimum effective bearing area of 95 percent. This shall be determined by a test consisting of filling a 2-inch diameter by 4-inch high metal cylinder mold covered with a glass plate coated with a release agent. A weight shall be placed on the glass plate. At 24 hours after casting, the weight and plate shall be removed and the area in plan of all voids measured. The surface of the grout shall be probed with a sharp instrument to locate all voids.

6. The peak exotherm of a 2-inch diameter by 4-inch high cylinder shall not exceed 95 degrees F when tested with 75 degree F material at laboratory temperature. The epoxy grout shall exhibit a maximum thermal coefficient of 30 x 10^{-6} inches/inch/degree F when tested according to ASTM C 531 - Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical- Resistant Mortars, Grouts, and Monolithic Surfacings or ASTM D 696 - Test Method for Coefficient of Linear Thermal Expansion of Plastics.

7. Application: Epoxy grout shall be used to embed all anchor bolts and reinforcing steel required to be set in grout, and for other applications specifically required in the

Contract Documents.

2.3 TOPPING GROUT AND CONCRETE FILL

A. Grout for topping of slabs and concrete fill for built-up surfaces of tank, channel, and basin bottoms shall be composed of cement, fine aggregate, coarse aggregate, water, and admixtures. All materials and procedures for concrete in Section 03310 - Cast-in-Place Concrete shall apply except as noted otherwise herein.

B. Topping grout and concrete fill shall contain a minimum of 564 pound of cement per cubic yard with a maximum water cement ratio of 0.45. Where concrete fill is thicker than 3 inches, concrete in accordance with Section 03310 - Cast-in-Place Concrete may be used if accepted by the ENGINEER.

C. Coarse aggregate shall be graded as follows:

U.S. STANDARD SIEVE SIZE	PERCENT BY WEIGHT PASSING
1/2"	100
3/8"	90-100
No. 4	20-55
No. 8	5-30
No. 16	0-10
No. 30	0

D. Final mix design shall be determined by trial mix design under supervision of the approved testing laboratory.

E. **Strength:** Minimum compressive strength of topping grout and concrete fill at the end of 28 days shall be 3000 psi.

2.4 CURING MATERIALS

A. Curing materials shall be in accordance with Section 03310 - Cast-in-Place Concrete for cement grout and be as recommended by the manufacturer of prepackaged grouts.

2.5 CONSISTENCY

A. The consistency of grout shall be as necessary to completely fill the space to be grouted for the particular application. Dry pack consistency is such that the grout is plastic and moldable but will not flow. Where "dry pack" is required by the Contract Documents, it shall mean a grout of that consistency; the type of grout to be used shall be as indicated herein for the particular application.

B. The slump for topping grout and concrete fill shall be adjusted to match placement and finishing conditions but shall not exceed 4 inches.

2.6 MEASUREMENT OF INGREDIENTS

A. Measurements for cement grout shall be made accurately by volume using containers. Shovel measurement shall not be allowed.

B. Prepackaged grouts shall have ingredients measured by means recommended by the manufacturer.

PART 3 – EXECUTION

3.1 GENERAL

A. All surface preparation, curing, and protection of cement grout shall be in accordance with Section 03310 - Cast-in-Place Concrete. The finish of the grout surface shall match that of the adjacent concrete.

B. The manufacturer of Class A non-shrink grout and epoxy grout shall provide on-Site technical assistance upon request.

C. Base concrete or masonry must have attained its design strength before grout is placed, unless authorized by the ENGINEER.

3.2 GROUTING PROCEDURES

A. **Prepackage Grouts:** All mixing, surface preparation, handling, placing, consolidation, curing, and other means of execution for prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.

B. **Base Plate Grouting:**

1. For base plates, the original concrete shall be blocked out or finished off a sufficient distance below the plate to provide for a one-inch thickness of grout or a thickness as indicated on the Drawings.

2. After the base plate has been set in position at the proper elevation by steel wedges or double nuts on the anchor bolts, the space between the bottom of the plate and the original pour of concrete shall be filled with non-shrink-type grout. The mixture shall be of a trowelable consistency and be tamped or rodded solidly into the space between the plate and the base concrete. A backing board or stop shall be provided at the back side of the space to be filled with grout. Where this method of placement is not practical or where required by the ENGINEER, alternate grouting methods shall be submitted for acceptance.

C. Topping Grout

1. All mechanical, electrical, and finish work shall be completed prior to placement of topping or concrete fill. The base slab shall be given a roughened textured surface by sandblasting or hydroblasting, exposing the aggregates to ensure bonding to the base slab.

2. The minimum thickness of grout topping and concrete fill shall be one inch. Where the finished surface of concrete fill is to form an intersecting angle of less than 45 degrees with the concrete surface it is to be placed against, a key shall be formed in the concrete surface at the intersection point. The key shall be a minimum of 3-1/2-inches wide by 1-1/2-inches deep.

3. The base slab shall be thoroughly cleaned and wetted prior to placing topping and fill.

No topping concrete shall be placed until the slab is completely free from standing pools or ponds of water. A thin coat of neat cement grout shall be broomed into the surface of the slab just before topping of fill placement. The topping and fill shall be compacted by rolling or tamping, brought to established grade, and floated. Grouted fill for tank and basin bottoms where scraping mechanisms are to be installed shall be screeded by blades attached to the revolving mechanism of the equipment in accordance with the procedures outlined by the equipment manufacturer after the grout is brought to the established grade.

4. Topping grout placed on sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the placement.

5. The surface shall be tested with a straight edge to detect high and low spots which shall be immediately eliminated. When the topping and fill has hardened sufficiently, it shall be steel troweled to a smooth surface free from pinholes and other imperfections. An approved type of mechanical trowel may be used as an assist in this operation, but the last pass over the surface shall be by hand-troweling. During finishing, no water, dry cement, or mixture of dry cement and sand shall be applied to the surface.

3.3 CONSOLIDATION

A. Grout shall be placed in such a manner, for the consistency necessary for each application, so as to assure that the space to be grouted is completely filled.

- END OF SECTION -

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall furnish all tools, equipment, materials, and supplies and shall perform all labor required to complete the precast concrete work in accordance with the Contract Documents.

B. This Section covers the design, fabrication, delivery and installation of all precast concrete units, including connections, complete, in place, as shown and specified.

1.2 CODES AND STANDARDS

A. **Commercial Standards:**

ANSI/ACI 315	Concrete Reinforcement
ANSI/ACI 318	Concrete Construction
ANSI/AWS A5.4	Welding Rods and Electrodes
AWS B2.1	
ANSI/AWS D1.1	Welding and Cutting
ANSI/AWS D1.4	Welding and Cutting
ASTM A 184	Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement
ASTM A 185	Specification for Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement
ASTM A 193	Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 194	Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service
ASTM A 351	Specification for Steel Castings, Austenitic, for High-Temperature Service
ASTM A 497	Specification for Welded Deformed Steel Wire Fabric for Concrete Reinforcement
ASTM A 580	Specification for Stainless and Heat-Resisting Steel Wire
ASTM A 615	Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

ASTM A 666	Specification for Austenitic Stainless Steel, Sheet, Strip, Plate, and Flat Bar for Structural Applications
ASTM A 775	Specifications for Epoxy-Coated Reinforcing Steel Bars
ASTM C 33	Specification for Concrete Aggregates
ASTM C 67	Method for Sampling and Testing Brick and Structural Clay Tile
ASTM C 127	Test Method for Specific Gravity and Absorption of Coarse Aggregate
ASTM C 128	Test Method for Specific Gravity and Absorption of Fine Aggregate
ASTM C 150	Specification for Portland Cement
ASTM C 173	Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C 204	Test Method for Fineness of Portland Cement by Air Permeability Apparatus
ASTM C 231	Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	Specification for Air-Entraining Admixtures for Concrete
ASTM C 311	Method for Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland Cement Concrete
ASTM C 494	Test Method for Shear Fatigue of Sandwich Core Materials
ASTM D 2240	Test Method for Rubber Property -- Durometer Hardness
AWS D12.1	
PCI MNL-116	
PCI MNL-117	
PCI MNL-121	

1.3 CONTRACTOR SUBMITTALS

A. Submittals shall be made in accordance with Section 01300, "Contractor Submittals."

B. **Shop Drawings:**

1. Shop drawings shall show details in accordance with ACI 315 and ACI 318 including installation details and design computations.

2. Shop drawings, including design computations, shall be stamped and signed by a structural engineer registered in the State and shall be approved by the ENGINEER.

3. Shop drawings shall indicate precast unit identification marks, location of units in the WORK, elevations, fabrication details, welding details, reinforcement, connections, dimensions, interface with adjacent members, and special handling instructions in sufficient detail to cover manufacture, handling, and erection. Shop drawings shall include erection drawings.

4. Shop drawings shall be divided into complete separate submittals for each structure. Each complete submittal shall consist of a panel schedule and shop drawings.

   a. Panel Schedule: Showing all exterior elevations of the building, including all precast concrete enclosure faces exposed to view, in its associated shop drawing submittal. Elevations at a minimum scale of 1/8" = 1'0" shall be drawn, identifying the type and location of each panel by a number which corresponds to the panel number appearing on an associated shop drawing; this same number shall be permanently marked on the back of each panel as they are fabricated.

   b. Shop Drawings: Showing all elevations, dimensions, horizontal and vertical sections, openings, inserts, reinforcing, anchorage devices, details, design computations, and other requirements for each different type of panel to be incorporated into the portion of the project covered by the submittal. Drawings shall be 24 inches x 36 inches maximum.

C. **Precast Prestressed Core Plank**

1. Precast prestressed hollow core planks shall be provided where shown on the Drawings. All connections shall be designed by the manufacturer, to resist all required vertical and lateral loads as shown on the drawings. Planks shall be designed for zero tension stress under all loading conditions required. furnish units of the size detailed on the Drawings or the equivalent section required to carry the design loads shown.

2. Units shall be cured by applying heat, with adequate moisture control provided to prevent shrinkage cracks, until the required strength for releasing the tension from the steel is reached.

3. Anchor bolts, bearing plates, rods and sleeves required or shown on the Drawings as cast into the units shall be furnished and installed.

4. Locations and size of openings shall be coordinated by the subcontractor shown on the shop drawings. A double stand shall be provided at all opening locations where it is required to out a strand.

D. **Small Samples:**

1. Two 72-inch by 72-inch samples of precast concrete unit finish shall be submitted, as required for the project. Each sample shall show matrix color, surface color, surface texture, and panel back finish.

2. The face of each sample shall contain at least two areas of approved size and shape which have been chipped out and then patched and repaired and one form joint; the color, texture and appearance of patched areas and form joint shall match that of adjacent surface.

3. Samples will be inspected for color and texture match to the samples selected by the ENGINEER, uniformity of color and texture throughout the panel and acceptability of patching and joint treatment. Exposed face of samples shall be tested for efflorescence in accordance with ASTM C 67; rating shall not be more than "slightly effloresced."

4. If the ENGINEER rules a sample, or samples, to be unacceptable, the CONTRACTOR shall fabricate and resubmit additional samples at no additional cost to the OWNER.

5. When approved, one sample will be kept at the ENGINEER's field office and the other shall be picked up by the CONTRACTOR and returned to the manufacturing plant. These sample panels will be used as a comparison to judge acceptability of the full-size panel samples and, where necessary, the production precast units.

E. **Full-Size Panel Samples at Manufacturing Plant:**

1. After the small samples and shop drawings have been approved, and prior to fabricating panels for the project, a full-size panel of specified color and each finish shall be produced and erected at the manufacturing plant for inspection and approval by the ENGINEER.

2. The full-size panels shall be fabricated utilizing tools, forms, materials and techniques proposed and the dimensions, profile cross section, color and texture required for the project. Panels will be inspected for color and texture to match approved samples, uniformity of color and texture throughout the panel, accuracy and sharpness of shape, acceptability of patched and repaired areas, and form joint treatment.

3. If the ENGINEER rules a sample to be unacceptable, the CONTRACTOR shall fabricate additional revised panel(s) at no additional cost to the OWNER. When approved, panels shall be preserved, remain at the plant, and become the job standard against which all panels will be compared as they come off the production line.

F. **Full-Size Panel Samples at Project Site:** From the first loads of acceptable panels for the Project, the ENGINEER will select one panel of each texture which is scheduled to be erected in a prominent location. If the ENGINEER chooses, panels may be selected from a later load. The selected panel(s) together with the 72-inch by 72-inch panel kept at the ENGINEER's field office, will become the jobsite standard against which all panels will be compared.

G. **Mix Proportions:** Prior to commencing operations, including fabrications of the precast for any mock-up, a statement shall be submitted giving the nominal maximum aggregate

size and proportions of all ingredients that will be used in manufacture of concrete. The statement shall include test results from an approved testing laboratory, certifying that the proportions selected will produce concrete of the properties required. No substitutions shall be made in materials used in the concrete mix without approval and additional tests to verify that the concrete properties are satisfactory. A copy shall be submitted of concrete mix with each set of samples.

H. **Test Reports:** Tests for compressive strength of concrete shall be performed by an independent commercial testing laboratory. Copies of test reports including all test data and all test results shall be submitted.

I. **Certificates of Compliance:** Certificates of compliance shall be submitted attesting that materials and products meet or exceed specified requirements.

J. **Manufacturer's Qualifications:** Prior to commencing operations, a statement shall be submitted giving the qualifications of the precast concrete Manufacturer, and evidence that the Manufacturer and plant are PCI certified.

1.4 QUALITY ASSURANCE

A. **General Requirements:** Design members under direct supervision of a professional structural engineer experienced in design of precast concrete units, registered in the State and conforming to requirements of PCI MNL-121 and to ACI 318.

1. Precast Manufacturer and erectors shall be qualified in accordance with PCI MNL-117 and MNL-116.

2. Welding shall be in accordance with AWS D1.1, AWS D12.1, AWS B2.1, and AWS A5.4.

3. Manufacture, Transportation and Installation: The Manufacturer shall specialize in providing architectural precast products and services normally associated with precast concrete construction with high quality architectural finishes similar to that indicated on drawings, using procedures complying with PCI MNL-116 and MNL-117, and PCI plant certified for at least 2 years.

B. **Sample:**

1. Prebid samples representing the color, surface, texture and panel back finish specified and required for this project can be viewed at the ENGINEER's office, by bidders and precast concrete Manufacturers prior to submitting bids.

2. It shall be the CONTRACTOR's responsibility to assure that all precast architectural concrete conforms to specified requirements for quality and appearance. The only appearance criterion is that all precast architectural finishes provided for this project conform in appearance, when viewed from a distance of 20 feet, to the design, color, and texture as represented by the prebid sample except that closeup inspection shall not exhibit any evidence of "bugholes" on exposed surfaces exceeding 1/8-inch and in quantity not more than 2 average per square foot.

C. **Sample Construction:**

1. A typical precast concrete combination sectioned wall and related perimeter window assembly shall be constructed and provided by the CONTRACTOR. This sample

construction, after approval, shall serve for comparison as a sample of construction requirements for the rest of the building.

2. The precast concrete units shall structurally support the window assemblies and include anchorage inserts for windows as indicated. Use of drilled-in anchorage inserts for window supports and anchorage of other items is prohibited. Sample construction shall be sealed and finished as required for completed wall.

3. The sample construction shall demonstrate precast concrete units and window framing, sealants, anchorage, and other elements of construction. The sample construction will be inspected and judged for compliance with requirements and visual appearance including, but not limited to, uniformity of color and texture, acceptability of patching and repair, and conformance to required tolerances. If the sample does not provide an acceptable window assembly or meet visual appearance or tolerance requirements as determined by the ENGINEER, the CONTRACTOR shall modify, repair, or reconstruct the sample at no additional cost.

1.5 DESIGN REQUIREMENTS

A. **General:** The precast concrete panel and connection designs shown represent minimum precast construction requirements. The Manufacturer shall verify the panel and connection designs for all handling, erection, and service conditions, and shall provide any additional materials necessary to meet the design conditions.

B. **Standards and Loads:** The precast panel and connection design and construction shall conform to all applicable codes and AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings. The precast or prefabricated, nonbearing, nonshear wall panels and connections which are attached to or enclose the exterior, shall resist, in addition to initial handling and erection loads and dead loads, the following forces:

1. Wind pressure and load combinations relative to panel design in accordance with UBC, Exposure C, 70 mph, I=1.0

2 The design shall be based on a differential temperature of 50 degrees F between interior and exterior faces of the units and an 80 degrees ($\pm$40 degrees from erected temperature) average panel temperature differential.

3 Stresses due to restrained volume changes caused by shrinkage and temperature differentials shall be accounted for.

C. **Connections:** Prior to submitting shop drawings, the CONTRACTOR shall verify the precast connection designs shown against the aforementioned and following design criteria and provide any additional materials necessary to meet the design conditions.

1. The panel joints shall be designed to accommodate an in-plane movement between stories of 0.005 times the story height in inches but not less than 3/4-inch.

2. Panel connections shall accommodate building movement and permit panels to move freely so as not to resist in plane deformation of the main frame structural system. Adjustment shall be provided to accommodate misalignment of structure without permanent distortion, damage to components, racking of joint connection, breakage of seals, or moisture penetration.

D. **Concrete Mix:** The concrete mix shall be designed by the manufacturer and approved by the ENGINEER, using the materials and quantities specified to meet all of the requirements of this specification.

1. Proportioning of Concrete Mixes: Mixes shall be proportioned by weight except water and admixtures may be batched by volume if desired. Trial mixes and testing to meet requirements of the strengths of concrete specified is the CONTRACTOR's responsibility. Design mix shall contain similar materials as those proposed for use in the WORK.

2. Admixtures: Concrete shall contain an air entraining admixture in proportion so as to provide 4 percent plus or minus 1 percent total air in the concrete as determined by ASTM C 173 or C 231. Set retarding admixtures may be used provided cement content is not reduced. Water reducing admixtures may be used provided they are used in the mix design studies. High-range water reducers (superplasticizers) shall be used only where specifically called for in this Section, otherwise superplasticizers shall not be used without written approval from the ENGINEER. No admixture may contain chlorides, bromides, or fluorides.

3. Water: Clean, potable water. The CONTRACTOR shall provide tests to assure that no more than 200 parts per million total aggregated content of chlorides, bromides, and fluorides are present.

4. If a variance from the Local Authority is required for the precast concrete mix design, the CONTRACTOR shall be responsible for submitting and obtaining the 5,000-psi precast concrete mix variance. The admixtures used in the mix design shall be used in approved combinations and proportions in accordance with the local requirements.

E. **Formwork:** Formwork shall be designed to withstand high-frequency vibration and to ensure finished units.

F. **Pickup Points and Boxouts:** Pickup points, boxouts, and inserts on panel faces and surfaces to be exposed are prohibited except as approved.

1.6 DELIVERY, STORAGE AND HANDLING

A. **General:** Precast members shall be handled to position consistent with their shape and design; they shall be lifted and supported from design incorporated support points and provided with strong backs and other devices as required. Lifting or handling equipment shall be capable of maintaining units during manufacture, storage, transportation, erection, and in position for fastening.

B. Blocking and supports, lateral restraints and protective materials during transport and storage shall be clean, nonstaining, without causing harm to exposed surfaces, including temporary support to prevent bowing and warping. Lateral restraints shall be provided to prevent undesirable horizontal movement. Edges and exposed faces of members shall be protected to prevent straining, chipping, or spalling of concrete.

C. Units shall be marked with date of production and final position in structure in location not visible after erection.

D. Precast units shall be stored off the ground in a manner to prevent warpage and they shall be protected from weather, marring, and overload.

E. **Stainless Steel Hardware:** Stainless steel hardware shall be transported, handled, stored, and protected in wood crates.

PART 2 – PRODUCTS

2.1 CONCRETE MATERIALS

A.	Cement	ASTM C 150, Type II, "low alkali," white color. "Low alkali" requirement may be waived if not reactive as defined in Appendix to ASTM C 33. Submit laboratory test reports.
B.	Aggregate	ASTM C 33, 1/2-inch max coarse aggregate size fine aggregate ratio to total aggregate volume = 0.35 min, 0.55 max.
	1. Water Absorption, Coarse	ASTM C 127.
	2. Water Absorption, Fine	ASTM C 128.
C.	Reinforcing Steel	ASTM A 615, Grade 60, deformed epoxy coated in accordance with ASTM A 775.
D.	Welded Wire Fabric:	
	1. Plain	ASTM A 185, epoxy coated.
	2. Deformed Steel	ASTM A 497, epoxy coated.
	3. Fabricated Steel Bar or Rod Mats.	ASTM A 184, epoxy coated.
E.	Tie Wire	ASTM A 580, Type 316L, cold finished annealed, **Huntington Alloy Co. "Monel"** or **"Inconel."**
F.	Air Entrainment Admixture	ASTM C 260.
G.	Water Reducing or Retarding Admixtures	ASTM C 494, Type C, D, or F/G, with no chloride, bromide, and fluoride ingredients.
H.	Silica Fume Slurry Admixture	45 to 50 percent silica fume, water, and superplasticizer as dispersant. Silica Fume: 85 percent amorphous silicon dioxide in accordance with ASTM C 311; loss on ignition shall not exceed 6 percent and moisture shall not exceed 3 percent in accordance with ASTM C 311. Surface area not less than 10,000 square meters per kilogram at bed porosity of 0.50 in accordance with ASTM C 204.

Reduce water in mix by 5.6 to 9.5 lbs for each gallon of slurry added to mix, as recommended by slurry Manufacturer used.

Slurry to concrete mix to achieve 7.5 percent dry silica fume by weight of cement. Mixing procedures as recommended by silica fume slurry manufacturer. **Sika "Sikacrete 950" or W.R. Grace "Force 10,000."**

I. Pigment

Pure mineral type, color-resistant to alkalis, nonfading. Color as required to produce finished concrete matching color and appearance of prebid sample and the 72-inch by 72-inch sample at the ENGINEER's field office.

2.2 SUPPORT DEVICES

A. Connecting and Support Devices

ASTM A 666, Type 316L stainless steel.

B. Bolts

ASTM A 193, Grade B8M (Type 316).

C. Nuts and Washers

ASTM A 194, Grade 8M (Type 316).

D. Weld Filler Metal for Stainless Steel

Stainless steel to stainless steel; AWS A5.4, Grade 316L filler metal; stainless steel to carbon steel, AWS A5.4, Grade 309 filler metal, 3/32-inch diameter.

E. Primer

Zinc-dust, zinc oxide primer in a phenolic resin spare varnish vehicle, TT-P-641 Type III (for galvanized surfaces).

2.3 ACCESSORIES

A. Plates, Angles, Anchors, and Studs

ASTM A 666, Type 316L stainless steel.

B. Austenitic Steel Castings for Embedments and Anchorage Assemblies

ASTM A 351, Type CF3M, with Type 316 stainless steel bolts, nuts, and washers.

C. Reglets

Plastic, shaped and flanged to remain in place once cast; tape closed to prevent concrete intrusion.

D. Bearing Pads

Neoprene, molded to size or cut from molded sheet, 70-80 Type A durometer, ASTM D 2240.

E. Sealant

Specified in Section 07920, "Sealants and Caulking."

2.4 FORMS

A.	Forms	Manufacturer's standard with smooth, hard, dense, and rigid casting surface; without bow, warpage, oil canning, or other imperfections.
B.	Form Release Agent	Manufacturer's standard, nonstaining, nonpetroleum based; compatible with concrete surface sealer.
C.	Surface Sealer	Clear, flat, penetrating, nonyellowing, nonclouding solution; high concentration of organosilane in an aqueous alcoholic vehicle which is designed to provide water repellent concrete surfaces from which graffiti can be easily removed. Oil-type silicones, paraffins, waxes, vinyls, modified urethanes, or acrylics shall not be used. Sealant shall be tested by Manufacturer and proved compatible with surface sealer.

2.5 MIX

A.	Silica Fume Concrete	Minimum 5,000 psi, 28-day compressive strength; aggregate 3/8-inch max; water - 305 lbs per cu yd; cement - 763 lbs per cu yd; w/c ratio 0.40 max; slump range 3 inches to 5 inches with silica fume slurry; air entrainment 4 percent plus or minus 1 percent; 7.5 percent dry silica fume by weight of cement, provided through specified silica fume slurry; add superplasticizer to achieve desired working slump for precast concrete as may be required by silica fume slurry Manufacturer. Add colorant as required to achieve match with ENGINEER's sample. Moist cure by spray mist.

2.6 FABRICATION

A. **General:** Precast concrete units shall be fabricated by a licensed shop in accordance with ACI 318, PCI MNL-116 (structural features), PCI MNL-117 (nonstructural features, surface treatments, patching, and tolerances). Plant records and quality control program shall be maintained during production of precast units. Records and access to plant shall be available to the ENGINEER upon request.

Rigid molds shall be used, constructed to maintain precast unit uniform in shape, size, and finish, free from castings and dents, gouges, oil canning, or other irregularities that will adversely affect appearance or strength of units. Consistent quality shall be maintained during manufacture.

Equipment for handling epoxy-coated reinforcing bars shall have protected contact areas. Bundles of coated bars shall be lifted at multiple pickup points to prevent bar-to-bar

abrasion from sags in the bundles. Coated bars or bundles of coated bars shall not be dropped or dragged. Coated bars shall be stored on protective cribbing. The maximum amount of damage shall not exceed 2 percent of the surface area of each bar.

Reinforcing steel, anchors, inserts, plates, angles, and other cast-in-place items shall be embedded as indicated on shop drawings. Reinforcement shall be fabricated and placed in conformance with ACI 318. No tack welding of or to reinforcement permitted. Welding when allowed shall conform to AWS D1.4 requirements. No carbon steel chairs, spacers, nails or tie wire shall be used in positioning reinforcing and embedments.

Adequate reinforcing steel shall be provided to control cracking. Maximum permissible crack width:

Surfaces exposed to weather:	0.005 inch.
Surfaces exposed to view but not weather:	0.01 inch

Connecting devices, plates, angles, items fit to steel framing members, inserts, bolts, and accessories shall be fabricated to permit initial placement and final attachment.

Anchors, inserts, lifting devices, and other accessories shall be placed and embedded in accordance with approved shop drawings, accurately positioned in their designed location and anchored to prevent dislocation during panel construction. Flashing reglets shall be placed and embedded continuous and straight, with lifting devices to permit removal after erection.

Units shall be moist cured with water mist to develop concrete quality and to minimize surface drying and appearance blemishes such as nonuniformity, staining, or surface cracking.

Precast units shall be removed from formwork using procedures conforming to PCI MNL-117. Minor patching in plant acceptable, providing structural adequacy and appearance of units are not impaired. Each precast unit shall be identified with corresponding code on erection drawings, in location not visible to finished work.

Repair of damaged epoxy coating, when required, shall be made with patching material conforming to ASTM A 775. Repair shall be in accordance with the material Manufacturer's recommendations.

B. **Fabrication and Tooling of Stainless Steel Connections and Embedments:** All tools used during fabrication shall be made of stainless steel. Use of carbon steel tools is prohibited.

Welding of stainless steel shall conform to AWS A5.4, AWS B2.1 and AWS D1.1, using tungsten inert gas procedures and 316L filler metal for stainless steel to stainless steel and 309 filler metal for stainless steel to carbon steel. Surfaces shall be sanded smooth (do not grind), and oxidized discoloration removed (blue heat tint). Threaded parts of stainless steel bolts shall be lubricated with graphite suspended in alcohol (Neo-Lube) every time that nut is run on or off the threads. No other lubricant is acceptable.

Erection slings, cables, blocking, hardware and restraints shall be nonmetallic or stainless steel. Cribbing or crating shall be wood.

2.7 FINISH OF PRECAST UNITS

A. **Backs and Sides (Unexposed Edges):** Smooth, dense, uniform surface free from blemishes. Defects in backs and sides (unexposed edges) shall be repaired as approved.

B. **Faces:** Appearance, color, and texture finish of all panels shall match appearance, color and texture of the approved sample panels constructed by the CONTRACTOR. Panels that do not match will be rejected. Repairs will be acceptable only if structural adequacy and appearance of product are not impaired and the repair and surrounding area match the approved sample panels at the ENGINEER's field office.

Mechanical finishing of panels at precast plant shall be at essentially the same age (or strength) of concrete to assure finished appearance is uniform from panel to panel.

To reduce possibility of stains occurring during transportation and erection, sealer shall be applied at the plant as recommended by Manufacturer and the precaster and shall be guaranteed in writing that sealer will not alter or yellow the original precast concrete color in any way and that it is compatible with the joint sealants to be used on the project. Seal finish surfaces of precast units to be exposed in completed work as follows: apply a uniform coat of surface sealer in accordance with Manufacturer's written instructions. Apply sealer by method and in quantity required to provide coverage specified by sealer Manufacturer. Forty-eight hours after application of sealer, apply water to face of each panel in sufficient quantity to determine if full sealer coverage was achieved. Panels not fully sealed shall be resealed and retested. A second coat shall be applied at the jobsite after erection and cleanup in accordance with the Manufacturer's instructions.

PART 3 – EXECUTION

3.1 INSTALLATION

A. **Examination:** The CONTRACTOR shall verify that building structure, anchors, devices, and openings are ready to receive work of this Section. Beginning of installation means acceptance of existing condition.

B. **Preparation:** The CONTRACTOR shall provide for erection procedures and induced loads, during erection, maintain temporary bracing in place until final support is provided, provide necessary hoisting equipment and safety and protective devices.

C. **Erection:** The units shall be erected in accordance with approved shop/erection drawings without damage to shape or finish or adjacent work. Damaged panels shall be replaced or repaired. Unless otherwise shown, members shall be erected level and plumb within allowable tolerances.

The CONTRACTOR shall align and maintain uniform horizontal and vertical joints as erection progresses, provide approved shims and wedges as required, and when members required adjustment beyond design or tolerance criteria, discontinue affected work. Units shall be secured in place and field welds, scratches and otherwise damaged steel surfaces shall be touched up.

Field fabrication and erection of stainless steel shall conform to the procedures outlined in the paragraph entitled "Fabrication and Tooling of Stainless Steel Connectors and Embedments."

The vertical units shall be set dry, without grout, attaining joint dimension with lead or plastic shims and spacers.

Pickup points, boxouts, inserts and bearing surfaces shown shall be grouted with non-shrink grout. The color and texture of concrete surfaces of adjacent areas shall be finished to match in the same plane.

D. **Tolerances:** In accordance with requirements of PCI MNL-117 unless otherwise indicated.

1. Variation from Plane of Location: 1/4-inch in 10 feet and 3/8-inch in 100 feet maximum, compensating not cumulative.

2. Offset from True Alignment between Two Connecting Members: 1/4-inch maximum.

3. Out of Square: 1/8-inch in 10 feet maximum, noncumulative.

4. Variation in Dimensions Indicated in Shop Drawings: Plus or minus 1/8-inch.

5. Misalignment of Anchors, Inserts, Openings: 1/8-inch, maximum.

6. Bowing or Warpage of Units: 1/700 of panel dimension.

7. Exposed Joint Dimension: 3/4-inch plus or minus 1/8-inch.

8. Location of Reglets: 1/4-inch from true position.

E. **Joint Sealing:** Specified in Section 07920, "Sealants and Caulking."

3.2 CLEANING

A. Not sooner than 72 hours after joints are sealed, faces and other exposed surfaces of precast units shall be cleaned using a cleaning detergent recommended by the sealer manufacturer and water applied with a soft bristle brush, and thoroughly rinsed using clean water or other approved procedures.

B. Units shall be cleaned when temperature and humidity conditions are such that surfaces dry rapidly (e.g., 70 degrees F and rising, 50 percent RH or less).

C. Discolorations which cannot be removed by these procedures shall be considered defective work, and repaired or replaced as directed by ENGINEER.

3.3 PROTECTION

A. Adjacent surfaces shall be protected from damage during sealing and cleaning operations and against damage, disfiguration or discoloration from subsequent operations. Noncombustible shielding shall be used during welding operations.

- END OF SECTION -

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide all architectural precast concrete work complete, including furnishing, fabricating, and placing of required reinforcing steel, and the furnishing and setting of embedded items and all other appurtenant work, in accordance with the requirements of the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **Codes:** All codes, as referenced herein, are specified in Section 01090, "Reference Standards."

B. **Commercial Standards:** The precast concrete work shall conform to the requirements and recommendations of applicable portions of standards list.

1. American Concrete Institute:

ACI 214	Recommended Practice for Evaluation of Compression Test Results of Field Concrete.
ACI 301	Specifications for Structural Concrete for Buildings.
ACI 318	Building Code Requirements for Reinforced Concrete.

And comply with the recognized acceptable practices contained in:

ACI 315; ACI 347, ACI 533.

2. American Society for Testing Materials:

ASTM C 31	ASTM C 192	ASTM A 185
ASTM C 33	ASTM C 231	ASTM A 416
ASTM C 39	ASTM C 260	ASTM A 421-80
ASTM C 94	ASTM C 666	ASTM A 497
ASTM C 150	ASTM C 567	ASTM A 616
ASTM C 143	ASTM C 330	ASTM A 615
ASTM C 173	ASTM C 36a	ASTM A 617

3. Prestressed Concrete Institute:

PCI MNL. 116-70	Manual for Quality Control for Plants Production of Precast Prestressed Concrete Products.
PCI JR 119	Recommended Practices for Grouting Post-Tensioned Prestressed Concrete.

4. Industrial Fasteners Institute:

Handbook on Fastener Standards.

5. National Ready Mixed Concrete Association:

NRMCA Bulletin No. 44 Control of Quality of Ready-Mixed Concrete.

6. American Welding Society:

AWS D 1.1-72	Structural Welding Code.
AWS D 12.1-61	Recommended Practices for Welding Reinforcing Steel, Metal Inserts and Connections in Reinforced Concrete Construction.
AWS B 3.0-41	Standard Qualification Procedure.

1.3 CONTRACTOR SUBMITTALS

A. **Shop Drawings:** Shop drawings of all miscellaneous metalwork shall be submitted to the ENGINEER for review in accordance with Section 01300, "Contractor Submittals."

B. **Design Calculations:** If the OWNER so requests, the CONTRACTOR shall submit for approval design calculations prepared by the manufacturer.

PART 2 – PRODUCTS

2.1 ARCHITECTURAL PRECAST CONCRETE

A. Furnish per plans and specifications all precast concrete elements such as copings, sills, and fascias, including the loose connection hardware indicated on the plans as being supplied by the precast contractor.

B. Coordinate work under this Section with related work performed elsewhere under the Contract.

C. Concrete members shall be produced by a manufacturer thoroughly experienced and qualified in this type of work. Manufacturer's production equipment must be capable of producing a high quality concrete product. This includes forms, mixers, accurate batching equipment, concrete consolidating equipment, reinforcing steel fabrication equipment, and testing equipment to accurately ascertain required concrete strengths.

D. All design and manufacturing must be under the supervision off a registered engineer, regularly employed, full time, by the manufacturer.

E. Coordination by General Contractor

1. Provision of required access for erection including access for trucks and cranes, shall be provided by General Contractor.

2. Protection of precast members after erection and cleaning by the Precast Contractor shall be the responsibility of the General Contractor.

3. Control lines, elevations, and reference points from which the proper locations and orientation of the precast elements can be determined. (To be provided by the General Contractor who alone is responsible for their accuracy.)

4. General Contractor shall coordinate delivery and erection of precast units with the erector.

F. Materials

1. Uniformity - To minimize irregularities in appearance and/or color, the cement, aggregates, admixtures and water shall each be obtained form the same source for the entire job.

2. Cement shall be Portland Cement, conforming to ASTM Specifications for Portland Cement - Designation 81, Type I or Type III.

3. Fine and coarse aggregates shall consist of clean, hard, strong, and durable inert material, free of injurious amounts deleterious substances and conforming to ASTM Specification C 33.

4. Water shall be free of any acid, alkali, oil or organic material that may interfere with the setting of the cement or cause discoloration.

5. Reinforcing steel or mesh shall conform to ASTM Specifications. All reinforcing steel shall be free of grease and dirt.

6. Air entrainment shall be required to increase resistance to freezing and thawing.

G. Concrete Tests

1. The manufacturer shall make a minimum of four (4) standard 6" x 12' test cylinders for every 5 cubic yards of concrete. Casting and curing of the test cylinders shall be identical with the actual method of production.

2. Cylinders shall be tested to failure. Test of concrete shall be performed by the manufacturer. One cylinder is to be tested prior to stripping the members to ascertain adequate strengths for stripping stresses. Two cylinders shall be tested at 28 days to verify required design strengths. The remaining cylinder shall be held in reserve until after the 28 day test and used if required to verify any erratic tests.

3. Testing shall be done by the manufacturer whose laboratory shall at all times be open to inspection by the OWNER. Test results and all records shall be kept and made available to the OWNER upon request.

4. Any additional testing or supervision as required by OWNER or by local building codes shall be done at the expense of the OWNER.

H. Finish

1. Finish, color and texture of all precast elements shall be such that the appearance of all precast elements shall meet with the approval of the OWNER. Submit samples, 4'-0" long minimum, to ENGINEER for approval.

I. Design

1. Design shall be in accordance with all current governing state and local codes.

2. The precast supplier is responsible for any additional reinforcing as required for live and dead load, fabrication, storage, handling, shipping and erection stresses. Analysis for these conditions shall be made by a registered professional civil engineer, who is employed, full time, by the manufacturer.

3. The precast supplier shall be responsible for the design of the concrete mixes to give the desired finish while producing the required physical properties.

4. If it is found that the mix producing the desired finish will not provide the required physical properties the precast supplier shall work with the OWNER to obtain a mix with acceptable modifications.

5. In order to prevent shrinkage cracks the cement content and water-cement ratio shall be kept to a minimum which will produce concrete with the required physical properties. (Cement content not to exceed 6-1/2 sacks per cubic yard, water-cement ratio not to exceed 0.41.)

6. All concrete shall have a compressive strength of not less than 6,000 psi at 28 days when tested on 6" x 12" cylinders according to ASTM C 39.

7. At time of stripping, all concrete shall have obtained strengths sufficient to withstand the stresses to be encountered as determined by an engineering analysis.

8. Air entrainment: minimum 3%; maximum 6%.

9. Concrete slump: maximum 5 inches per ASTM C 143.

10. Absorption: maximum 5%.

11. No calcium chloride or other salts.

J. Fabrication

1. Precast concrete elements shall be produced inside under controlled conditions. All work shall be done under the close supervision of trained personnel experienced in the production of precast concrete units of the type required for this project.

2. Concrete materials shall be proportioned by weight using accurate batching equipment.

3. Mixing shall be done in a type of mixer which thoroughly and uniformly distributes the ingredients throughout the mix.

4. The concrete shall be transported from the mixer to the form immediately after mixing and shall be handled so as to prevent segregation.

5. The concrete shall be consolidated in the forms by means of a low frequency, high amplitude external impacting process which will prevent segregation, produce a high density concrete free of air pockets or honeycomb, and produce the required surface finish and physical properties.

6. Where a separate facing mix is used it shall be a minimum of 3/4" thick. The back-up mix shall be placed soon after the facing mix and before it has started its initial set so that it will be an integral part of the concrete element.

7. Reinforcing shall be fabricated to the required configuration prior to casting the element. Precautions shall be taken to assure that the reinforcing remains in the proper location during the placing and consolidation of the concrete.

8. The elements shall be cast in accurate forms of rigid construction so as to yield members with the required finish properties and tolerances. The forms shall be accurate in detail with precise corners and arises so as to assure excellence in the finished product.

9. Curing of the concrete shall be done according to ACI 533, with utmost care so as to prevent shrinkage and loss of ultimate strength.

10. Each element shall be marked to correspond with the proper designation on the shop drawings.

11. During the first 16-20 hours after casting, maintain temperatures and prevent loss of moisture from the concrete for the initial phase of curing. After removal from the form, continue the secondary phase of curing until the compressive strength has been attained and confirmed by standard tests.

12. The plant facilities, equipment, and materials shall at all times be open to inspection by the OWNER.

13. The precast concrete elements shall be carefully handled, stored, and shipped so as to prevent warpage, spalling, cracking or staining.

K. Quality Control

1. The architectural precast concrete manufacturer shall have an established quality control program in effect prior to letting of the contract. An outline of this program shall be submitted along with the shop drawings.

2. Manufacturing and testing procedures shall be in general compliance with PCI recommendations in MNL 117. Tests for compliance shall be conducted by a qualified testing laboratory. Certified copies of test results shall be transmitted to the OWNER for approval.

L. Tolerances

1. **Warpage:** Warpage at time of delivery should not exceed 1/8 in. per 6 ft. length of member for the minimum length.

2. **Thickness:** Total thickness shall be within -1/8 in., ±1/4 in.

3. **Squareness:** No member shall be more than 18 inc. in 6 ft. out of square as measured on the diagonal.

4. **Location of anchors and inserts:** All anchors and inserts shall be within 3/8-in. of the centerline shown on drawings.

5. **Blockouts and Reinforcement:** Blockouts and reinforcement shall be within 1/4-in. of the position shown on the drawings to meet structural and cover requirements; otherwise within ±1/2 in.

6. **Joints:** Specified joint widths are normally 3/8 to 5/8-in. With member tolerances as required, this would result in joint widths of a minimum of 1/4-in., and a maximum of 3/4-in. which is suitable for standard sealants. If building tolerances are to be accommodated in the joints, or if excessive building movements are anticipated after erection of members, these factors must be considered and allowed for at the design stage and realistic joint width tolerances specified.

7. Tolerances on any dimension not specified above: the numerically greater of ±1/16 in. per 10 ft. or ±1/8 in.

2.2 LEAD JOINT CAPS

A. The CONTRACTOR shall furnish and install lead joint caps at all joints in all precast concrete copings, fascias, and sills, and this shall include all joints where members abut vertical or sloping surfaces of like or different materials.

B. The caps shall be made of pure, soft lead with anchor barbs to set and hold them in the caulking, as manufactured by **Weathercap, Inc.**

C. Use 9/16 inch size caps for joints up to 3/8 inch width, 11/16 inch size for joints 3/8 inch to 7/16 inch width and 1 inch size for joints 1/2 inch to 3/4 inch width. A 3/8 inch wide joint is specified for coping pieces. If actual joints on the job are greater than 3/8 inch wide, use the proper size cap for the larger joints, but mixing of cap sizes will not be allowed and the same size cap shall be used for all the joints in the coping stones on each building.

D. The joint caps shall be fitted in one continuous piece to cover the front, top and back face of each joint in the copings and outside front face and top of each joint in the sills, including joints where copings and sills abut other masonry.

2.3 STAINLESS STEEL DOWELS

A. The CONTRACTOR shall furnish and install stainless steel dowels and threaded rod dowels to anchor all precast concrete members as shown on Drawings or specified herein. Dowels shall be 3/4 inch in diameter by 6" long minimum or longer to suit conditions. There shall be two (2) dowels minimum for each piece, but spacing shall not exceed 4'-0" on center. Dowels shall be secured with grout in masonry walls and parapets and grouted into holes in bottom or backs of coping and sill pieces. Seal with mastic where dowels penetrate flashing under coping and sill pieces.

B. The abuting ends of all coping and sill pieces shall be connected together with a minimum of one (1) dowel; this shall also apply where ends abut masonry walls.

PART 3 – EXECUTION

3.1 ERECTION

A. Prior to installation, the building structure to which the precast concrete elements are attached shall be examined and any conditions adversely affecting the installation per plans and specifications shall be noted. If adverse conditions do exist, installation shall not proceed until they are corrected or until installation requirements are modified by the OWNER.

B. Control lines, elevations, and reference points shall have been clearly established by the General Contractor prior to installation and all precast units shall be oriented from them.

C. Delivery Handling and Storing at Job

1. Before unloading, check the condition of the members and if any damage has been sustained in transit, make proper notations to that effect on the bill of lading or delivery ticket.

2. Carefully remove all bracing, packing, etc., protecting edges of members. Corners and casts with returns of unusual lengths may be shipped with braces wired from loop to loop for greater protection in transit. Do not remove this bracing until just prior to installation. At all times, handle and lift members so as not to exceed allowable stress for which they are designed. General Contractor shall coordinate delivery, handling and storing with the erector.

3. Protective material shall be laid horizontally under the members and between each member. Members must be stored in their original square, flat plane. Place stored members os that identification marks are discernible. For spacers under and between members, acceptable protective material referred to above should be celotex wrapped in plastic sheeting of even thickness throughout.

3.2 INSTALLATION

A. All handling, setting and cleaning of precast members must be accomplished by experienced workmen. The precast erector must be approved by the manufacturer.

B. The precast members should be located in the center of their theoretical location on the building and adjusted to accommodate adjacent products, proper joint width and alignment with adjacent members.

C. All surfaces forming beds or other joints in precast members shall be cleaned of all dust, dirt and other foreign substances. Each shall be set level and true to line with uniform joints. All necessary precautions shall be taken to protect precast members form being damaged after they have been installed. Wedges, spacers, or other appliances (which are likely to cause staining) used in setting shall be removed from the joints as soon as practicable.

D. Precast and cast-in-place units shall be set to within plus or minus 1/4 inch of the location shown on the approved shop drawings.

E. Non-cumulative Erection Tolerances

1. **Joint dimension:** nominal 1/2 inch; to vary not more than plus or minus 1/8 inch.

2. **Joint taper:** edges at joint out of parallel; to comply with joint dimension tolerance.

3. **Edge alignment:** alignment job in alignment of edges; to vary not more than plus or minus 1/8 inch.

4. **Face offset:** exterior face unless otherwise noted; faces of adjacent members offset no more than 1/8 inch. Bowed members within allowable bowing tolerances, arranged so offset between adjacent members does not exceed 1/4 inch.

F. Set units dry, without mortar, attaining specified joint dimension with lead, plastic, cement-asbestos, or steel spacers.

G. Fasten precast in place by bolting or welding, or both.

H. Tighten bolted connections with equal torque.

I. Secure bolts or threaded rods and nuts with tack-weld after final adjustments are made.

J. Provide temporary erection anchorage for welded anchorage system.

K. Clean field welds with wire brush and protect materials other than stainless steel with same material used for shop coat or with zinc rich coating.

L. Remove shims and spacers from joints of non-load bearing members after fastening, before applying sealant.

M. Certified welders are to be employed for all field welding. Use low hydrogen electrodes and comply with standards of A.W.S.

3.3 CLEANING

A. The precast supplier and/or precast erector shall provide adequate means to protect all surfaces, tops, faces, edges and backs from staining, injury or other damage during handling and erection and until acceptable by the OWNER. After the members have been erected and caulked or pointed, the exposed faces requiring cleaning as determined by the OWNER, shall be cleaned down thoroughly in a manner which is compatible with the painted and cement coat finish specified in Section 09900 and Section 07150.

B. Surfaces shall be cleaned until acceptable to the OWNER.

C. Protection of the precast members after installation and approved cleaning is the responsibility of the General Contractor who therefore shall be responsible for any additional cleaning that might be required.

3.4 GUARANTEE

A. The precast concrete contractor shall furnish a written guarantee to the OWNER against defects in materials or workmanship for a period of five (5) years dating from acceptance of building.

- END OF SECTION -

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide brick masonry and appurtenant work, in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards

ANSI/ASTM C 5	Quicklime for Structural Purposes
ASTM A 82	Steel Wire, Plain, for Concrete Reinforcement
ASTM A 116	Zinc-Coated (Galvanized) Steel Woven Wire Fence Fabric
ASTM A 153	Zinc Coating (Hot Dip) on Iron and Steel Hardware
ASTM A 615	Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM C 62	Building Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C 67	Method of Sampling and Testing Brick and Structural Clay Tile
ASTM C 90	Load Bearing Concrete Masonry Units
ASTM C 144	Aggregate for Masonry Mortar
ASTM C 150	Portland Cement
ASTM C 207	Hydrated Lime for Masonry Purposes
ASTM C 216	Facing Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C 404	Aggregates for Masonry Grout
ASTM E 447	Test Methods for Compressive Strength of Masonry Prisms
UBC Standard 21-16	Field Test Specimens for Mortar

1.3 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01300 - Contractor Submittals.

B. Samples

1. Samples of brick masonry units and mortar for approval and selection of colors and textures. The ENGINEER may select more than one color and/or texture if desired.

2. A free-standing, minimum 4-ft square 12 inches high sample panel of the masonry work with at least one 90 degree corner, shall be prepared for approval. The sample panel shall remain at the Site and shall be kept in good condition until the completion and acceptance of all of the masonry work.

C. Documentation

1. Reports from testing brick masonry units

2. Reports from testing grout and mortar

3. Reports from prism testing

1.4 QUALITY ASSURANCE

A. **Matching Existing Work:** Where the brick work is required to match existing brick and/or brick work, the CONTRACTOR shall, prior to bid submittal, visit the Site or otherwise verify the existing brick and brick work so that the bid will include the required matching.

B. **Sampling and Testing:** In order to assure compliance with governing codes and specifications, material sampling and testing shall be performed by a reputable testing laboratory approved by the ENGINEER. All costs of sampling, testing, and test reports shall be paid for by the CONTRACTOR. The costs of any additional tests and reports requested by the ENGINEER will be paid by the OWNER if said tests and reports verify CONTRACTOR compliance with the requirements of the Contract Documents. When tests and reports indicate non-compliance, the costs thereof shall be paid by the CONTRACTOR.

C. **Masonry Unit Testing:** Brick masonry units shall be sampled and tested in accordance with the requirements of ASTM C 67.

D. **Mortar and Grout Testing:** Mortar and grout shall be sampled and tested as follows:

1. At the commencement of the masonry work: At least 2 test samples each of mortar and grout shall be taken on 3 successive working days.

2. At any change in materials or job conditions: At least 2 samples of each modified material, grout and mortar shall be tested.

3. Four random tests each of mortar and grout shall be made. The random test samples shall be taken when requested by the ENGINEER.

4. Additional samples and tests may be required whenever, in the judgment of the

ENGINEER, additional tests (beyond the random tests) are necessary to determine the quality of the materials.

5. Mortar and grout samples shall be stored in a moist environment until tested, unless directed otherwise by the ENGINEER or testing laboratory. Tests shall be in accordance with property specification requirements of ASTM C270 and ASTM C476. The grout mortar strengths shall be not less than the minimum strength herein.

E. **Inspection:** Whenever required under the provisions of the Building Code, work hereunder will be subject to continuous inspection by a Special Inspector selected by the ENGINEER and approved by the local Building Official having jurisdiction. Costs of such inspection will be paid by the OWNER. The Special Inspector will work under the supervision of the ENGINEER.

1.5 MATERIAL STORAGE

A. Cement, lime, and other calcareous materials shall be delivered and stored in dry, weather-tight sheds or enclosures, in unbroken bags, barrels, or other approved containers which are plainly marked and labeled with the manufacturers' names and brands. Mortar and grout shall be stored and handled in a manner which will prevent the intrusion of foreign materials and damage by water or dampness. Brick units shall be handled with care to avoid chipping and breakage and shall be stored as directed in the Masonry Design Manual. Materials shall be protected from contact with the earth and exposure to the weather and shall be kept dry and clean until used. Materials stored on newly constructed floors shall be stacked in such a manner that the uniformly-distributed loading does not exceed 30 psf.

PART 2 – PRODUCTS

2.1 BRICK

A. **Face Brick:** All face brick shall conform to ASTM C 216 and the following requirements:

1. Grade: SW

2. Type: FBS (Face Brick Standard)

3. Size: 4-inch by 2-2/3-inch by 8-inch

4. Color: Face brick shall be equal in texture, color, and composition to match existing brick.

B. **Veneer Brick:** Veneer brick shall be face brick as indicated above, unless otherwise indicated.

2.2 REINFORCEMENT STEEL

A. **Reinforcement Bars:** Reinforcement bars shall conform to the requirements of ASTM A 615 for deformed billet steel bars for concrete reinforcement, Grade 60 unless otherwise indicated in Section 03200 - Reinforcement Steel.

B. **Wire Devices:** Wire devices shall be factory-fabricated from steel wire conforming to the requirements of ASTM A 82. Wire devices in all walls shall be formed wire that has been zinc coated in accordance with ASTM A 116, Class (1).

1. Centering clips shall be formed from wire not lighter than 9-gage. Clips shall be of a design that will prevent displacement of the reinforcing bars during construction.

2. Wire anchors for use with embedded slots or wire inserts shall be formed from looped and closed wire not lighter than 9-gage.

3. Dovetail anchors for use with embedded slots shall be not lighter than 16-gage steel at least one inch wide. Anchors shall be crimped, corrugated, or bent at the end to provide anchorage. Dovetail anchors shall be hot-dip galvanized in accordance with the requirements of ASTM A 153, Class E-2.

C. **Veneer Ties:** Veneer ties shall be provided as required by local building code and as follows:

1. Ties for veneer brick connected to concrete or concrete block masonry shall be **Dur-O-Wal, "Rectangular Type" or AA Wire Products Company "Type AA 301."**

2.3 MORTAR AND GROUT

A. Mortar

1. Mortar for brick masonry shall be Type S with a minimum 28-day compressive strength of 1800 psi. Proportions shall be one part portland cement; 1/4- to 1/2-part lime paste or hydrated lime; and damp, loose sand in an amount (by volume) not less than 2-1/4 times nor more than 3 times the sum of the cement and lime volumes used. Water shall be carefully proportioned as needed to produce the required workability and strength.

2. Color of mortar shall match existing mortar on the buildings of the existing wastewater plant. In case of more than one existing color, the colors shall be selected by the ENGINEER to match.

B. **Grout:** Grout shall have a minimum 28-day compressive strength of 2000 psi. Proportions shall be one part portland cement, not more than 1/20 part lime paste or hydrated lime; 2-1/4 to 3 parts (by volume) damp loose sand; and not more than 2 parts (by volume) pea gravel. Water shall be proportioned to produce a consistency which will allow pouring without segregation of components. Where the grout space is less than 4 inches, the pea gravel shall be omitted. Grout shall have a slump of 9 inches plus or minus one inch and shall be cohesive and homogeneous.

C. **Transit-Mixed Grout:** Transit-mixed grout shall be continually rotated at idle speed from the time the water is added until the grout is discharged.

2.4 MISCELLANEOUS MATERIALS

A. **Portland Cement:** Portland Cement shall be Type I or II, low alkali, Portland Cement conforming to ASTM C 150. Masonry cements or plastic cements will not be permitted. White cement, where called for, shall be White Portland Cement meeting the same requirements.

B. **Quick Lime:** Quick lime shall conform to ANSI/ASTM C 5.

C. **Hydrated Lime:** Hydrated lime shall be Type B conforming to ASTM C 207.

D. **Aggregates:** Sand shall conform to ASTM C 144. Coarse aggregate shall conform to ASTM C 404.

E. **Water:** Water for mixing into mortar or grout shall be clear, potable water.

F. **Admixtures:** Admixtures for use in mortar and grout shall conform to the following requirements:

1. Mortar: **Master Builders "PS-235 or Rheomix-235" or Sika Company "Sika-Red Label."**

2. Grout: **Sika Company "Sika Grout Aid," Type II or Master Builders "Pozzolith" normal.**

3. Coloring Admixture for Mortar: Pure, non-fading oxide pigments provided in sealed packages providing accurate measured amounts for uniform mix proportioning and color.

PART 3 – EXECUTION

3.1 MISCELLANEOUS REQUIREMENTS

A. **Weather Conditions:** All work shall be performed only under weather conditions meeting the requirements of the Building Code and referenced standards and subject to the approval of the ENGINEER.

B. **Embedded Items:** The CONTRACTOR shall set or embed all required anchors, bolts, reglets, sleeves, conduits, and other items in his work.

C. **Brick Cutting:** All brick cutting shall be by machine.

D. **Brick Protection:** Units shall be supported off the ground and shall be covered to protect them from rain. Only clean, dry, uncracked units shall be incorporated in the work.

E. Foundation Preparation

1. Immediately before starting work, the concrete upon which the masonry will be laid shall be cleaned with water under pressure.

2. The foundation for the wall shall be clean, rough, and level. Sand- blasting or other means shall be utilized as necessary to remove laitance or other foreign material or

to render the foundation sufficiently rough.

3. The foundation shall be sufficiently level such that the bed joint thickness is between 1/4-inch and 3/4-inch. The foundation face shall be sufficiently true so that the masonry face projects nowhere more than 1/4-inch.

F. **Admixtures:** Admixtures for mortar and grout, when allowed, shall be used in accordance with the manufacturer's printed recommendation.

1. Mortar admixtures may be used only when approved by the ENGINEER and local Building Department.

2. Grout admixtures may be used only when approved by the ENGINEER where the brick has high absorption or the wall is being grouted by the high lift method. In these cases, an admixture shall be used to reduce grout shrinkage.

G. Reinforcement

1. Horizontal joint reinforcement shall be as required by the Building Code or as indicated.

2. Reinforcement bars, including projecting reinforcement dowels, shall be free of loose rust and scale and all oil, paint, laitance, dirt, concrete, or other material that will inhibit bond. Dowels shall be in proper location prior to start of masonry work.

H. **Mortar and Grout Proportioning:** Mortar and grout proportioning shall be uniformly and accurately made. Shovel measurements shall not be used. Proportions shall be accurately controlled and maintained.

3.2 BRICK LAYING

A. **Brick Surface Conditions:** Surface condition(s) of the brick shall be maintained or prepared so as to promote the quality of the finished construction and shall conform to the following requirements:

1. Freedom from foreign or loose material: All brick shall be clean and free of dust, dirt, or other foreign materials before laying.

2. Surface moisture of bricks: When being laid, the brick shall have suction sufficient to hold the mortar and to absorb water from the mortar and grout, but shall be sufficiently damp so that the mortar will remain plastic enough to permit the brick to be leveled and plumbed without destroying bond immediately after being laid.

B. **Alignment:** All brick work shall be plumb, level, and true to line, and all corners and angles shall be square unless otherwise indicated.

1. Line blocks shall be used whenever possible. When it is absolutely necessary to use a line pin, the hole in the joint shall be filled with mortar immediately after the pin is withdrawn.

2. Both outer wythes of a brick wall shall be laid to a line.

C. **Patterns and Details:** All pattern work, bonds, or special details indicated on the

Drawings shall be accurately executed. Bonding headers shall not be used in grouted masonry.

D. **Joints and Mortaring:** Mortaring and joint development shall be as follows:

1. Mortar for all bed joints shall be beveled. Beveled bed joints shall be sloped toward the center of the wall in such a manner that the bed joints will be filled when the brick is finally brought to line. Furrowing of bed joints will not be permitted. The protrusion of fins of bed joint mortar into the grout space shall be avoided. If they occur, they shall be left in place if not projecting more than the bed joint thickness. In no case shall they be cut off and dropped onto the grout below.

2. All head joints, regardless of thickness, shall be completely filled with mortar or grout.

3. All brick in stretcher (flat-wise) courses shall be shoved into place.

4. Bricks that are moved or shifted shall be relaid in fresh mortar.

E. **Adjoining Work Protection:** All adjoining work, including door jams and corners, shall be protected from damage or disturbance during the masonry work. All sills, ledges, offsets, etc., shall be protected from droppings of mortar.

3.3 GROUTING - GENERAL

A. **Grout Consistency:** The consistency of grout shall be adjusted so that it will flow into place without segregation of ingredients. Water may be added to compensate for loss, but grout that has begun final set and becomes hard shall not be used.

B. **Grouting Courses:** All grout shall be stopped approximately 1-inch below the top of the last brick course except at the finishing course. At the finished course the last grout pour shall be brought flush with the top of the brick.

C. **Protection of Masonry Surfaces:** Whenever possible, grouting shall be done from the inside face of the masonry. Extreme care shall be used to prevent any grout or mortar from staining the face of masonry to be left exposed or unpainted. If any grout or mortar does contact the face of such masonry, it shall be removed immediately with fresh water and a stiff vegetable fiber brush. All sills, ledges, offsets, etc., shall be protected from droppings of grout.

3.4 LOW LIFT GROUTING

A. One outer wythe may be carried 18-inches higher before the backup wythe is laid and grouted. Other wythes are to be laid up not more than 8 inches before grouting.

B. All interior grout spaces shall be grouted full. Grout lifts shall not exceed 6 times the width of the grout space, with a maximum of 8 inches. Slushing with mortar shall not be permitted. The grout shall be puddled to flow into all voids between the bricks and surround the reinforcing steel.

C. Where it is necessary to stop a longitudinal run of masonry, it shall be stopped only by racking back 1/2 brick length in each course. Where 1/3-bond or other pattern bond is used, racking shall be according to bond. A suitable dam to retain the grout shall be provided.

3.5 MEDIUM LIFT GROUTING

A. Each wythe shall be laid up to a maximum height of 4 feet. The wythes shall be bonded together with wall ties that are not lighter than No. 9-gage wire. The ties shall be rectangular in form, 4 inches in width, and 2 inches less in length than the overall wall thickness.

B. For walls with a grout space more than 4 inches wide, or for walls laid up in stack bond, ties shall be spaced 12 inches vertically and 16 inches horizontally; for walls with the grout space 4 inches or less in width, the ties shall be spaced 16 inches vertically and 16 inches horizontally.

C. Cleanouts are not required. Care shall be taken to prevent mortar from dropping into the grout space.

D. All units in the 2 tiers shall have full head and bed mortar joints. Mortar on the bed joint shall be applied in such a way as to prevent it from protruding or falling into the grout space.

E. The grout space (longitudinal vertical joint) shall not be less than 3 inches in width and not less than the thickness required by the placement of steel with the required clearances and shall be poured solid with grout. If the grout space contains no horizontal steel, it may be reduced to 2 inches width. Masonry walls shall cure at least 18 hours to gain strength before pouring grout.

F. Vertical grout barriers or dams shall be built of solid masonry across the grout space for the height of each grout lift to control the flow of the grout horizontally. Grout barriers shall be not more than 30 feet apart.

G. Grout shall be a plastic mix suitable for pumping without segregation of the constituents and shall be mixed thoroughly. Grout shall be placed by pumping or by other approved method and shall be placed before any initial set occurs, but in no case more than 1-1/2 hours after water has been added.

H. Grout shall be placed in a continuous pour, shall be consolidated by puddling or mechanical vibrating during placing, and shall be reconsolidated after excess moisture has been absorbed but before plasticity has been lost.

I. The grouting of any section of the wall between control barriers shall be completed with no interruptions longer than one hour. The maximum grout pour height shall be limited to 4 feet during any 24-hour period.

3.6 HIGH LIFT GROUTING

A. Wythes shall be laid full-story prior to grouting.

B. The 2 tiers shall be bonded together with wall ties. Ties shall be not lighter than No. 9-gage wire bent into the form of rectangles 4 inches wide by 2 inches less than the overall wall thickness. Kinks, water drips or deformations shall not be permitted in the ties. One tier of the wall shall be built up not more than 18 inches ahead of the other tier. Tie spacing shall not exceed 24 inches on center horizontally, nor 16 inches on center vertically for running bond, and not more than 24 inches on center horizontally nor 12

inches on center vertically for stack bond.

C. Cleanouts shall be provided for each pour by leaving out every other unit in the bottom of the section being poured. During the work, a high pressure water stream may be used to remove mortar fins and other foreign matter from the grout space. Alternatively, the space may be cleaned by a stick and compressed air.

D. The cleanout shall be sealed after inspection but before grouting.

E. Vertical grout barriers or dams shall be built of solid masonry across the grout space for the entire height of the wall to control the flow of the grout horizontally. Grout barriers shall be not more than 30 feet apart.

F. No grout shall be poured unless the masonry wall has been allowed to set a minimum of 3 days in hot weather or 5 days in cold weather.

G. Grout may be placed by grout pump, hopper, or bucket.

H. Grout spaces shall not be wetted down prior to pouring the grout.

I. Unless otherwise indicated on the working drawings, the grout shall have a 9- to 10-inch slump.

J. Grout shall be placed to a depth not exceeding 4 feet in each lift.

K. Grout shall be consolidated immediately after placement by puddling with a vibrator or rodding with a 1- by 2-inch wood pole. It shall be reconsolidated after water loss and before final set.

L. A succeeding lift of grout may be placed following an approximate 10 minute lapse of time for grout settlement of the previous lift. The initial consolidation of a grout lift and reconsolidation of the previous grout pour may be done in the same operation.

3.7 JOINERY

A. At the time of laying, all masonry shall have the mortar joints finished as specified. Defective joints shall be cut out and repointed. Joints having holes such as made by line pins shall be pointed and tooled properly. Regardless of other jointing indicated, all jointing in all masonry surfaces which are exposed to the weather shall be tooled, making solid, smooth, watertight, compact joints. Tooled joints shall be made by striking them with a metal jointing tool to produce "Concave" finished joints.

1. Vertical and horizontal joints shall be 3/8-inch wide unless otherwise indicated.

2. Flush joints, which shall be made by cutting off the mortar flush with the face of the work with a trowel, may be used in non-exposed masonry and masonry which will subsequently be plastered.

3.8 POINTING AND CLEANING

A. At the completion of the work all holes or defective mortar joints in exposed masonry shall be pointed. Defective joints shall be cut out and repointed.

B. Exposed masonry shall be protected against staining from wall grouting or other sources and excess mortar shall be cleaned off the surfaces as the work progresses.

C. At the completion of the work, all exposed masonry shall be cleaned using a dilute acid solution. In the event that ordinary acid wash cleaning is not adequate, special methods such as sandblasting or chipping shall be used to facilitate cleaning.

D. All waste and surplus masonry materials shall be removed from the job, and all stains or dirt from this operation affecting adjacent surfaces shall be removed by an approved cleaning method.

E. If the sample panel is not part of the wall system, it shall be removed from the Site after completion and acceptance of the masonry work.

- END OF SECTION -

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide concrete masonry and other appurtenant work, complete and in place, in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Federal Specifications

SS-C-621B Int. Amd. 2	Concrete Masonry Units, Hollow (And Solid, Prefaced and Unglazed)

B. Commercial Standards

ANSI/ASTM C 5	Quicklime for Structural Purposes
ASTM A 615	Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM C 90	Load-Bearing Concrete Masonry Units
ASTM C 129	Non load bearing Concrete Masonry Units
ASTM C 140	Test Methods of Sampling and Testing Concrete Masonry Units
ASTM C 144	Aggregate for Masonry Mortar
ASTM C 150	Portland Cement
ASTM C 207	Hydrated Lime for Masonry Purposes
ASTM C 404	Aggregates for Masonry Grout
ASTM E 447	Test Methods for Compressive Strength of Masonry Prisms
UBC 21-16	Field Test Specimans for Mortar

1.3 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01300 - Contractor Submittals.

B. Samples

1. Samples of concrete masonry unit colors with texture ranges indicated for selection of color. Full size samples of the blocks selected shall be submitted for final approval by the ENGINEER after color selection, if requested. If the specified product is a

colored and textured unit, the samples shall be colored and textured units.

2. Samples of mortar colors for color selection.

3. A 4-ft minimum square free-standing sample panel shall be prepared for approval before starting masonry work. The panel shall remain at the Site for reference until all masonry work is completed.

C. Documentation

1. Reports from testing masonry units

2. Reports from mortar and grout testing.

3. Reports from prism testing.

1.4 QUALITY ASSURANCE

A. **Applicable Standards:** Concrete masonry shall conform to the Building Code, the Masonry Design Manual published by the Masonry Industry Advancement Committee, and other applicable codes and standards of governing authorities.

B. All work shall conform to the standard of quality established by the approved free-standing sample panel.

C. Concrete block masonry units shall be sampled and tested in accordance with ASTM C 140.

D. **Testing of Mortar and Grout:** The CONTRACTOR shall have the mortar and grout tested to assure compliance with the Specifications and the governing codes by a recognized testing laboratory approved by the ENGINEER. Test reports shall be submitted to the ENGINEER.

1. Tests shall be taken at the following times:

a. At commencement of masonry work, at least 2 test samples each of mortar and grout shall be taken on 3 successive working days.

b. At any change in materials or job conditions, at least 2 samples of each modified material, grout, and mortar shall be tested.

c. Four random tests each of mortar and grout shall be made. The random test samples shall be taken when requested by the ENGINEER.

d. Additional samples and tests may be required whenever, in the judgment of the ENGINEER, additional tests (beyond the random tests) are necessary to determine the quality of the materials.

e. The costs of tests and test reports, except for any additional tests requested by the ENGINEER, shall be paid by the CONTRACTOR. The costs of the additional tests and reports, when reports verify compliance with the Contract Documents, will be paid by the OWNER. When tests or reports do not verify compliance, the cost of all additional tests and reports shall be paid by the

CONTRACTOR.

2. Test samples shall be stored in a moist environment until tested, unless directed otherwise by the ENGINEER or the testing laboratory. Tests shall be in accordance with the property specification requirements of ASTM C270 and ASTM C476. The grout and mortar strengths shall not be less than the minimum strengths specified herein.

E. **Inspection:** Whenever required under the provisions of the Building Code, work hereunder will be subject to continuous inspection by a Special Inspector selected by the ENGINEER and approved by the local Building Official having jurisdiction. Costs of such inspection will be paid by the OWNER. The Special Inspector will work under the supervision of the ENGINEER.

F. **Weather Conditions:** Concrete masonry units shall not be placed when air temperature is below 40 degrees F (4 degrees C) and shall be protected against direct exposure to the wind and sun when erected when the ambient air temperature exceeds 99 degrees F (37 degrees C) in the shade with relative humidity less than 50 percent. Cold weather installation shall be per code and Reference Standards and as approved by the ENGINEER.

G. **Product Storage:** Cement, lime, and other cementitious materials shall be delivered and stored in dry, weather-tight sheds or enclosures, in unbroken bags, barrels, or other approved containers, plainly marked and labeled with the manufacturers' names and brands. Mortar and grout shall be stored and handled in a manner which will prevent the inclusion of foreign materials and damage by water or dampness. Masonry units shall be handled with care to avoid chipping and breakage, and shall be stored as directed in the Masonry Design Manual. Materials stored on newly constructed floors shall be stacked in such manner that the uniformly-distributed loading does not exceed 30 psf. Masonry materials shall be protected from contact with the earth and exposure to the weather and shall be kept dry and clean until used.

PART 2 – PRODUCTS

2.1 CONCRETE MASONRY UNITS

A. Concrete masonry units shall conform to ASTM C 90, Type II, with maximum linear shrinkage of .06 percent from standard to oven-dried condition. Units shall be medium weight units unless indicated otherwise.

B. Concrete masonry units shall be 12-inch by 8-inch by 16-inch modular size. Units shall be of natural gray color.

C. All bond beam, corner, lintel, sill, and other specially shaped blocks shall be provided where required or necessary. Specially shaped non-structural blocks may be constructed by saw cutting. Color and texture shall match that of adjacent units.

D. Concrete masonry units hidden from view entirely may be natural color units the same size as other adjacent masonry units.

E. Concrete masonry units at interior walls shall be medium weight block 8-inch by 8-inch by 16-inch modular size of natural color.

2.2 MATERIALS

A. Portland cement shall be Type I or II, low alkali, conforming to ASTM C 150.

B. Lime paste shall be made with pulverized quicklime or with hydrated lime which shall be allowed to soak not less than 72 hrs before use except that hydrated lime processed by the steam method shall be allowed to soak not less than 24 hrs and shall be made by adding the lime to the water. In lieu of hydrated lime paste for use in mortar, the hydrated lime may be added in the dry form. Hydrated lime shall be Type S, conforming to ASTM C 207. Pulverized quicklime shall conform to ANSI/ASTM C 5, shall pass a No. 20 sieve, and 90 percent shall pass a No. 50 sieve.

C. Sand shall conform to ASTM C 144. Coarse aggregate shall conform to ASTM C 404.

D. Water for mixing shall be clear potable water.

E. Reinforcing steel shall be deformed bars conforming to ASTM A 615, Grade 60.

F. Admixture for mortar shall be **Master Builders "PS-235 or Rheomix-235;" or "Sika Co., "Sika Red Label."** The admixture shall not be detrimental to the bonding or help the process of efflorescence.

G. Admixture for grout shall be **Sika Co., "Sika Grout Aid," Type II; or Master Builders "Pozzolith" normal.**

H. Veneer ties shall be per local governing code.

2.3 MORTAR

A. Mortar for concrete block masonry shall be Type S, with a minimum 28-day compressive strength of 1800 psi. Proportions shall be one part portland cement, 1/4- to 1/2-part lime paste or hydrated lime, and damp, loose sand in an amount (by volume) of not less than 2-1/4 nor more than 3 times the sum of the volumes of cement and lime used, with the precise amount of water required to produce the required workability and strength.

2.4 GROUT

A. Grout shall have a minimum 28-day compressive strength of 2000 psi. Proportions shall be one part portland cement, not more than 1/10-part lime paste or hydrated lime, 2-1/4 to 3 parts damp, loose sand, not more than 2 parts pea gravel, and water in the amount necessary to produce a consistency for pouring without segregation of components. Where the grout space is less than 4 inches, pea gravel shall be omitted.

B. Admixtures may only be used when approved by the ENGINEER. When it has been approved for use, it shall be used in accordance with the manufacturer's published recommendations for the grout.

PART 3 – EXECUTION

3.1 GENERAL

A. Measurements for mortar and grout shall be accurately made. Shovel measurements are not acceptable. Mortar proportions shall be accurately controlled and maintained.

B. Work shall be performed in accordance with the provisions of the applicable code for reinforced concrete hollow-unit masonry.

C. The CONTRACTOR shall set or embed all anchors, bolts, reglets, sleeves, conduits, and other items as required.

D. All block cutting shall be by machine.

E. Masonry units shall be supported off the ground and shall be covered to protect them from rain. Only clean, dry, uncracked units shall be incorporated.

F. Reinforcing steel shall be cleaned of all loose rust and scale, and all oil, dirt, paint, laitance, or other substances which may be detrimental to or reduce bonding of the steel and concrete.

G. Immediately before starting work, the concrete upon which the masonry will be laid shall be cleaned with water under pressure.

H. Full mortar joint for first course shall be provided.

I. Units shall be shoved tightly against adjacent units to assure good mortar bond.

J. All equipment for mixing and transporting the mortar and grout shall be clean and free from set mortar, dirt, or other foreign matter.

3.2 MIXING

A. Mortar shall be mixed by placing the water and sand in the operating mixer, following which the cement, lime, and remainder of the sand and water shall be added. After all ingredients are in the mixer, they shall be mechanically mixed for not less than 5 minutes. Retempering shall be done on the mortar board by adding water within a basin formed within the mortar, and the mortar reworked into the water. Mortar which is not used within one hour shall be discarded.

3.3 ERECTION OF CONCRETE BLOCK MASONRY

A. Masonry work shall be erected in-plane, plumb, level, straight, and true to dimensions and executed in accordance with acceptable practices of the trade.

B. Unless indicated otherwise, masonry shall be laid up in straight uniform courses with running bond.

C. All masonry shall be erected to preserve the unobstructed vertical continuity of the cells measuring not less than 3-inch by 3-inch in cross-section. Walls and cross webs shall be full bedded in mortar. All head (or end) joints shall be solidly filled with mortar for a distance in from the face of the wall or unit not less than the thickness of the longitudinal

face shells.

3.4 JOINTS

A. Vertical and horizontal joints shall be uniform and approximately 3/8-inch wide. Exterior joints and interior exposed block joints shall be concave-tooled to a dense surface. Special care shall be used in tooling joints so as to match existing construction. Interior or exterior non-exposed masonry and masonry behind plaster shall have flush joints.

3.5 CLEANOUTS

A. Cleanout openings shall be provided at the bottoms of all cells to be filled at each lift or pour of grout, where such lift or pour is over 4 ft in height. Any overhanging mortar or other obstructions or debris shall be removed from the insides of such cell walls. The cleanouts shall be sealed before grouting and after inspection. Cleanout openings shall match the finished wall in exposed masonry.

3.6 REINFORCEMENT

A. Deep cut bond beam blocks shall be used where horizontal reinforcing steel is embedded. H-block bond beams may be used at locations other than openings.

B. Vertical reinforcement shall be held in position at top and bottom and at intervals not exceeding 192 diameters of the reinforcement.

3.7 GROUTING

A. All cells containing reinforcing and bond beam spaces shall be filled solidly with grout unless indicated otherwise. Grouting shall not be started until the wall has cured for 24 hours. Grout shall not be poured in more than 8-ft lifts.

B. All grout shall be consolidated at time of pouring by puddling or vibrating. Where the grouting operation has been stopped for one hour or longer, horizontal construction joints shall be formed by stopping the grout pour 1-1/2 inches below the top of the uppermost unit.

3.8 PROTECTION

A. Wall surfaces shall be protected from droppings of mortar or grout during construction.

3.9 FINISHING AND CLEANING

A. Masonry shall not be wet-finished unless exposed to extreme hot weather or hot wind and then only by using a nozzle-regulated fog spray sufficient only to dampen the face but not of such quantity to cause water to flow down over the masonry.

B. Finish masonry shall be cleaned and pointed in a manner satisfactory to the ENGINEER, based upon the standards established by the approved sample panel.

C. All exposed masonry surfaces of openings and window and door openings such as sills, heads, and jambs shall be finish block surfaces, not formed surfaces, unless indicated otherwise. Closed bottom bond beam blocks shall be used at heads and sills. Pour holes may be used at the sill under window frame and where approved by the ENGINEER.

3.10 VENEER TIES

A. Veneer ties shall be provided per Building Code and trade standards where veneered surfaces are indicated.

- END OF SECTION -

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide structural steel framing and appurtenant metal parts required for permanent connection of the structural steel system, complete and in place, in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. References herein to "Building Code" shall mean the BOCA National Building Code. The edition of the codes adopted as of the date of award of this contract shall apply to the WORK herein.

B. Federal Specifications and Commercial Standards:

AISC	Code of Standard Practice for Steel Buildings and Bridges
AISC	Structural Steel Buildings-Allowable Stress Design and Plastic Design
AISC	Allowable Stress Design Specifications for Structural Joints Using ASTM A325 and A490 Bolts approved by the Research Council on Structural Connections of the Engineering Foundation
ASTM A 36	Structural Steel
ASTM A 53	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 307	Carbon Steel Bolts and Studs
ASTM A 325	Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 500	Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 501	Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
AWS D1.1	Structural Welding Code - Steel

1.3 CONTRACTOR SUBMITTALS

A. Submit in accordance with Section 1300 - Submittals.

B. Shop drawings shall conform to AISC recommendations and specifications and shall show all holes, etc. required for other work. Drawings shall include complete details showing all members and their connections, anchor bolt layouts, schedules for fabrication procedures, and diagrams showing the sequence of erection.

C. Testing laboratory certifications for shop and field welders shall be submitted in triplicate directly to the ENGINEER with copies to the CONTRACTOR and others as required.

PART 2 – PRODUCTS

2.1 MATERIALS

A. All structural steel shapes, plates, bars and their products shall be ASTM A36 unless otherwise indicated.

B. Structural steel pipe shall be ASTM A501, or ASTM A53, Type E or S, Grade B.

C. Structural tubing shall be ASTM A500, Grade B. All members shall be furnished full length without splices unless otherwise indicated or approved by the ENGINEER.

D. Bolts for connections shall be ASTM A325, unless indicated otherwise. Bolts used to connect dissimilar metals shall be ASTM A193 and A194, Type 316 stainless steel.

E. Welded anchor studs shall be headed concrete anchor studs (HAS), or deformed bar anchors (DBA), or threaded studs (TAS), as indicated on the Drawings and as supplied by **Nelson Stud Welding Company**, Lorain, OH; or **Omark Industries, KSM Fastening Systems Division**, Seattle, WA, or Portland, OR.

F. Structural steel shall be cleaned and coated in accordance with Section 09800 - Protective Coating.

G. All steel members in contact with aluminum shall be galvanized per Section 05500 - Miscellaneous Metalwork, unless indicated otherwise.

H. All structural members shall be furnished full length without splices unless otherwise indicated or approved by the ENGINEER.

2.2 INSPECTION AND TESTING

A. Shop inspection may be required by the OWNER at its own expense. The CONTRACTOR shall give ample notice to the ENGINEER prior to the beginning of any fabrication work so that inspection may be provided. The CONTRACTOR shall furnish all facilities for the inspection of materials and workmanship in the shop, and inspectors shall be allowed free access to the necessary parts of the WORK. Inspectors shall have the authority to reject any materials or WORK which does not meet the requirements of these Specifications. Inspection at the shop is intended as a means of facilitating the work and avoiding errors, but it is expressly understood that it will in no way relieve the CONTRACTOR from responsibility for proper materials or workmanship under this Specification.

B. The OWNER may engage inspectors to inspect welded connections and high-strength bolted connections, and to perform tests and prepare test reports.

1. Ten percent of all butt and bevel welds which extend continuously for 24 inches or less shall be completely tested in accordance with AWS D1.1, Part B, Radiographic Testing of Welds, Chapter 6. All butt and bevel welds which extend continuously for more than 24 inches shall be spot tested at intervals not exceeding 36 inches.

2. Welds that [redacted] required by the ENGINEER to be [redacted]ected shall be corrected or redone and retested as directed, at the CONTRACTOR'S expense and to the satisfaction of the ENGINEER and/or approved independent testing lab.

3. The CONTRACTOR shall test to failure three bolts from each heat lot of bolts furnished to the job to verify compliance with this Specification. The testing laboratory shall be approved by the ENGINEER and all test reports shall be supplied to the ENGINEER in accordance with Section 1300 - Submittals. In addition, high-strength bolts shall be inspected using one of the methods set forth in the AISC Specification "Structural Joints Using ASTM A325 or A490 Bolts".

C. The costs for all initial testing will be paid by the OWNER. However, the CONTRACTOR shall pay for all costs for any additional testing and investigation on WORK which does not meet Specifications. The CONTRACTOR shall supply material for testing at no cost to the OWNER and shall assist the ENGINEER in obtaining material for test samples.

PART 3 – EXECUTION

3.1 MEASUREMENT

A. The CONTRACTOR shall verify all dimensions and shall make any field measurements necessary and shall be fully responsible for accuracy and layout of work. The CONTRACTOR shall review the Drawings, and any discrepancies shall be reported to the ENGINEER for clarification prior to starting fabrication.

3.2 FABRICATION

A. Structural steel shall be fabricated in accordance with the Drawings, AISC Specifications, and as shown on the shop drawings.

B. Materials shall be properly marked and match-marked for field assembly.

C. Where finishing is required, assembly shall be completed including bolting and welding of units, before start of finishing operations.

3.3 CONNECTIONS

A. Shop and field connections shall be bolted or welded as shown or specified. All connections shall develop full strength of members joined and shall conform to AISC standard connections.

3.4 WELDED CONSTRUCTION

A. The CONTRACTOR shall comply with the current AWS D1.1 Code for procedures, appearance, and quality of welds and welders, and methods used in correcting welding work. All welded architectural metal work where exposed to view shall have welds ground smooth. Shielded metal are welding method or gas metal arc welding methods shall be used for welding structural steel.

B. Unless otherwise shown, all butt and bevel welds shall be complete penetration.

3.5 HOLES FOR OTHER WORK

A. Holes shall be provided as necessary or as indicated for securing other work to structural steel framing, and for the passage of other work through steel framing members. No torch cut holes will be permitted.

3.6 SHOP PAINT PRIMER

A. Shop paint primer shall be applied in accordance with Section 09800 - Protective Coating. Omit shop applied primer at field weld locations, for the portion of a member to be embedded in concrete, and where galvanizing with no further coating is required.

3.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Structural members shall be loaded in such a manner that they may be transported and unloaded without being excessively stressed, deformed, or otherwise damaged.

B. Structural steel members and packaged materials shall be protected from corrosion and deterioration. Material shall be stored in a dry area and shall not be placed in direct contact with the ground. Materials shall not be placed on the structure in a manner that might cause distortion or damage to the members or the supporting structures. Repair or replace damaged materials or structures as directed.

3.8 ERECTION

A. The CONTRACTOR shall comply with the AISC Specifications and Code of Standard Practice, and with specified requirements.

B. High-strength bolts shall be installed in accordance with the AISC Specification for Structural Joints using ASTM A325 Bolts. The connections shall be the friction type, unless noted otherwise.

C. Anchor bolts and other connectors required for securing structural steel to in-place work and templates and other devices for presetting bolts and other anchors to accurate locations shall be furnished by the CONTRACTOR.

D. The CONTRACTOR shall be responsible for designing and installing any temporary bracing required for the safe erection of all structural steel members.

3.9 SETTING BASES AND BEARING PLATES

A. Prior to the placement of non-shrink grout beneath base and bearing plates, the bottom surface of the plates shall be cleaned of all bond-reducing materials, and concrete and masonry bearing surface shall also be cleaned of all bond-reducing materials and roughened to improve bonding.

B. Loose and attached baseplates, and bearing plates for structural members shall be set on wedges, leveling nuts, or other adjustable devices.

C. Anchor bolts shall be tightened after the supported members have been positioned and plumbed and the non-shrink grout has attained its indicated strength.

D. Baseplates shall be grouted with non-shrink grout to assure full uniform bearing. Grouting shall be done prior to placing loads on the structure.

3.10 FIELD ASSEMBLY

A. Structural frames shall be set accurately to the lines and elevations indicated. The various members shall be aligned and adjusted to form a part of a complete frame or structure before permanently fastening. Bearing surfaces and other surfaces which will be in permanent contact shall be cleaned before assembly. Necessary adjustments to compensate for discrepancies in elevations and alignments shall be performed.

B. Individual members of the structure shall be leveled and plumbed within AISC tolerances.

C. Required leveling and plumbing measurements shall be established on the mean operating temperature of the structure.

3.11 MISFITS AT BOLTED CONNECTIONS

A. Where misfits in erection bolting are encountered, the ENGINEER shall be immediately notified. The CONTRACTOR shall submit a method to remedy the misfit for review by the ENGINEER. The ENGINEER will determine whether the remedy is acceptable or if the member must be refabricated.

B. Incorrectly sized or misaligned holes in members shall not be enlarged by burning or by the use of drift pins.

C. The CONTRACTOR shall pay for all costs associated with repairing misfits at no increased cost to the OWNER.

3.12 GAS CUTTING

A. Gas cutting torches shall not be used in the field for correcting fabrication errors in the structural framing, except when approved by the ENGINEER. Gas-cut sections shall be finished equal to a sheared appearance.

3.13 TOUCH-UP PAINTING

A. Immediately after erection, field welds, bolted connections, and abraded areas shall be cleaned of the shop paint primer. Touch-up paint primer shall be applied by brush or spray which is the same thickness and material as that used for the shop paint. Galvanized surfaces which have been field welded or damaged shall be repaired in accordance with Section 05500 - Miscellaneous Metalwork.

B. Finish painting of all structural steel shall be as indicated in Section 09800 - Protective Coating.

- END OF SECTION -

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide miscellaneous metalwork and appurtenances, complete and in place, in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Federal Specifications

MIL-G-18015 A (3)	(Ships) Aluminum Planks. (6063-T6)
MIL-A-907E	Antiseize Thread Compound, High Temperature

B. Commercial Standards

AA-M32C22A41Aluminum Assn.

AASHTO HS-20	Truck Loading
AISC	Manual of Steel Construction
AISI	Design of Light Gauge, Cold-Formed Steel Structural Members
ASTM A 36	Carbon Structural Steel
ASTM A 48	Gray Iron Castings
ASTM A 53	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 123	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 193	Alloy Steel and Stainless Steel Bolting Materials for High Temperature Service
ASTM A 194	Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service
ASTM A 307	Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM A 325	Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

ASTM A 500	Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ANSI/AWS D1.1	Structural Welding Code - Steel
ANSI/AWS D1.2	Structural Welding Code - Aluminum
ANSI/AWS QC1	Qualification and Certification of Welding Inspectors

1.3 CONTRACTOR SUBMITTALS

A. **Shop Drawings:** Shop Drawings of all miscellaneous metalwork shall be submitted in accordance with Section 01300 - Contractor Submittals.

B. Layout drawings for grating shall be submitted showing the direction of span, type and depth of grating, size and shape of grating panels, seat angle details, and details of grating hold down fasteners. Load and deflection tables shall be submitted for each style and depth of grating used.

C. An ICBO report listing the ultimate load capacity in tension and shear for each size and type of concrete anchor shall be submitted. CONTRACTOR shall submit manufacturer's recommended installation instructions and procedures for adhesive anchors. Upon review, by ENGINEER, these instructions shall be followed specifically.

D. No substitution for the indicated adhesive anchors will be considered unless accompanied with ICBO report verifying strength and material equivalency, including temperature at which load capacity is reduced to 90 percent of that determined at 75 degrees F.

1.4 QUALITY ASSURANCE

A. All weld procedures and welder qualifications shall be available in the CONTRACTOR□s field office for review.

B. All welding shall be inspected by a CONTRACTOR-furnished inspector qualified in accordance with AWS requirements and approved by the ENGINEER.

PART 2 – PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Steel

1.	Shapes, Plates, Bars	ASTM A 36
2.	Pipe, Pipe Columns, Bollards	ASTM A 53, Type E or S, Grade B standard weight unless noted otherwise
3.	Tubes	ASTM A 500 Grade B

B. **Corrosion Protection:** Unless otherwise indicated, fabricated steel metalwork which will be used in a corrosive environment and/or will be submerged in water/wastewater shall be

coated in accordance with Section 09800 -Protective Coating and shall not be galvanized prior to coating. All other miscellaneous steel metalwork shall be hot-dip galvanized after fabrication.

C. **Stainless Steel:** Unless otherwise indicated, stainless steel metalwork and bolts shall be of Type 316 stainless steel.

D. **Aluminum:** Unless otherwise indicated, aluminum metalwork shall be of Alloy 6061-T6. Aluminum in contact with concrete, masonry, wood, porous materials, or dissimilar metals shall have contact surfaces coated in accordance with Section 09800.

E. **Cast Iron:** Unless otherwise indicated, iron castings shall conform to the requirements of ASTM A 48, Class 50B or better.

2.2 ALUMINUM RAILINGS

A. **General:** Aluminum handrails and railings shall be component systems complete with all anchors, attachments, balusters, brackets, caps, fasteners, gates (swing with self-latching hardware or removable), posts, sleeves, trim, and any other related items required or necessary for a complete installation. All gates and removable rail sections shall be complete with all hardware such as self-closing hinges, self-latching latches, hasps, etc. Railings shall conform to the Building Code and OSHA General Industry Occupational Safety and Health Standards (29CFR1910).

B. **Materials:** Materials shall conform to the following:

1. Aluminum: Aluminum shall be U.S. Alloy 6063 T-5 or T-6. Aluminum pipe rail shall not be less than 1-1/2-inch diameter Schedule 40 pipe.

2. Electrolysis Protection: Electrolysis protective material shall be alkali-resistant asphaltum base paint, **Koppers "Bitumastic 50," or Texaco "Cement 1401."**

3. Sleeves: Sleeves shall be of galvanized steel or PVC.

4. Grout: Grout for hand rail posts shall consist of an inorganic, non-shrink, non-metallic premixed grout [in accordance with Section 03315 - Grout] with a minimum 28-day compressive strength of 4,000 psi.

5. Fasteners: Fasteners, screws, and bolts shall be concealed and shall be of stainless steel or aluminum.

6. Welding Rods: Aluminum welding rods shall be of a type recommended by the aluminum manufacturer for anodized finished products.

C. **Finishes:** Pipe railing system including handrails, railings, tube caps, and other miscellaneous parts of rails shall be provided with a clear anodized finish, AA-M32 C22A41.

D. Manufacturers:

1. **C-V Pipe Rail, by Crane Veyor Corp.;**

2. **Connectorail, by Julius Blum and Co.**

2.3 METAL STAIRS

A. **Metal Stairs:** Metal stairs shall be composed of steel or aluminum stringers and supports, be fabricated in accordance with standard practice of the National Association of Ornamental Metal Manufacturers, and be as indicated. Steel stair members shall be hot-dip galvanized after fabrication.

2.4 GRATING STAIR TREADS

A. Grating stair treads shall be designed to support a live load of 100 psf or a concentrated load at mid-span of 1000 pounds, whichever creates the higher stress. The maximum deflection due to the uniform live load shall be as required for metal grating below. All grating stair treads shall have an integral non-slip nosing.

2.5 SAFETY STAIR NOSINGS

A. Safety stair nosing shall be provided on all concrete stairs and other locations as indicated. The nosing shall be 3-inch wide, extruded aluminum with cast-in abrasive strips and integral extruded anchors. The color of the cast abrasive shall be as selected by the ENGINEER from the manufacturer's standard colors. The nosing shall be **American Abrasive Metals Company, Style "231-A" or American Mason Safety Tread Company, Figure "31A."**

2.6 LADDERS

A. Ladders which may be partially or wholly submerged, or which are located inside a hydraulic structure, shall be entirely of Type 316 stainless steel. All other ladders shall be of aluminum.

B. Every ladder that does not have an exterior handhold shall be equipped with a pop-up extension. Pop-up extension device shall be manufactured of the same material and finish as the ladder with telescoping tubular section that locks automatically when fully extended. Upward and downward improvement shall be controlled by stainless steel spring balancing mechanisms. Units shall be completely assembled with fasteners for securing to the ladder rungs in accordance with the manufacturer's instructions.

2.7 METAL GRATING

A. **General:** Metal grating shall be of the design, sizes, and types indicated. Grating shall be completely banded at all edges and cutouts using material and cross section equivalent to the bearing bars. Such banding shall be welded to each cut bearing bar. Grating shall be supported on all sides of an opening by support members. Where grating is supported on concrete, embedded support angles matching grating material shall be used on all sides, unless indicated otherwise. Such angles shall be mitered and welded at corners.

3. All pieces of grating shall be fastened in two locations to each support.

4. Where grating forms the landing at the top of a stairway, the edge of the grating, which forms the top riser, shall have an integral non-slip nosing, width equal to that of

the stairway.

5. Where grating depth is not given, grating shall be provided which will be within allowable stress levels, and which shall not exceed a deflection of 1/4 inch or the span divided by 180, whichever is less. For standard duty plank, and safety grating, the loading to be used for determining stresses and deflections shall be the uniform live load of the adjacent floor or 100 psf, whichever is greater or a concentrated load of 1000 pounds. For heavy duty grating, the loading used for determining stresses and deflections shall be AASHTO HS-20.

B. Material

1. Except where indicated otherwise, bar grating shall be fabricated entirely of aluminum as follows: Bearing and banding bars, alloy 6061-T6; cross bars, alloy 6063-T5.

2. Safety grating shall be fabricated of aluminum alloy 5052-H32.

3. Plank grating shall be fabricated of aluminum alloy 6063-T6.

4. Grating which may be partially or wholly submerged shall be fabricated entirely of stainless steel, Type 316.

C. Standard-Duty Grating

1. No single piece of grating shall weigh more than 80 pounds, unless indicated otherwise. Standard duty grating shall be serrated bar grating.

2. Cross bars shall be welded or mechanically locked tightly into position so that there is no movement allowed between bearing and cross bars.

D. Safety Grating

1. Safety grating shall be made of sheet metal punched into an open serrated diamond pattern and formed into plank sections. The open diamond shapes shall be approximately 1-7/8 inch by 11/16 inch in size. Safety grating shall be **Grip Strut by Metal Products Division, United States Gypsum Company or Deck Span by IKG Industries.**

E. Heavy-Duty Grating: Heavy-duty grating shall be of welded steel, galvanized after fabrication. Cross bars shall be welded in position.

2.8 CHECKERED PLATE

A. Checkered plate shall have a pattern of raised lugs on one face and shall be smooth on the opposite face. Lugs shall be a minimum of one inch in length and raised a minimum of 0.050 inch above the surface. The lugs shall be located in a pattern in which the lugs are oriented at 90 degrees from the adjacent lugs in two orthogonal directions. The rows of lugs shall be oriented at 45 degrees from the edges of the plates.

B. Where no plate material is indicated on the Drawings, aluminum shall be provided. Unless indicated otherwise, the minimum plate thickness shall be as required to limit deflection resulting from a live load of 100 psf to 1/4-inch or the span divided by 240, whichever is

less.

2.9 FLOOR HATCHES

A. Where access hatches are mounted on a floor slab (including top slabs which are not covered with a roofing membrane) or on a concrete curb, the hatch shall be a flush type as indicated herein. Hatches mounted on a roof surface which has a membrane or other roofing material covering it shall be the integral raised curb type in accordance with Section 07720 - Roof Accessories.

B. Hatches shall be fabricated from Aluminum 6061 T6, unless otherwise indicated. Hatch hardware shall be Type 316 stainless steel. Hatches shall be gutter-type; **Bilco Type "J" or "JD" Babcock-Davis type "FT" or "AM."**

C. The design live load shall be 300 psf, unless indicated otherwise.

D. Hatch opening sizes, number and swing direction of door leaves, and locations, shall be as indicated. Sizes are for the clear opening. Where the number of leaves is not given, openings larger than 42 inches in either direction shall have double-leaf doors. Unless indicated otherwise, hinges shall be located on the longer dimension side. Unless indicated otherwise, ladder hatches shall be a minimum of 30 inches wide by 36 inches long, with the ladder centered on the shorter dimension, and the door hinge opposite the ladder.

E. Door leaves shall be a minimum of 1/4-inch thick checkered pattern plate. Channel frames shall be a minimum of 1/4-inch material with an anchor flange around the perimeter. Hatches shall be provided with an automatic hold-open arm with release handle. Hatches shall be designed for easy opening from both inside and outside.

F. Hatches shall be designed to be water-tight and shall be equipped with a joint gutter and moat-type edge drain. A minimum 1-1/2-inch diameter drain connection shall be provided, located by the manufacturer.

G. Hatches for submersible pump stations shall include a unistrut channel around the frame perimeter. The face of the unistrut channel shall be flush with the face of the frame and be compatible with the upper guide rail bracket of the submersible wastewater pump manufacturer.

H. Hatches shall include a recessed hasp for a padlock that is covered by a hinged lid flush with the surface.

2.10 CAST-IN-PLACE THRESHOLD

A. The cast-in-place threshold at overhead roll-up doors shall be a steel threshold embedded in the concrete floor slab. The threshold shall be the product of **Eastern Metal Products Co., Elizabeth City, NC (telephone: 919-335-5451).**

2.11 BOLTS AND ANCHORS

A. **Standard Service (Non-Corrosive Application):** Unless otherwise indicated, bolts, anchor bolts, washers, and nuts shall be steel as indicated herein. Threads on galvanized bolts and nuts shall be formed with suitable taps and dies such that they retain their normal clearance after hot-dip galvanizing. Except as otherwise indicated, steel for bolt

material, anchor bolts and cap screws shall be in accordance with the following:

1. Structural connections: ASTM A 307, Grade A or B, hot-dip galvanized.

2. Anchor Bolts: ASTM A 307, Grade A or B, or ASTM A 36, hot-dip galvanized.

3. High strength bolts where indicated: ASTM A 325

4. Pipe and equipment flange bolts: ASTM A 193, Grade B-7

B. **Corrosive Service:** All bolts, nuts, and washers in the locations listed below shall be stainless steel as indicated below.

1. All buried locations.

2. All submerged locations.

3. All locations subject to seasonal or occasional flooding.

4. Inside hydraulic structures below the top of the structure.

5. Inside buried vaults, manholes, and structures which do not drain through a gravity sewer or to a sump with a pump.

6. All chemical handling areas.

7. Inside trenches, containment walls, and curbed areas.

8. Locations indicated by the Contract Documents or designated by the ENGINEER to be provided with stainless steel bolts.

C. Unless otherwise indicated, stainless steel bolts, anchor bolts, nuts, and washers shall be Type 316 stainless steel, class 2, conforming to ASTM A 193 for bolts and to ASTM A 194 for nuts. All threads on stainless steel bolts shall be protected with an antiseize lubricant suitable for submerged stainless steel bolts, to meet government specification MIL-A-907E. Buried bolts in poorly drained soil shall be coated the same as the buried pipe.

1. Antiseize lubricant shall be classified as acceptable for potable water use by the NSF.

2. Antiseize lubricant shall be "PURE WHITE" by **Anti-Seize Technology,** Franklin Park, IL, 60131, or AS-470 by **Dixon Ticonderoga Company,** Lakehurst, NJ, 08733.

D. Bolt Requirements

1. The bolt and nut material shall be free-cutting steel.

2. The nuts shall be capable of developing the full strength of the bolts. Threads shall be Coarse Thread Series conforming to the requirements of the American Standard for Screw Threads. All bolts and cap screws shall have hexagon heads and nuts shall be Heavy Hexagon Series.

3. Bolts and nuts shall be installed with washers fabricated of material matching the base material of bolts, except that hardened washers for high strength bolts shall conform to the requirements of the AISC Specification. Lock washers fabricated of material matching the bolts shall be installed where indicated.

4. The length of each bolt shall be such that after the joint is made up, the bolt extends through the entire nut, but in no case more than 1/2-inch beyond the nut.

E. **Adhesive Anchors:** Unless otherwise indicated, all drilled, concrete or masonry anchors shall be adhesive anchors. No substitutions will be considered unless accompanied with ICBO report verifying strength and material equivalency.

1. Epoxy adhesive anchors are required for drilled anchors where exposed to weather, in submerged, wet, splash, overhead, and corrosive conditions, and for anchoring handrails, pumps, mechanical equipment, and reinforcing bars. Epoxy anchor grout shall comply with Section 03315 - Grout. Threaded rod shall be stainless steel Type 316.

2. Unless otherwise indicated, glass capsule, polyester resin adhesive anchors will be permitted in locations not included above and shall be **Hilti HVA** or **Cobra Anchors.** Threaded rod shall be galvanized steel.

F. **Expanding-Type Anchors:** Expanding-type anchors if indicated or permitted, shall be steel expansion type **ITW Ramset/Redhead "Trubolt" anchors or McCullock Industries "Kwick-Bolt."** Lead caulking anchors will not be permitted. Size shall be as indicated. Expansion type anchors which are to be embedded in grout may be steel. Non-embedded buried or submerged anchors shall be stainless steel.

2.12 POWDER-DRIVEN PINS

A. **Materials:** Powder-driven pins for installation in concrete or steel shall be heat-treated steel alloy. If the pins are not inherently sufficiently corrosion-resistant for the conditions to which they are to be exposed, they shall be protected in an acceptable manner. Pins shall have capped or threaded heads capable of transmitting the loads the shanks are required to support. Pins that are connected to steel shall have longitudinal serrations around the circumference of the shank.

2.13 IMPACT ANCHOR

B. Impact anchors shall be an expansion type anchor in which a nail type pin is driven to produce the expansive force. The pin shall have a zinc sleeve with a mushroom style head and stainless steel nail pin. Anchors shall be **Metal Hit Anchors, manufactured by Hilti, Inc. or Rawl Zamac Nailin, manufactured by the Rawlplug Company.**

PART 3 – EXECUTION

3.1 FABRICATION AND INSTALLATION REQUIREMENTS

A. **Fabrication and Erection:** Except as otherwise indicated, the fabrication and erection of structural steel shall conform to the requirements of the American Institute of Steel Construction "Manual of Steel Construction."

B. **Aluminum Railings:** Aluminum railing fabrication and installation shall be performed by craftsmen experienced in the fabrication of architectural metalwork. Exposed surfaces shall be free from defects or other surface blemishes. Dimensions and conditions shall be verified in the field. All joints, junctions, miters and butting sections shall be precision fitted with no gaps occurring between sections, and with all surfaces flush and aligned. Electrolysis protection of materials shall be provided.

C. **Steel Railings:** Field welding of steel pipe handrail joints will be permitted only if approved by the ENGINEER, and then only in accordance with its instructions.

D. **Floor Hatches:** Unless otherwise indicated, the CONTRACTOR shall provide a 1/2-inch drain line to the nearest floor drain for all floor hatches.

E. **Powder-Driven Pins:** Powder-driven pins shall be installed by a craftsperson certified by the manufacturer as being qualified to install the manufacturer's pins. Pins shall be driven in one initial movement by an instantaneous force that has been carefully selected to attain the required penetration. Driven pins shall conform to the following requirements where "D" = pin's shank diameter:

Material Penetrated by Pin	Material Minimum Thickness	Pin Shank Penetration in Supporting Material	Minimum Space From Pin's CL to Edge of Penetrated Material	Minimum Pin Spacing
Concrete	16D	6D minimum	14D	20D
Steel	1/4-inch	Steel thickness	4D	7D

3.2 WELDING

A. **Method:** Welding shall be by the metal-arc method or gas-shielded arc method as described in the American Welding Society's "Welding Handbook" as supplemented by other pertinent standards of the AWS. Qualification of welders shall be in accordance with the AWS Standards governing same.

B. **Quality:** In assembly and during welding, the component parts shall be adequately clamped, supported and restrained to minimize distortion and for control of dimensions. Weld reinforcement shall be as indicated by the AWS Code. Upon completion of welding, weld splatter, flux, slag, and burrs left by attachments shall be removed. Welds shall be repaired to produce a workmanlike appearance, with uniform weld contours and dimensions. All sharp corners of material which is to be painted or coated shall be ground to a minimum of 1/32-inch on the flat.

3.3 GALVANIZING

A. Structural steel plates shapes, bars, and fabricated assemblies required to be galvanized shall, after the steel has been thoroughly cleaned of rust and scale, be galvanized in accordance with the requirements of ASTM A 123. Any galvanized part that becomes warped during the galvanizing operation shall be straightened. Bolts, anchor bolts, nuts and similar threaded fasteners, after being properly cleaned, shall be galvanized in accordance with the requirements of ASTM A 153. Field repairs to galvanizing shall be made using **"Galvinox"** or **"Galvo-Weld."**

3.4 DRILLED ANCHORS

A. Drilled anchors and reinforcing bars shall be installed in strict accordance with the manufacturer's instructions. Holes shall be roughened with a brush on a power drill, cleaned and dry. Drilled anchors shall not be installed until the concrete has reached the required 28-day compressive strength. Adhesive anchors shall not be loaded until the adhesive has reached its indicated strength in accordance with the manufacturer's instructions.

3.5 FALL PREVENTION SYSTEM

A. Fall prevention systems shall be provided on all ladders used to ascend heights exceeding 20 feet.

- END OF SECTION -

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide aluminum railing work complete, in accordance with the Contract Documents.

B. This Section does not include railings which are specified with and furnished under equipment specifications.

1.2 CONTRACTOR SUBMITTALS

A. **General:** Submittals shall be in accordance with Section 01300 - Contractor Submittals.

B. **Shop Drawings:** Show railing layouts, post locations, and spacings, gate locations, removable railing sections, and construction details.

C. **Calculations:** Engineering structural calculations for railings, handrail brackets, brackets, support flanges, and fasteners or anchors.

PART 2 – PRODUCTS

2.1 SYSTEM DESIGN AND STRUCTURAL PERFORMANCE OF RAILING COMPONENTS

A. **General:** All railings and installation shall be in accordance with the manufacturer's published recommendations and specifications.

B. **Code Requirements:** All railings, guardrails and handrails shall conform to the code requirements for limited public use and the State-approved OSHA. Railings, guardrails, and handrails, when part of a means of egress as defined by the governing codes, shall conform to the requirements of the most stringent of the codes or reference standards. The buildings areas shall be limited public use areas. The other areas of the project shall conform to the code and State-approved OSHA for industrial-commercial, non-public use unless otherwise indicated. Limited public use shall mean that the facility is not designed for general public use; however, occasionally the public is allowed controlled access when approved.

C. **Loading Conditions:** Railings and handrail brackets shall be capable of withstanding either of the following loading conditions without exceeding the allowable working stress of the material and without permanent deformation.

1. A 200-pound concentrated load applied to any point in any direction.

2. A 50-pound per linear foot loading applied perpendicular to the top rail.

D. The allowable working stress shall be 60 percent of the material yield stress for materials that are more than 3 inches from a weld and 40 percent of the yield stress for all materials within 3 inches of any weld.

2.2 MATERIALS

A. **Rail Section:** Railings and handrails shall be round pipe design railing system unless otherwise indicated.

B. **Rail Material:** Aluminum shall be U.S. Alloy 6061 or 6063, T-5 or T-6. Aluminum pipe rail shall be not less than 1-1/2-inch diameter, Schedule 40 pipe.

C. **Welding Rods:** Aluminum welding rods shall be of type recommended by the aluminum manufacturer for anodized finished products.

D. **Protective Coating:** Electrolysis protective material shall be in accordance with Section 09800 - Protective Coating.

E. **Sleeves:** Sleeves for removable posts shall be of steel, hot-dip galvanized after fabrication. Galvanizing of steel sleeves shall be done after fabrication to prevent raw steel from being exposed to the elements.

F. **Fasteners:** Fasteners, screws, and bolts shall be concealed and shall be of stainless steel or aluminum. Handrail bracket fasteners and fasteners over water basins shall be of stainless steel.

G. **Brackets:** Handrail brackets shall be aluminum with a finish that matches the handrail or railing of which they are a part.

H. **Toeboards:** Toeboards shall be extruded (match railing system) aluminum of not less than 4 inches in height. Toeboards for pipe railing shall be channel section for strength.

I. **Socket Grout:** Non-shrink grout for handrail post sockets shall consist of an inorganic, non-metallic, premixed grout with a minimum 28-day compressive strength of 4,000 psi.

2.3 FINISHES

A. **Pipe Railing System:** Pipe railing system including handrails, railings, tube caps, and other miscellaneous parts of rails shall be provided with a 0.7-mil clear anodized finish.

B. **Picket Railing System:** Picket railing system including handrails, railings, tube caps, gates, and other miscellaneous parts of railing shall be provided with a 0.7-mil clear anodized finish.

2.4 SUB-ASSEMBLIES

A. **Height Requirements:** Top of upper railing shall be 42 inches above the working surface. Toeboards shall be installed not more than 1/4-inch off the working surface and shall be provided where indicated and/or required by codes or Reference Standards.

B. **Rectangular Sections:** Rectangular picket railings shall be designed for side mounting unless otherwise indicated. Posts shall be not less than 1-1/2-inch square, evenly spaced at not less than 4 feet nor more than 5 feet on centers. Field conditions may require some adjustment of spacing. Pickets shall be not less than 3/4-inch square and spaced not more than 4 inches on centers. Top rails and railings shall be not less than 2-1/2-inch by 1-1/8-inch and shall be provided with bottom enclosures. Bottom rails shall be not less than 1-3/8 inch by 1-inch and shall be provided with bottom enclosures. Top railings shall

be as long as possible and the posts shall not project through the top rails. Toe board of picket rails shall function as a bottom rail enclosure.

C. **Round Sections:** Round tube and round picket railings shall be side mounted unless otherwise indicated. Posts shall be not less than 1-1/2-inch diameter, Schedule 40 pipe or 1-1/2-inch x 2-inches oval section. The posts shall be evenly spaced at not less than 4 feet nor more than 5 feet on centers. Field conditions may require some adjustment of spacing. Pickets shall be not less than 3/4-inch OD, spaced at 4 inches on centers. Top rails and railings shall be not less than 1-1/2-inch OD pipe or 2-inch oval section. Rails may be type with bottom enclosures. Bottom rails shall be not less than 1-1/2-inch OD pipe or 1-7/8-inch diameter extrusion with bottom enclosures. The top railings shall be as long as possible and the post shall not project through the top rails. Toeboard of picket rails shall be a specially extruded, snap-in bottom rail enclosure with toeboard or special extruded centered toeboard that is screw applied to bottom of the bottom rail.

2.5 MANUFACTURERS

A. Round Pipe Railings:

1. **"C-V Pipe Rail" by CraneVeyor Corp.**

2. **"Wesrail" by Moultrie Manufacturing Co.**

PART 3 – EXECUTION

3.1 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. **Delivery of Materials:** Manufactured materials shall be delivered in original, unbroken packages, containers, or bundles bearing the label of the manufacturer.

B. **Storage:** All materials shall be carefully stored in a manner that will prevent damage and in an area that is protected from the elements.

3.2 COMPONENT SYSTEMS

A. Unless otherwise indicated, all aluminum handrails and railings shall be component systems, installed complete and ready for use with all anchors, attachments, balusters, brackets, caps, fasteners, gates, posts, sleeves, trim, and all other related items required or necessary for the complete installation.

3.3 CRAFTSMANSHIP

A. All work shall be performed by craftsmen experienced in the fabrication of architectural metal work. Exposed surfaces shall be free from defects or other surface blemishes. All dimensions and conditions shall be verified in the field in advance. All joints, junctions, miters, and butting sections shall be precision-fitted, with no gaps occurring between sections, and all surfaces shall be flush and aligned.

3.4 ALIGNMENT

A. Extruded, case, molded, or bent work shall be straight with true edges. Railings and handrails shall be provided with continuous top rails, without post projections or other obstructions.

3.5 WELD FINISH

A. All exposed welds shall be ground smooth and flush and shall be polished and anodized. Discoloration of exposed aluminum surfaces, whether or not due to welding, shall constitute a basis for rejection of the entire assembly.

3.6 EXPANSION/CONTRACTION

A. Exterior railing systems shall provide for 1/4-inch expansion and contraction per 20 linear feet of railing. Interior railing systems shall provide for 1/8-inch expansion or contraction per 20 linear feet of railing.

3.7 FASTENER FINISH

A. Stainless steel fasteners shall be painted to match adjacent aluminum finishes.

3.8 RAILING CONTINUITY AND END TREATMENT

A. Handrails and railings shall be designed to form a continuous run system with elbow turns and bends that do not have interferences with hand movement. Handrails shall be continuous for the full length of the stairs and landings. The handrails shall extend not less than 6 inches beyond the top and bottom risers. Whenever possible, the extension shall be at least 18 inches for the possible use by handicapped people. The ends of handrails shall be returned to wall or shall be terminated in newel posts or safety terminals. Newel posts and safety terminals may be used only when approved by the ENGINEER.

3.9 GATES AND REMOVABLE SECTIONS

A. Gates shall be provided with self-closing hinges and self-closing latch bolts. Removable handrail sections shall be provided where indicated. The gate and removable railing hardware's color shall match that of the railing system of which it is a part.

B. Aluminum items in contact with concrete or steel or embedded in concrete shall be provided with an electrolysis protective material. The protective material shall be applied to the aluminum surface which will be in contact with the dissimilar material.

C. Handrail post installed into sleeves shall be provided with weep holes between 1/2-inch and 1/4-inch above the finish deck for condensation drainage.

- END OF SECTION -

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall construct all rough carpentry and appurtenant work, complete, in accordance with the requirements of the Contract Documents.

B. The work shall include, but not be limited to, completion of the following principal items:

1. Wood framing, blocking, furring, stripping, backing, and nailers, as shown, specified, or otherwise required for securing other work, except for such items as are specified to be furnished by other trades.

2. Plywood sheathing.

3. All rough hardware appurtenant to the work of this Section, as defined in the Paragraph in Part 2 entitled "Rough Hardware."

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **Codes:** All codes, as referenced herein, are specified in Section 01090, "Reference Standards."

B. **Federal Specifications:**

U.S. Product Std. PS-1 - Softwood Plywood

C. **Commercial Standards:**

AWPA C1	AWPA Manual of Recommended Practice, Standard For Preservative Treatment by Pressure Process--All Timber Product
SPIB	Grading Rules for Southern Pine Lumber of the Southern Pine Inspection Bureau
WCLIB	Standard Grading and Dressing Rules No. 16 of the West Coast Lumber Inspection Bureau
WWPA	Standard Grading Rules for Western Lumber, Western Wood Products Association

1.3 CONTRACTOR SUBMITTALS

A. Detailed, dimensioned shop drawings shall be submitted to the ENGINEER for review and approval in accordance with Section 01300, "Contractor Submittals."

PART 2 – PRODUCTS

2.1 UNTREATED LUMBER

A. **Grading:** Lumber shall be graded in accordance with the rules of one of the following associations: "Grading Rules for Southern Pine Lumber" of the Southern Pine Inspection Bureau (SPIB); "Standard Grading and Dressing Rules No. 16" of the West Coast Lumber Inspection Bureau (WCLIB); or "Grading Rules for Western Lumber" published by Western Wood Products Association (WWPA).

B. **Grade Marking:** Each piece of lumber shall bear the official grade mark of one of the above-mentioned grading rules. The Association standards for grading and grade marking of the lumber shall be acceptable to the ENGINEER.

C. **Size Dressing:** All lumber, except as otherwise specified or shown, shall be dressed to size in accordance with the standards of the association under which the lumber is graded. All lumber shall be S4S unless otherwise specified.

D. **Drying:** All lumber incorporated in the work, except where otherwise specified, shall be air or kiln dried to a moisture content of not more than 19 percent and not less than one percent.

E. **Minimum Design Valves:**

Minimum design values for lumber shall be:

Extreme fiber street in bending:	
- single:	1500 psi
- repetitive:	1750 psi
Tension parallel to grain:	1000 psi
Horizontal shear:	95 psi
Compression:	
- perpendicular to grain:	385 psi
- parallel to grain:	1250-1500 psi
Modulus of elasticity:	1,800,000

Hidden exterior wood trim shall be pressure treated with a wood preservative

2.2 TREATED LUMBER

A. **Marking:** Each piece of treated lumber shall bear the approval mark of an approved testing agency.

B. **Kiln Drying:** Kiln-dried lumber shall be treated with a water-borne preservative and shall have a maximum moisture content of 15 percent after treatment.

C. **Pressure-Treated Lumber:** All wood nailing blocks, sills, and plates resting on or embedded in concrete or masonry within 18 inches of grade shall be pressure-treated in accordance with AWPA C1. Preservative shall conform to American Wood Preservers

Assn. and Americ[redacted] Wood Preservers Bureau Standard [redacted]cifications. Creosote shall not be used.

D. **Preservative:** Two thorough coats of preservative, **Zehrung "Pentaseal"; or Sherwin Williams, "Kemwood Penta,"** shall be applied at least 2 hours before installation, to all surfaces which come in contact with, or are set close to concrete and plaster, except lumber specified to be pressure-treated. Tank dipping or pressure-treating may be used.

E. **Cuts:** Wherever necessary to cut, notch, dap, drill, or frame treated lumber, newly cut or bored surfaces shall be treated with 2 heavy coats of the same preservative used in the original treatment. The minimum penetration depth shall be 1/4-inch.

2.3 PLYWOOD

A. **Plywood:** Plywood shall conform to the requirements of U.S. Product Standard PS-1 as specified herein. All plywood panels shall be marked with grade mark of the American Plywood Association. The mark shall identify the plywood as to species, glue type, and grade in compliance with the applicable commercial standard. Except as otherwise specified below or shown, plywood shall be Douglas Fir, Exterior, C-D, S1S. Plywood for other specific applications shall be as follows:

1. Plywood for use in concrete forms shall conform to the requirements of Section 03300, "Concrete."

2. Plywood for back-up boards behind telephone equipment, electrical equipment, or communication equipment shall be Douglas Fir, A-C INT grade for interior locations and A-C-EXT for exterior locations.

2.4 ROUGH HARDWARE

A. **General:** The term "rough hardware" shall include nails, screws, lag screws, bolts, nuts, washers, plates, metal fasteners, and framing anchors; anchor bolts which are to be embedded into concrete, concrete masonry, or brick masonry; and similar items employed in erection and construction of the rough carpentry work. Rough hardware shall be of standard manufacture, approved by a recognized agency for the intended applications and shall be provided with laboratory test results on capabilities when requested by the ENGINEER. Bolts, screws and nails shall be of proper size to hold members securely in place. All nails on the building exterior shall be aluminum. All screws on the building exterior shall be aluminum. All other bolts, nuts, washers, screws and nails shall be galvanized.

Bolts for bolting wood blocking to concrete roof slabs and concrete block walls shall be 5/8 inch diameter and length suited to conditions. Washers and nuts shall be provided for all bolts. All bolts, washers, nuts, etc., shall be galvanized.

Common nails shall be used for nailing all joints of rough carpentry work.

PART 3 – EXECUTION

3.1 GENERAL

A. **Preliminaries:** Rough carpentry shall be as specified, shown, and as necessary for complete work. The CONTRACTOR shall verify drawing dimensions with actual field conditions and shall inspect related work and adjacent surfaces, and shall report to the ENGINEER all conditions which could prevent proper execution of this work.

B. **Work Coordination and Performance:** The CONTRACTOR shall coordinate all the work and cooperate with the subcontractors and the trades doing related work. All work of construction shall be carefully planned and laid out. All work shall be performed under the direction of a capable, experienced supervisor.

C. **Rough Hardware:** All rough hardware not otherwise specified and which is necessary for the satisfactory execution of framing, including nails, spikes, dowels, fasteners, and similar incidentals shall be provided and installed by the CONTRACTOR. Rough hardware shall be coordinated, furnished, installed, and embedded as shown and as required for a complete work.

D. **Framing:** Framing members and assemblies shall be closely fitted, accurately set, and rigidly secured to required lines, levels, and arrangements shown. Framing shall be accurately and neatly cut and shall be securely nailed, screwed, or otherwise fastened in place in a workmanlike manner.

3.2 FASTENERS AND FRAMING DEVICES

A. **Nailing:** Where nail spacing is not otherwise regulated by the Building Code, nails shall not be driven closer together than 1/2 their length unless driven in drilled holes, nor driven closer to the edge of a member than 1/4 of their length. When necessary to prevent splitting, holes shall be drilled slightly smaller than nail diameters. The nails shall penetrate the second or farther member not less than 1/2 the nail length. Common nails shall be used unless otherwise specified or shown.

B. **Bolts and Nuts:** Malleable or cut-steel washers shall be provided under bolt heads and nuts except where bearing on steel plates or other steel attachments or where flat-head countersunk bolts are shown. Bolt holes shall be drilled 1/32-inch to 1/16-inch larger diameter than the bolts they are to accommodate, and shall be bored true-to-line. Members shall be clamped together and bolts shall be driven in place and nuts drawn up tightly. Bolts shall be drawn tight again immediately prior to enclosing with finish or, if left exposed, upon completion of other work. Holes at anchor bolts embedded in concrete may be 1/16-inch larger than bolt diameter.

C. **Screws:** Lag and wood screws shall be screwed, not driven, into place. Holes to receive lag screws shall be bored first of the same diameter and depth as shank, then continued to depth equal to length of screw with diameter equal to the base of the screw thread. Screws shall penetrate into the farther member a distance equal to a least 7 times the diameter of the screw shank. Washers shall be installed under each lag screw head bearing on wood.

D. **Metal Framing Devices:** Metal framing devices shall be furnished and installed where shown. Nails for the framing devices shall be as furnished or recommended by the manufacturer of the anchor device. All nails shall be driven to their full depth at all holes in anchors. Bolt and lag fasteners shall be drawn tight.

3.3 FRAMING

A. **Strength Considerations:** Structural wood framing members shall not be spliced between bearing points or supports. Approval shall be secured from the ENGINEER before cutting of any wood members that may weaken structure. Due care shall be exercised in placing framing so that structural and other important members do not require cutting for openings, pipes, vents, conduits, or ducts. Bearing surfaces on which wood structural members are to rest shall be finished to give full, true, and even support. Wedges or shims shall not be used to correct faulty work. Wood members which have been split or otherwise damaged to such an extent as to impair their strength shall be removed and replaced at no additional cost to the OWNER.

B. **Cutting and Notching:** Only skilled workmen shall be used for all cutting and framing of wood members required to accommodate structural members, routing of piping, conduit, ducts, and the installation of mechanical, electrical, or other apparatus or equipment. Members shall not be cut, notched, nor bored more than 1/4 of their depth without adequate and approved reinforcing.

C. **Blocking and Backing:** All blocking and backing in walls and ceilings shall be nominal 2-inch thick material of a depth as needed and shall be accurately located around light fixtures, ceiling registers, grilles, and other required mechanical and electrical items. The blocking shall fit snugly and shall be spiked into the supporting framing members. Wood blocking (backing) to receive sheathing, siding, metal lath, and gypsum board shall be provided wherever necessary for securing the facing materials.

D. **Backing for Specialties and Accessories:** Backing shall be accurately located and installed for all building specialties, toilet accessories, and finish hardware items as required.

E. **Concrete-Ernbedded Blocks:** Where required and approved, nominal 2-inch thick nailing blocks (dovetail type) shall be provided in concrete to receive superimposed wood stripping, grounds, and backing. Applied grounds or stripping shall be securely nailed into wood nailing blocks, using nails of approved length.

F. **Plywood Sheathing:** Plywood sheathing shall be installed with face grain across supports and end joints shall be over joists and shall be staggered. Blocking shall be provided at all unsupported edges.

G. **Sleepers:** All sleepers for mechanical equipment and curb openings shall be provided and coordinated with appropriate trades for locations and sizes. Sleepers shall be ripped to conform to roof slope if necessary.

- END OF SECTION -

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall furnish and install fabricated fiber glass items, complete and serviceable as shown and specified herein, all in accordance with the requirements of the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **Commercial Standards:**

ANSI/AWWA F101	Contact-Molded, Fiberglass-Reinforced Plastic Wash Water Troughs and Launders
ANSI/AWWA F102	Matched-Die-Molded, Fiberglass-Reinforced Plastic Weir Plates, Scum Baffles, and Mounting Brackets
ASTM D 638	Test Method for Tensile Properties of Plastics
ASTM D 790	Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

1.3 CONTRACTOR SUBMITTALS

A. **Shop Drawings:** The CONTRACTOR shall furnish shop drawings of all fabricated items and accessories in accordance with the requirements of Section 01300 - Contractor Submittals.

B. **Certification:** The CONTRACTOR shall certify, on the shop drawings, that all items and fabrications have been manufactured of material(s) suitable for potable water usage, and that all fabricated items are of sufficient strength to serve their intended function without undue distortion or deflection.

PART 2 – PRODUCTS

2.1 GENERAL REQUIREMENTS

A. **Manufacturer's Experience:** All items to be provided under this Section shall be furnished only by manufacturers having experience in the manufacture of similar products, with a record of successful installations.

B. **Quality:** All fiber glass items shall be constructed of new, first-class, commercial-quality, fiber glass-fabric-reinforced, polyester resin laminate material of the strength, thickness, and dimensions shown and specified herein, using the matched die-molded method.

C. **Finish:** All finished surfaces of fiber glass items and fabrications shall be smooth, resin-rich, free of voids, and without dry spots, crazes, or unreinforced areas, and shall provide

for corrosion resistance and weathering. Outer surfaces shall be reasonably smooth and no glass fibers shall be exposed.

D. **Supports and Fasteners:** The CONTRACTOR shall provide all bolts, anchor bolts, nuts, washers, and supports as required for all the plastic and fiber glass items specified in this Section, in accordance with the requirements of the manufacturers of the plastic and fiber glass items, unless otherwise noted. All bolts, anchor bolts, washers and supports required in connection with the plastic or fiber glass items provided under this Section shall be of Type 316 stainless steel.

2.2 FIBER GLASS GRATINGS

A. Furnish and install, at the locations shown on the Contract Drawings the fiberglass reinforced plastic gratings complete with fiberglass reinforced plastic angles with Type 316 stainless steel anchors and hold down clips, bolts and nuts.

B. Fiber glass grating shall be minimum one inch high with one inch by 4-inch grid, or 1-1/2 inch high with 1-1/2 inch by 6-inch grid, and all cut edges shall be resealed. The maximum deflection under design load (200 psf) shall not exceed 1/8-inch at 24-inch span. All fiberglass grating shall have a permanently slip-resistant surface.

C. Grating shall be fiberglass roving reinforced thermoset plastic, constructed to provide thorough wetting of the glass by the resin. The grating shall be made in a mold and of single piece construction so the reinforcing glass of the bearing bars are interwoven with the glass of the cross bars. Resin content will be a minimum of 60% and fiberglass a maximum of 40% by weight. Angular silica particles shall be integrally embedded in the top surface of the grating as an anti-slip surface.

D. Unless otherwise indicated on the Contract Drawings, bearing bars shall be 1-1/2" high by minimum 1/4" wide on 1-1/4" centers. Unless otherwise indicated on the Contract Drawings, cross bars shall be 1-1/2" high by minimum 1/4" wide on 6" centers. The tops of the bearing bars and cross members shall be in the same plane to maximize the anti-slip top surface area.

E. The angles for framing shall be 2" x 2" x 1/4" minimum and shall be cut to match the height of the grating. Angle anchors shall be Type 316 stainless steel minimum 4" long by 3/16" thick, spaced at maximum 18" centers. Anchors shall be fastened to angle framing with 1/4" x 1" Type 316 stainless steel nuts and bolts. Resin for the framing angles and the grating shall be chemical grade thermoset resin, CP-84.

F. Grating bars shall be tapered to promote self cleaning.

G. Grating and angles shall be as manufactured by:

1. **Chemgrate Corp.**

2. **Fibergrate Corp., "Fibergrate"**

3. **IKG Industries**

4. **Stongwell Corporation (MMFG)**

2.3 FIBER GLASS SUPERNATANT TROUGHS

A. **Scope of Work:** One fiber glass supernatant trough shall be provided for each gravity thickener. Each trough shall have flat bottom, designed for collection of supernatant from the gravity thickeners at the rate of approximately 860 gpm per trough. The minimum size of each trough shall be 10 inches wide by 18 inches total depth. The top edges of the trough shall be level, while the bottom of the troughs shall have a slope of 0.5% from the high point to the low point of the trough bottom. An integrally-molded dropbox shall be provided on the low point of the trough. The troughs shall be set inboard so that there is a 1' gap between the outer wall of the trough and the inner wall of the gravity thickener. Fiber glass troughs shall conform to ANSI/AWWA F101, except where more stringent requirements are specified in this Section.

B. **Construction:** The minimum trough wall thickness shall be 1/4-inch. Troughs shall be reinforced with triangular-shaped longitudinal stiffeners, molded as an integral part of the trough. Care shall be exercised in fabricating, to maintain the edges of the troughs level and straight throughout the entire length. Bracing for the troughs shall be supplied by the MANUFACTURE.

C. **Color:** Troughs shall be constructed with a blue-green color integral with the material. Up to 4 percent by weight of thixotropic agent may be added to the polyester resin as required to prevent runoff.

D. **Physical Properties:** A minimum physical property of the trough (1/4-inch thickness) shall be 12,000 psi for ultimate tensile strength and 19,000 psi for flexural strength based upon ASTM D 638 and D 790.

E. **Manufacturers:**

1. **F.B. Leopold Co., "Leo Lite";**

2. **Warminster Fiberglass Co.**

2.4 ADJUSTABLE FIBER GLASS WEIR PLATES

A. **Construction:** Adjustable fiber glass weir plates shall be fabricated with 1/4-inch minimum thickness and of a blue-green color integral with the material. Weir plates shall have at maximum 3-inch, 90-degree V-notches at a maximum spacing of 6 inches on centers, where shown, and all cut edges shall be resealed. Weir plates shall be provided with slotted holes for 2 ½" of vertical adjustment as shown. All necessary accessories required to complete the installation shall be provided. Fiber glass weir plates shall conform to ANSI/AWWA F102, except where more stringent requirements are specified in this Section.

B. **Physical Properties:** Minimum physical properties shall be as follows:

1.	Tensile strength	7,500 psi	ASTM Test D 638
2.	Flexural strength	16,000 psi	ASTM Test D 790
3.	Coefficient of thermal expansion (average)	16×10^{-6} inch per inch, per degree F	
4.	Water absorption in 24 hours	Less than 0.2 percent	

C. **Manufacturers:**

1. **F.B. Leopold Co.;**

2. **Warminster Fiberglass Co.**

PART 3 – EXECUTION

3.1 INSTALLATION

A. Fiber glass troughs shall be fabricated and installed to maintain trough edges as level as possible and straight throughout the trough's lengths. In no case shall the variation in level exceed 1/16-inch above, nor 1/8-inch below the established grade. Weir plates shall be installed plumb and level. Weir plates shall be attached to the trough by stainless steel bolts, which shall be located in the center of the vertical slots as to allow for maximum field adjustment in the future. Gaskets shall be placed where bolts are used to attach the weir and braces to the trough.

B. Installation of the troughs and weirs shall be coordinated with section 11230 – Gravity Thickener so that there are no construction conflicts or mechanical interference.

- END OF SECTION -

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall furnish all the materials for and shall properly erect and install all dampproofing at the locations shown and as indicated on the Contract Drawings and as specified herein.

B. This shall include all surface-applied bituminous and cementitious coatings, on concrete and masonry surfaces, and all labor, materials, tools, and appurtenances required to complete the work of this Contract.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **Codes:** All codes, as referenced herein, are specified in Section 01090, "Reference Standards."

B. **Commercial Standards:**

ASTM D 412	Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension
ASTM E 96	Test Methods for Water Vapor Transmission of Materials

1.3 CONTRACTOR SUBMITTALS

A. **Shop Drawings:** Detailed, dimensioned shop drawings and data conforming to the requirements of Section 1300 of the General Requirements shall be submitted to the Engineer and approved before fabrication, shipment or work specified under this Section begins.

B. **Certificates of Compliance:** Submit Certificates of Compliance for all materials in accordance with the provisions of Section 1300 of the General Requirements.

PART 2 – PRODUCTS

2.1 SURFACE-APPLIED BITUMINOUS WATERPROOFING

A. Bituminous waterproofing material shall be Karnak Corporation "KARNAK #920."

2.2 SURFACE-APPLIED CLEAR SEALER

A. All exposed face brick shall receive spray-applied, clear penetrating sealer, sealer shall be "OKON W-1" as manufactured by OKON, Inc., or "SILOXANE" by Prosoco.

2.3 SURFACE-APPLIED CEMENTITIOUS COATINGS

A. Cementitious coatings shall be Thoroseal by Thoro System Products. Color shall be as selected by the Engineer from manufacturer's standard colors.

B. For finishing concrete use an additive to improve bonding such as acryl 60 Thoroseal.

PART 3 – EXECUTION

3.1 SURFACE-APPLIED BITUMINOUS WATERPROOFING

A. Before beginning to lay any veneer masonry work, the Contractor shall paint the exterior part of the vertical concrete or C.M.U. walls, with bituminous waterproofing material. Extreme care shall be taken to keep all exposed concrete surfaces free from bituminous waterproofing and/or splatters. Apply only to clean, firm and dry surfaces, follow manufacturer's instructions. This material shall be compatible with, and act as an adhesive for any insulation.

3.2 SURFACE APPLIED CLEAR SEALER

A. All surfaces should be thoroughly cleaned. Caulking and other sealants should be in place before sealer application. Air and substrate temperature should be 50°F and rising. The surface to be treated can be slightly damp but no obvious signs of wetness should exist. In hot, dry weather, surfaces to be treated should receive a light spray of water prior to sealer application. Application and coverage shall be according to manufacturer's recommendations. Protect adjacent areas which would be adversely affected from overspray.

3.3 SURFACE-APPLIED CEMENTITIOUS COATINGS

A. A cement base, aggregate type, heavy duty, waterproof coating shall be furnished and installed for all exterior plain and fluted concrete walls located above ground at all buildings and for all exterior plain and fluted concrete tank walls located above ground, including splitter boxes, etc., erected under this Contract.

B. Surface to be coated shall be structurally sound, clean and free of dirt, loose mortar particles, paint, films, protective coatings, etc. Concrete to receive coating shall be carefully formed to provide a smooth surface, free of form marks and in condition to receive a coating of approximately 1/8" thickness. Do not use form treatments that will stain or otherwise injure the concrete or prevent a good bond for cement-base coatings. Cut rods, steel separators back to depth of 2 inches and patch all holes, cracked and spalled concrete, and honeycombed areas with patching cement as recommended by manufacturer of finish coating.

C. For finishing concrete, mix cement coat according to manufacturer's instructions, including an additive to improve bonding. Mix and apply first coat at 2 lbs. per sq. yd. Apply second brush coat at same rate after first coat has set. When finish coat has set, float it to uniform texture with a sponge float.

- END OF SECTION -

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall furnish all the materials for and shall properly erect and install all vapor retarders at the locations shown and as indicated on the Contract Drawings, and as specified herein. This shall include all plastic sheet moisture vapor retarders, and all labor, materials, tools, and appurtenances required to complete the work of this Contract.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **Codes:** All codes, as referenced herein, are specified in Section 01090, "Reference Standards."

1.3 WORKMANSHIP AND MATERIALS

A. All equipment and materials furnished under this Contract shall be new, suitable for the conditions on service to which they will be subject, and equal to the best of their respective classes. Grade and quality shall meet the applicable cited specifications and standards.

B. Workmanship shall be of the highest quality and shall be carried out by competent and experienced workmen.

1.4 CONTRACTOR SUBMITTALS

A. **Shop Drawings:** Detailed, dimensioned shop drawings and data conforming to the requirements of Section 01300 of the General Requirements shall be submitted to the Engineer and approved before fabrication, shipment or work specified under this Section begins.

PART 2 – PRODUCTS

2.1 PLASTIC SHEET

A. The plastic vapor retarder shall be a 0.010 inch thick polyethylene film with 2 inch wide, 3M, or ("Scotch") glass filament tape.

PART 3 – EXECUTION

3.1 A plastic vapor retarder shall be placed over the backfill and under the concrete floor slab. The plastic sheets shall be lapped 6 inches at joints and sealed with tape and the sheets shall be turned up the wall at the edges of the slab. Tears caused by sharp stones or placement of reinforcement steel shall be repaired with additional sheets of film taped in place with tape.

- END OF SECTION -

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall furnish and install all building insulation work complete, in accordance with the requirements of the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **Codes:** All codes, as referenced herein, are specified in Section 01090, "Reference Standards.

B. **Federal Specifications:**

HH-I-524C	Insulation Board, Thermal (Polystyrene)
HH-I-1972/1	Insulation Board, Thermal, Polyurethane Or Polyisocyanurate, Faced With Aluminum Foil On Both Sides Of The Foam

C. **Commercial Standards:**

ASTM C 518	Test Method for Thermal Transmission Properties
ASTM C 578	Specification for Preformed, Cellular Polystyrene Thermal Insulation
ASTM C 665	Specification for Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
ASTM D 1621	Test Method for Compressive Properties of Rigid Cellular Plastics
ASTM E 84	Test Method for Surface Burning Characteristics of Building Materials
ASTM E 96	Test Methods for Water Vapor Transmission of Materials
UL	Underwriters' Laboratories, Inc.

D. **Manufacturer's Standards:** In addition to the standards listed above, the insulation products and their installation shall be in accordance with the manufacturer's published recommendations and specifications.

1.3 CONTRACTOR SUBMITTALS

A. **General:** Submittals shall be in accordance with Section 01300, "Contractor Submittals."

B. **Samples:** The CONTRACTOR shall submit to the ENGINEER for approval, samples of all materials and fabricated items proposed for use on the work. The samples shall be clearly marked to show the manufacturer's name and product identification. All sample submittals shall conform to the requirements for "Samples" in Section 01300, "Contractor Submittals."

C. **Manufacturer's Information:** Manufacturer's literature, specifications, installation instructions, technical data, and general recommendations shall be submitted to the ENGINEER.

D. Manufacturer's certification or other data substantiating that the proposed materials comply with the Specification shall be submitted to the ENGINEER.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. **Delivery of Materials:** Manufactured materials shall be delivered in original unbroken packages, containers, or bundles bearing the name of the manufacturer.

B. **Storage:** All materials shall be carefully stored in an area which is protected from the elements in a manner recommended by the material manufacturer, to prevent damage to the material and marring of its finish.

PART 2 – PRODUCTS

2.1 GENERAL

A. The materials and application of building insulation shall conform to the applicable requirement of the Underwriters Laboratories "Fire Resistance Index," Factory Mutual requirements, manufacturer's printed recommendations and specifications, and Federal specifications.

B. Thermal and acoustical insulation shall have a flame-spread rating of 25 or less and a smoke density not exceeding 450 when tested in accordance with ASTM E 84.

2.2 ROOF INSULATION

A. Roof insulation shall be tapered board polyisocyanurate HP, Sure-Seal by Carlisle Syntec Systems. Board size 4' x 8', variable thickness, R-Value at 40°F (1" thickness) of 6.00, compressive strength (at 10% deformation) 16 psi, min., and density 1.5 pcf. Insulation shall have both Factory Mutual approval for Class 1 construction and Underwriter's Laboratories approval for use in Construction I and Construction II.

B. The roof crickets and other pitched layers shall be by the same manufacturer, and be of the same material as the tapered insulation.

2.3 CAVITY WALL INSULATION

A. Rigid insulation shall be extruded polystyrene board, 1½-inch thickness unless otherwise shown or specified, Styrofoam Score Board, as manufactured by Dow Chemical Co.

B. Insulation board shall have the following physical properties:

1. Typical five-year aged thermal conductivity, K factor of 0.20 BTU in./hr. sq. ft. °F when tested at 75°F mean temperature in accordance with ASTM C518.

2. Typical compressive strength of 40 lbs./sq.in., 25 lbs./sq.in. minimum, when tested in the vertical direction in accordance with ASTM D1621.

3. Maximum water absorption of 0.1 percent by volume when tested in accordance with ASTM C 272.

4. Water Vapor Permeance for one inch product of 1.0 perm (maximum) when tested in accordance with ASTM E96.

5. Insulation shall meet physical property requirements given in ASTM C 578, Type IV.

2.4 FASTENERS

A. Fasteners shall be per written recommendations of the manufacturer of the insulating materials.

PART 3 – EXECUTION

3.1 GENERAL

A. All roof structures shall be provided with the roof insulation system shown.

B. The roof insulation shall be installed over a roof vapor retarder membrane system.

3.2 PREPARATION

A. The CONTRACTOR shall verify site conditions affecting work of this Section and shall obtain accurate dimensions of all openings, levels, and location and arrangements of embedded anchorage.

B. Any discrepancies between the Drawings and field dimensions and other irregularities or improper conditions which effect the work shall be reported to the ENGINEER for correction prior to commencing work. Commencement of work shall indicate acceptance of conditions and surfaces underlaying or adjacent to work of this Section.

3.3 INSTALLATION OF INSULATION

A. Insulation shall be installed in accordance with the manufacturer's printed installation instructions.

B. Insulation shall be installed to provide maximum sound and thermal benefits for material specified. The insulation shall be installed to completely fill or cover voids providing a continuous blanket of insulation. Insulation shall be cut neatly to snugly fit angles, corners and irregular areas and carefully wrapped around pipes, conduits, outlets, switches, beams, etc., to maintain continuity of insulation. Gaps or bridges shall be avoided. Insulation shall be tight fitting and shall be secured as recommended by the material manufacturers for job conditions.

3.4 ADJUSTMENT AND CLEANING

A. **Protection:** The CONTRACTOR shall adequately protect all work from damage resulting from subsequent construction operations. Damaged or soiled work shall be replaced by the CONTRACTOR, at no additional cost to the OWNER.

B. **Clean-up:** The CONTRACTOR shall at all times keep the premises free from accumulation of waste materials and rubbish caused by his employees.

C. Upon completion of work, rubbish and excess materials shall be removed from the site, leaving the areas acceptably clean.

- END OF SECTION -

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall furnish all the materials for and shall properly erect and install all membrane roofing at the locations shown and as indicated on the Contract Drawings, and as specified herein.

B. This shall include all membrane roofing materials, base flashings, adhesives stone ballast, walkway precast concrete pavers, miscellaneous single-ply membrane roofing and other items integral with membrane roofing, and all labor, materials, tools and appurtenances required to complete the work of this Contract.

C. It is the intent of this Specification that the installation shall be complete in all respects and ready for use. The Contractor will be responsible for all incidental details and for any special construction necessary to complete the work in an acceptable manner.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **Codes:** All codes, as referenced herein, are specified in Section 01090, "Reference Standards."

B. **Commercial Standards:**

UL Underwriters' Laboratories, Inc.

1.3 CONTRACTOR SUBMITTALS

A. **Shop Drawings:** Submit to the Engineer detailed shop drawings and data in accordance with the requirements of Section 1300 of the General Requirements. Do not undertake the manufacture, fabrication or other work until the Engineer has approved the submittals.

1.4 QUALITY ASSURANCE

A. The design is based on a Sure-Seal Fully-Adhered Single-Ply roofing system.

B. Roofing system shall be installed by a Certified Roofing Applicator in compliance with shop drawings as approved by the ENGINEER. There shall be no deviations made without the PRIOR WRITTEN APPROVAL of the ENGINEER. Upon completion of the installation, an inspection will be conducted by THE ENGINEER to ascertain that the membrane roofing system has been installed according to MANUFACTURE'S published specifications and details applicable at the time of bid.

C. This roofing system shall be approved by Underwriters Laboratories (UL) as a Class A roofing system. For specific code approvals achieved with this roofing system, refer to Underwriters Laboratories Fire Resistance and Roofing Materials and Systems Directories.

1.5 COMPLIANCE

A. To ensure compliance with the MANUFACTURE'S minimum warranty requirements, the following projects shall be forwarded to the ENGINEER for review:

1. All Warranty projects where an extended wind uplift warranty coverage (up to 72 MPH peak gust wind speed) is specified.

2. Projects where the EPDM is expected to come in direct contact with petroleum based products or other chemicals.

B. For all projects (prior to project inspection by the ENGINEER) a final shop drawing must be approved and assigned a number by the ENGINEER.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the job site in the original, unopened containers labeled with the manufacturer's name, brand name and installation instructions.

B. Curable materials (i.e., uncured flashing, adhesives, sealants, Pourable Sealer and Pressure Sensitive Flashing) must be stored between 60-80 degrees Fahrenheit. When liquid adhesives and sealants are exposed to lower temperatures, restore to a minimum of 60 degrees Fahrenheit before use.

C. Insulation and underlayment must be stored so it is kept dry and is protected from the elements. Store insulation on a skid and completely cover with a breathable material such as tarp or canvas. If the insulation is lightweight, it should be weighted to prevent possible wind damage.

D. Do not store adhesive containers with opened lids due to the loss of solvent which will occur from flash off.

1.7 JOB CONDITIONS

A. Coordination between various trades is essential to avoid unnecessary rooftop traffic over sections of the roof and to prevent subsequent damage to the EPDM membrane roofing system.

1.8 WARRANTY

A. A 15-year Warranty is required. Warranty projects will receive a maximum peak gust wind speed coverage up to 55 miles per hour unless prior review is performed by the MANUFACTURE regarding an extended peak gust wind speed coverage up to 72 mph (measured at 10 meters aboveground level).

B. **Guarantee:** Upon completion of the project, the roofing subcontractor for the work under this Specification shall furnish a written guarantee on the subcontractor's letterhead, signed by the Contractor and roofing subcontractor, giving an unconditional, unlimited dollar coverage, two year guarantee insuring the watertightness of all roofing for the duration of the guarantee.

C. Should any leakage or damage occur, the guarantee shall be extended for a period of two years from the date of satisfactory correction of the leak and repair of the roofing.

D. The guarantee shall cover a period of two years from and after the completion of the entire project and its acceptance by the Owner.

PART 2 – PRODUCTS

2.1 GENERAL

A. The components of the Roofing Systems are to be products of **Firestone** or **Manville**.

2.2 MEMBRANE

A. Sure-Seal (black) .045 inch thick, 4'-6" wide at perimeter and 10'-0" wide otherwise, non-reinforced EPDM (Thylene, Propylene, Diene Terpolymer), fully-adhered. Adjoining sheets of EPDM membrane are spliced together a minimum of 6-inches using Sure-Seal EP-95 Splicing Cement, In-Seam Sealant and Lap Sealant.

B. For physical properties of the membrane, refer to the "Products" section of the MANUFACTURE'S technical manual.

2.3 RELATED MATERIALS

A. 90-8-30A Bonding Adhesive, Splice Cleaner, Splicing Cement, In-Seam Sealant, Lap Sealant, uncured Elastoform Flashing, Seam Fastening Plates and RUSS (with the corresponding fasteners) are required for use with this roofing system. Other products, such as, insulation, edgings and termination bars are required to comply with the 15-year Warranty which is specified above.

B. **Other Products:** Pre-Molded Pipe Seals, Pressure-Sensitive Flashing and Pressure-Sensitive Inside/Outside Corners, Pourable Sealer Pockets & Pipe Boots as required shall be provided by the MANUFACTURE.

PART 3 – EXECUTION

3.1 GENERAL

A. When feasible, begin the application at the highest point of the highest roof level and work to the lowest point to prevent moisture infiltration and to minimize construction traffic on completed sections. This will include completion of all flashings and terminations.

B. Follow criteria outlined in the "Design Criteria" Section of the manufacturer's technical manual to prepare the roof deck or the existing substrate prior to the application of the new roofing system.

C. Compression wood nailers must not be utilized for membrane securement.

3.2 ROOF DECK CRITERIA

A. A proper substrate shall be provided by the building owner. The structure shall be sufficient to withstand normal construction loads and live loads.

B. Defects in the roof deck must be reported and documented to the specifier, general contractor and building owner for assessment. The manufacturer's Authorized Roofing

Applicator shall not proceed with the installation unless the defects are corrected.

3.3 SUBSTRATE PREPARATION

A. For all projects, the substrate must be even without noticeable high spots or depressions, and must be free of accumulated water, ice or snow to prevent the absorption of moisture in the new roofing components and roofing system.

B. Prior to the placement of the membrane underlayment, clear the substrate of debris and foreign material which may be harmful to the roofing system. Fresh bitumen based roof cement must be removed or concealed.

3.4 INSTALLATION

A. Prior to the use of any of the manufacturer's products, refer to the "Safety" Section and the Material Safety Data Sheets in the manufacturer's technical manual for applicable cautions and warnings.

B. **Insulation Placement:**

1. Roof Insulation shall be mechanically fastened to the roof deck with one insulation fastener and plate per every 4 square feet, unless otherwise approved in writing by the insulation manufacturer.

C. **Membrane Installation:**

1. A minimum of one 4½ foot wide perimeter membrane sheet or RUSS (installed down the center of a 10 foot wide membrane sheet) shall be installed at the perimeter of each roof level and 10 foot wide membrane sheets (depending on project conditions) shall be installed over the field of the roof. All membrane sheets shall be mechanically fastened with the appropriate Seam Fastening Plates spaced a maximum of 12 inches on center within the membrane splice.

   a. When using the Sure-Seal HP lightweight Deck Fastener in conjunction with a cementitious wood fiber deck, the fasteners must be spaced a maximum of 6 inches on center.

   b. When using the Sure-Seal HP Fastener through lightweight insulating concrete into a steel deck below, the fastener spacing is dependent on the pullout values achieved. Refer to the "Design Criteria" Section of the manufacturer's technical manual for applicable requirements.

2. Overlap adjacent EPDM membrane sheets a minimum of 6 inches at Seam Fastening Plates (along the length of the membrane sheet) and 3 inches at end roll sections (the width of the membrane).

3. Clean the splice area with Splice Cleaner and apply Splicing Cement at the rate of approximately 85 linear feet per gallon for a 6 inch wide splice and approximately 150 linear feet per gallon for a 3 inch wide splice. Just prior to closing the splice, apply a bead of In-Seam Sealant no less than 1/8 inch and no more than 1/4 inch in diameter a minimum of 1/2 inch from the inside edge of the bottom membrane sheet and a minimum of 2 inches from the lead edge at end roll sections (the width of the membrane) as well as along the center of the membrane splice (along the preprinted

blue line approximately 3 inches from the edge of the membrane) and around the outside edge of the Seam Fastening Plates.

4. After adjoining membrane sheets are spliced together, wait a minimum of 2 hours and clean the exposed edge of the splice with Splice Cleaner and apply a 5/16 inch diameter bead of Lap Sealant. Feather the Lap Sealant to completely cover the splice edge.

D. **Additional Membrane Securement:**

1. The EPDM membrane must be secured at the perimeter of each roof level, roof section, expansion joint, curb, skylight, interior wall, penthouse, etc., at any angle change which exceeds 2 inches in one horizontal foot, and at all penetrations in accordance with the manufacturer's details published with the manufacturer's specifications. The additional membrane securement may be provided by RUSS (Reinforced Universal Securement Strip), HP Locking Seam Fastening Plates (required for steel decks) or Seam Fastening Plates.

E. **Membrane Flashing:**

1. When feasible, flash all penetrations and walls with cured EPDM membrane. Uncured Elastoform Flashing must be limited to overlay vertical seams (as required at angle changes) or to flash inside and outside corners, scuppers, pourable sealer pockets and other penetrations or unusually shaped walls where the use of cured membrane flashing is not practical. The manufacturer's prefabricated accessories (Pre-Molded Pipe Boots and Pressure-Sensitive Products such as Pourable Sealer Pockets, Pipe Boots, Flashing and Inside/Outside Corners) should be used, when feasible, in lieu of uncured Elastoform Flashing. Terminate the flashing in accordance with an appropriate U-9 Termination Detail.

F. **Other Related Work:**

1. Copings, counterflashing and other metal work, not supplied by the manufacturer, shall be fastened to prevent the metal from pulling free or buckling and sealed to prevent moisture from entering the roofing system or building.

- END OF SECTION -

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall furnish and install all sheet metal work and appurtenant work, complete, in accordance with the requirements of the Contract Documents.

B. The principal items of sheet metal work shall include, but not be limited to the following: metal fascia systems, copings, sheet metal flashings, collars, downspouts, equipment platforms, and equipment (sleeper) supports at all roof penetrations.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **Codes:** All codes referenced herein, are specified in Section 01090 - Reference Standards.

B. **Commercial Standards:**

ASTM A 480/A480M	Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip

C. **Trade Standards:**

Sheet Metal Contractors National Association "Standard Practice in Sheet Metal Work."

American Welding Society (AWS).

D. **Manufacturer's Standards:** In addition to the standards listed above, the flashing products and their installation shall be in accordance with the manufacturer's published recommendations and specifications.

1.3 CONTRACTOR SUBMITTALS

A. **General:** The following shall be submitted to the ENGINEER for review, approval, or verification in accordance with Section 01300, "Contractor Submittals."

B. **Samples:** Color samples and samples shall be submitted where required for color selections and/or review by the ENGINEER.

C. **Shop Drawings:** Shop drawings showing materials, gages, finishes, layout, jointing, profiles, fasteners, fabrication of special shapes, and method of attachment to adjacent construction shall be submitted.

D. **Manufacturers Information:** Manufacturers literature indicating materials, finish, construction, and method of installation of prefabricated items and sealants.

PART 2 – PRODUCTS

2.1 FLASHING AND SHEET METAL WORK

A. For all concealed and exposed flashing and sheet metal work, metal only shall be used and it shall be:

1. Nickel stainless steel, Type 304 with a 2D mill finish, 0.0156 inch thickness, weighing 0.6562 lb. per sq. ft. conforming to ASTM A480/A480M.

B. Concealed flashing shall have a uniform, matching pattern deformation, embossed to provide a mechanical bond in three directions within the mortar bed. Stainless steel flashing shall be as manufactured by Keystone Flashing Co.

C. Where joints and seams occur, the deformation design shall overlap to properly interlock and match uniformly and continuously at each end. All joints and seams shall be fully bedded, thoroughly filled and sealed with a rubber base contact adhesive type cement. Lengths of flashing shall not exceed 120 inches; widths shall not exceed 24 inches to avoid buckling and permit necessary movement in the walls with proper laps and joints in the installation. All joints and seams shall be made in the direction of the flow of water.

D. Curb covers shall be furnished for each roof opening such as at pipes, vents, etc. See HVAC and Plumbing Specs.

E. Fastening devices such as cleats, nails, screws and rivets shall be of the same material as the flashing or shall be of a compatible material which shall not produce a corrosive action when used in conjunction with the flashing or sheet metal work.

2.2 REGLETS

A. When reglets are used in conjunction with the flashing, they shall be of the same material as the flashing. Where reglets and cap flashing are used in conjunction, the reglet and cap flashing shall be by the same manufacturer. Manufacturers shall be Fry Reglet Corp. springlock flashing systems: Type SM-, surface mounted, Type CO- concrete, Type MA-4-masonry; Cheney Flashing Co. Type A snaplock concrete reglet, Type B snaplock masonry reglet; W.P. Hickman Co., Inc. See Drawings for type required.

2.3 SHOP FABRICATION REQUIREMENTS

A. Overflow downspouts shall be corrugated and rectangular, 5" wide.

B. All aluminum shall be welded where specified or shown. Welding shall conform to Reference Standards.

C. All work and finishes shall be protected from scratches and abrasions.

D. All flashings, reglets and counter-flashing and associated flashings shall be fabricated by the same manufacturer and be installed as a complete flashing system. All flashings shall be creased longitudinally or otherwise formed with sufficient spring action to hold bottom edges firmly against base flashing or similar material.

E. Flashing required through concrete shall be flexible flashing in order to assure against

undue separation between tiles on account of rigidity of the flashing material. Flashing around pipes, vents, flues, chimneys, etc., shall be of lead, copper, or other approved flexible flashing material.

2.4 SCUPPERS

A. Provide manufacturer's standard systems with all components supplied by the same manufacturer. Systems shall be as manufactured by **W.P. Hickman Co., Manville Corp., or MM Systems.**

B. The scupper shall be 5" wide with aluminum end closures.

PART 3 – EXECUTION

3.1 FLASHING AND SHEET METAL

A. The Contractor shall perform sheet metal work in accordance with the Sheet Metal Contractors National Association "Standard Practice in Sheet Metal Work", Manuals Nos. 1 and 2, except as modified herein. Work shall be bound and formed to the shapes and sizes required and securely fastened in place to make a first-class installation. Follow instructions of manufacturer.

B. The flashing for horizontal masonry surfaces shall be laid in a slurry of fresh mortar and topped with a fresh full bed of mortar. The flashing shall start with a drip 1/4-inch outside face of the wall, be carried through the wall turning up to facilitate flow through weep holes to outside, and turned up on inside face of wall not less than 2 inches or be carried upward across cavity a minimum of 2" or reglet.

C. Where interior faces of masonry walls are exposed to view, flashing shall terminate 3/4 inch back from the inside face and have minimum 1/4 inch hook dam. Weepholes as shown on Drawings.

D. Vertical surfaces to be flashed shall be thoroughly dry, free from loose materials, reasonably smooth, and shall be sufficiently spotted with mastic to hold flashing in place until the covering masonry is applied and the mortar is set.

E. The flashing for foundation sills shall be laid in a slurry of fresh water and topped with a fresh full bed of mortar. Flashing shall start with a drip 1/4" outside of exterior face and turn up on the inside not less than 2 inches (unless shown otherwise on Drawings) or be carried upward across the cavity a minimum of 6 inches and extended into the backing wall mortar joints a minimum of 2" or in a continuous reglet. Weep holes shall be installed at a maximum spacing of 24 inches on centers in the brick course immediately on top of the flashing. Where sills and columns meet, flashing shall be brought a minimum of 10 inches up the column and secured with plastic cement.

F. Through-wall flashing shall start with a drip 1/4" outside face of the wall, be carried through the wall, turning up to facilitate flow through the weep holes to the outside and shall be turned up on the back of wall not less than 2 inches (unless shown otherwise on Drawings) or carried upward and across the cavity a minimum height of 6 inches and extended into the backing wall mortar joints a minimum of 2" or in a continuous reglet.

G. Cavity wall flashing shall be laid in a slurry of fresh mortar and topped with a fresh full bed of mortar. Flashing shall start with a drip 1/4" outside face of wall, be carried through the wall and upward and across the cavity a minimum height of 6 inches and extended into the backing wall mortar joints a minimum of 2" or in a continuous reglet.

H. Flashing for heads and sills shall start with a drip 1/4" outside face of wall, be carried through the wall and be turned up at the inside not less than 2 inches (unless shown otherwise on Drawings). Head flashing shall be carried 6 inches beyond both ends of the steel lintel. Both head and sill flashing shall be turned up at the ends or sides to form a pan. All corners shall be folded, not cut. Weep holes shall be provided at a maximum spacing of 24 inches on centers in the first course of brick immediately above the flashing.

I. Spandrel flashing shall start with a drip 1/4" outside toe of the shelf angle or outside edge of the shelf plate, cover the angle or plate and go up the face of the beam and over the top flange and then through the wall, turning up in the mortar joints or on inside face of wall not less than 2 inches (unless show otherwise on Drawings). Weep holes shall be provided at a maximum spacing of 24 inches on centers in the first course of brick immediately above the flashing.

J. For stainless steel flashing, the joints shall be double seamed and soldered, not over 8 feet on centers. Flat or locked seams shall finish not less than 1/2 inch wide. Lapped seams, where soldered, shall finish not less than 1 inch wide. Lapped seams, where not soldered, shall lap not less than 3 inches and be thoroughly filled and sealed with a rubber base contact adhesive type cement. All flat or lapped seams shall be made in the direction of the flow of water. Lengths of sheets shall not exceed 120 inches; widths shall not exceed 24 inches, to avoid buckling. Expansion-contraction joints of a type and spacing shall be provided appropriate to the conditions of the work, conforming to standard practices. The exposed edges of all flashing shall be crimped in accordance with standard practices.

3.2 REGLETS

A. When reglets are used in conjunction with cap flashing, the systems shall have a constant pressure against both reglet and roofing with over-lapped ends to insure a tight seal. Cap flashing shall be readily removable and replaceable without clips or screws unless detailed otherwise on Drawings such as for tops of roof edge concrete curbs. Where roof surfaces abut vertical wall or parapet wall surfaces, the reglets shall be installed in the vertical wall to receive the cap flashing at a point at least 7 inches above the top of the cant strip unless otherwise shown on the Drawings.

B. Cap flashing shall be formed to allow anchoring appropriate to the shape of the reglet. Interior and exterior corner joints in the cap flashing shall be prefabricated. After roofing and composition base flashing are installed, cap flashing shall be inserted in the reglet with each section lapping the next section at least 3 inches.

3.3 GUARANTEE - FLASHING AND SHEET METAL WORK

A. The Contractor shall furnish an unconditional guarantee for all materials and workmanship and shall guarantee that the flashing and sheet metal work will be watertight for a period of two years from date of acceptance of the entire work, without exception. Any leaks shall be repaired and any defective material replaced at the expense of the Contractor, during that period.

B. Should any leakage or damage occur, the guarantee shall be extended for a period of two years from the date of satisfactory correction of the leak and repair of the flashing and sheet metal work, etc. Such guarantee shall be submitted with shop drawings for approval by Owner.

- END OF SECTION -

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall furnish and install all caulking, sealing, moisture protection, and appurtenant work, complete, in accordance with the requirements of the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **Codes:** All codes, as referenced herein, are specified in Section 01090, "Referenced Standards."

B. **Federal Specifications:**

TT-S-001543A	Sealing Compound, Silicone Rubber Base, (For Caulking, Sealing and Glazing in Buildings and Other Structures)
TT-S-00230C(2)	Sealing Compound, Elastomeric Type, Single Component, (For Caulking, Sealing, and Glazing in Buildings and Other Structures)

C. **Manufacturer's Standards:** In addition to the standards listed above, the sealants and caulking products and their application shall be in accordance with the manufacturer's published recommendations and specifications.

1.3 CONTRACTOR SUBMITTALS

A. **General:** All submittals shall be in accordance with Section 01300, "Contractor Submittals."

B. **Samples:** The CONTRACTOR shall submit to the ENGINEER for review, samples (including color samples) of all the caulking and sealant materials and other moisture protection materials proposed for use on the work. The samples shall be clearly marked with the manufacturer's name and product identification.

C. **Technical Data:** The CONTRACTOR shall submit a complete materials list along with the manufacturer's technical data and literature, specifications, and installation instructions.

D. **Certificates:** The CONTRACTOR shall provide (if requested by the ENGINEER) certificates from an independent testing laboratory approved by the ENGINEER, certifying that the submitted materials meet all the requirements of the ASTM and Federal Specifications cited.

E. **Warranty:** The CONTRACTOR shall furnish a copy of the manufacturer's warranty covering all sealants, caulking materials, and other moisture protection materials against defects in materials.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. **Delivery of Materials:** Manufactured materials shall be delivered in original, unbroken packages, containers, or bundles bearing the name of the manufacturer.

B. **Storage:** All materials shall be carefully stored in a manner that will prevent damage and in an area that is protected from the elements.

PART 2 – PRODUCTS

2.1 SEALANTS AND CAULKING MATERIALS

A. All caulking and sealing materials shall conform to the following requirements:

1. Sealant for exterior and/or interior use shall be 2-part polyurethane, gun grade, as manufactured by **Tremco "Dymeric 511"; Products Research Corp. "210";** or **Progress Unlimited "Iso-Flex 2000."** Sealant for interior use may be 1-part acrylic terpolymer sealant, as manufactured by **Tremco's "Mono 555"; or Dap "One-Part Acrylic."**

2. The sealants used with aluminum doors, windows, storefronts, and frames shall be silicone sealant conforming to Federal Specifications TT-S-001543A (Class A) and TT-S-00230C(2) (Type II, Class A), as manufactured by **Tremco "Spectrem 2."**

3. Fire-resistant penetration sealant shall be a medium density fire-resistant foam that retains form and stability at high temperature and meets UL test requirement for fire rating required at location used. Fire-resistant sealant shall be **Dow-Corning Corporation's "3-6548 Silicone RTV" foam; 3M Corporation's "Fire Barrier Caulk CP 25" and "Putty Corporation's "Fire Barrier Caulk CP 25" and "Putty 303."**

4. Caulking tapes shall be of the butyl-base, vulcanized type.

5. Primers shall be as recommended in the manufacturers printed instructions for caulking and sealants.

6. Cleaning and cleanup solvents shall be as recommended in the manufacturer's printed instructions for caulking and sealants.

2.2 EXPANSION AND RELATED CONTROL JOINT FILLERS

A. The Contractor shall furnish all the materials for expansion joints and fillers, and control joints and seals in all concrete floor slabs and masonry walls as indicated on the Drawings.

B. At the locations indicated on the Drawings, expansion joints and fillers (1/2 inch wide) are called for in the concrete floor slabs.

C. Both types of joints (expansion and control) shall be sealed with a two-part epoxy caulk sealant, Para-Caulk 2405 by Parawaz Company or similar by Tremco, in accordance with the manufacturer's recommendations.

2.3 PREFORMED EXPANDING FOAM SEALANT

A. The Contractor shall furnish at all expansion and control joints in masonry walls impregnated preformed compressible sealant which is a combination of polyurethane foam impregnated with polymer modified asphalt or acrylics with stabilizing agent supply material precompressed in shrink-wrapped lengths, or in tape form with adhesive backing on reels. Precompressed material shall always be less than joint size, to allow placing in joint and then expanding to seal the joint. Material shall be Emseal or Emseal Greyflex by Emseal U.S.A., Inc. Emseal is black in color and Emseal Greyflex is grey in color; submit samples to Engineer for approval.

PART 3 – EXECUTION

3.1 INSTALLATION REQUIREMENTS

A. **Manufacturer's Recommendations:** All work under this Section and all testing, where applicable, shall be performed in accordance with manufacturer's printed recommendations, specifications, and installation instructions except where more stringent requirements are specified or shown herein; and, except where project conditions require extra precautions or provisions to assure performance of the waterproofing system.

B. **Authorized Installers:** Caulking, and sealants shall be complete systems, and installed only by installers authorized and approved by the respective manufacturers.

3.2 SEALANT FILLED JOINTS

A. **Surface Preparation:** Joints and spaces to be sealed shall be clean, dry, and free of dust, loose mortar, and other foreign materials. Ferrous metal surfaces shall be cleaned of all rust, mill scale, and other coatings by wire brush, grinding, or sandblasting. Oil and grease shall be removed by cleaning in accordance with sealant manufacturer's printed recommendations. Protective coatings shall be removed from all aluminum surfaces against which caulking or sealing compound is to be placed. Bituminous or resinous materials shall be removed from surfaces to receive caulking or sealants.

B. **Sealant Depth:** Sealant depth in joints shall be 1/2 the width of joint, but not less than 1/8-inch deep and 1/4-inch wide nor more than 1/2-inch deep and 1-inch wide. All joints shall have a rigid filler material installed to proper depth prior to application of sealant.

C. **Joints In Porous Materials:** Where required by the manufacturer, sides of joints of porous materials shall be primed immediately prior to caulking or sealing.

D. **Applications:** A full bead of sealant shall be applied into the joint under sufficient pressure, with the nozzle drawn across sealant, to completely fill the void space and to ensure complete wetting of contact area to obtain uniform adhesion. During application the tip of the nozzle shall be kept at the bottom of the joint thereby forcing the sealant to fill from the bottom to the top. Sealants shall be tooled immediately after exposure with caulking tool or soft bristled brush moistened with solvent. The finished sealant filled joint shall be slightly concave unless otherwise shown.

E. **Cleaning:** After application of sealant and caulking materials, adjacent materials which have been soiled shall be cleaned and left in a neat, clean, undamaged or unstained condition. On porous surfaces, excess sealant shall be removed per sealant or caulking

manufacturer's printed instructions.

3.3 PREFORMED EXPANDING FOAM SEALANT

A. The Contractor shall install preformed foam sealant in vertical control joints in exterior masonry cavity walls (mean joint size 3/8" to 1/2") using Emseal Greyflex; joint shall be watertight requiring foam sealant compressed to 20% of original uncompressed dimension.

B. Install preformed foam sealant in joints at all locations where shown on Drawings or specified herein, for buildings erected under this contract. Use Emseal, joints shall require foam sealant compressed to 25% of original uncompressed dimension.

C. See details on Drawings for additional information regarding joint locations, dimensions, and use of other sealant when preformed foam sealant is to be used as a backup material.

D. Follow manufacturer's instructions for cleaning of joints, joint preparation, depth dimension of seal related to mean joint width, and general installation procedures.

3.4 EXPANSION AND RELATED CONTROL JOINT FILLERS

A. The filler for the expansion joints shall be placed so that ends are tightly butted and so that the top of the filler is level with the top of the concrete slab. Fillers shall be firmly anchored to avoid displacement. Joints, not completely filled with filler material and those with displaced or faulty fillers, shall be redone by the Contractor subject to final approval by the Engineer. In no case shall concrete bridge the gap of the expansion joint space. The joint shall be sealed.

B. Control joints (1/8 inch wide) shall be cut with a power carborundum circular saw in concrete slabs at locations as indicated on the Drawings; such joints shall be cut 1 inch deep maximum. Saw cuts shall run through to 1/2 inch expansion joints (w/fillers) and as close to vertical surfaces as possible, so each resulting area of concrete surface is isolated from all other areas. Immediately before sealing, the control joints shall be cleared of dust and debris with compressed air. Control joints in floors shall be filled and sealed to completely fill the joints. Excess sealant shall be removed from all adjacent floor and other surfaces. Top of seal shall be level with top of concrete floor surface.

- END OF SECTION -

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall furnish and install all steel doors, frames, and related items, complete and operable, including all finish hardware and all appurtenant work, all in accordance with the requirements of the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **Codes:** All codes, as referenced herein, are specified in Section 01090 - Reference Standards.

B. **Commercial Standards:**

ASTM A 366	Specification for Steel, Carbon, Cold-Rolled Sheet, Commercial Quality
ASTM B 117	Method of Salt Spray (Fog) Testing
ASTM D 1735	Method for Water Fog Testing of Organic Coatings
ANSI A115 Series	Door and Frame Preparation
UL	Underwriters' Laboratories, Inc.

C. **Trade Standards:**

National Association of Architectural Metal Manufacturers (NAAMM).

D. **Manufacturers' Standards:** In addition to the standards listed above, the steel doors and frames and their installation shall be in accordance with the manufacturer's published recommendations and specifications.

1.3 CONTRACTOR SUBMITTALS

A. **General:** Submittals shall be in accordance with Section 01300, "Contractor Submittals."

B. **Shop Drawings:** Shop drawings shall show details of the products and systems and connections to adjoining materials. Schedules showing sizes, types, and locations of door louvers and glass shall be submitted along with manufacturer's installation instructions.

C. **Manufacturer's Literature:** Manufacturer's literature and any engineering calculations that may be required elsewhere in this Section shall be submitted. Calculations by a registered civil or structural engineer shall be submitted showing that the doors, frames, and their structural connections are designed to meet code requirements and loads.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Doors and frames shall be shipped and stored with temporary stiffeners and spacers in place to prevent distortion.

B. Doors and frames shall be delivered in original, unbroken packages, containers, or bundles bearing the name of the manufacturer.

C. Doors and frames shall be carefully stored on wood blocking in an area that is protected from the elements. Storage shall be in a manner that will prevent damage or marring of finish.

PART 2 – PRODUCTS

2.1 MATERIALS AND FABRICATION - GENERAL

A. **Shop Fabrication and Assembly:** All steel doors and frames shall be shop fabricated and shop assembled, where possible. Temporary stiffeners, spacers, and other accessories necessary to facilitate handling and accurate erection shall be provided. After fabrication, all tool marks and other surface imperfections shall be filled and ground smooth.

B. **Fire Rating and Labelling:** Doors and frames specified or shown as fire-rated shall bear a UL label indicating the type of rating for which certified. Designs and construction of such products shall have specific UL approval according to current procedures for the specified fire rating, either 3-hour, 1-1/2-hour, 3/4-hour, or 20-minute as shown. Hollow steel doors and frames for fire-rated openings shall conform to Underwriters' Laboratories listing and shall be UL labeled.

C. **Materials for Doors and Frames:** All steel doors and frames shall be fabricated entirely of galvanized steel, conforming to ASTM A 525.

D. **Priming and Painting:** Doors and frames shall be chemically treated to ensure maximum paint adhesion and shall have all exposed surfaces painted with a rust-inhibitive primer after fabrication. Prime coat shall be capable of passing a 120-hour salt spray test in accordance with ASTM B 117 and a 250-hour humidity test in accordance with ASTM D 1735.

E. **Hardware:** Doors and frames shall be reinforced and drilled or tapped for fully templated mortised hardware; and shall be reinforced with plates for surface-mounted hardware, meeting ANSI A115 Series requirements. Hardware shall be as specified in Section 08710, "Finish Hardware," and/or as shown.

2.2 METAL FRAMES

A. **Pressed Metal Frames:** Pressed steel frames for doors, and other openings shall be combination buckled frame and trim of type and sizes as shown. Metal shall not be lighter than 16-gage steel. Frames shall be of the welded unit type. Special frames, oversized frames, and frames with transom shall be provided where shown.

B. **Frame Jamb Depths, Trim Profile, Stops, and Backbends:** Frame jamb depths, trim profile, stops, and backbends shall be as shown and on the CONTRACTOR approved

shop drawings reviewed by the ENGINEER.

2.3 FRAME ANCHORS

A. **Floor Anchors:** Floor anchors shall be welded inside each frame jamb head, and holes shall be provided for floor anchorage. Minimum thickness of floor anchors shall be 14-gage.

B. **Anchors for Masonry/Concrete Installations:** Frames for installation in masonry and/or concrete walls shall be provided with adjustable jamb anchors of the T-strap, stirrups and strap, or wire type. The number of anchors provided per frame jamb and head shall be as follows:

1. Frames up to 7 feet 6 inches in height: 3 anchors.

2. Frames over 7 feet 6 inches to 8 feet 0 inches in height: 4 anchors.

3. Frames over 8 feet 0 inches in height: One anchor for each 2 feet 0 inches or fraction in height.

4. Frame head anchors shall be not less than those required by the Reference Standards.

2.4 DUST COVER BOXES AND MORTAR GUARDS

A. Dust cover boxes or mortar guards of not less than 24-gage steel shall be provided at all hardware mortises on frames to be set in masonry, concrete, or plaster walls.

2.5 SILENCER HOLES

A. Appropriate holes for silencers shall be provided in the door frames which are not designated to receive weatherstripping, seals, or sound seals.

2.6 STEEL DOORS

A. **Design and Construction:** Steel doors shall be of hollow metal construction and shall be of full flush design with no visible seams. Face sheets shall be not less than cold-rolled, stretcher-levelled, 18-gage steel. All doors shall have flush seamless face sheets with continuously and fully welded seam edges. Doors shall be rigid and neat in appearance, and shall be free from warpage or buckle. Corner bends shall be true and straight and shall be of not less than the minimum radius for the gage of metal used. The door top and bottom shall be internally reinforced by steel members welded in place. Tops of exterior doors shall be provided with flush, water and weather tight, top enclosures.

B. **Door and Transom Cores:** Door and transom cores shall be water-resistant honeycomb. Fire rated doors shall be solid or fiber mineral core doors as required to meet code and Reference Standards requirements.

C. **Transom Panels:** Transom panels shall be provided where shown and shall be of construction same as doors.

D. **Manufacturers:**

1. **Pioneer**

2. **Ceco**

3. **Fenestra**

4. **Steelcraft**

PART 3 – EXECUTION

3.1 CONSTRUCTION

A. **General:** All work shall be in accordance with manufacturer's published recommendations and specifications.

B. All work shall be coordinated with appropriate related subcontractors work to assure a proper installation. Field conditions and dimensions shall be verified prior to fabrication.

3.2 FRAME INSTALLATION

A. Frames shall be set plumb and square in a true plane, and be securely anchored to the adjoining construction. Steel shims shall be provided and shall be set tight and rigidly attached between frame anchors and structure. All finished metal frames shall be strong and rigid; neat in appearance; and square, true, and free of defects, warp, or buckle.

B. Molded members, trims, and stops, shall be clean cut, straight, and shall be of a uniform profile throughout their lengths.

C. Corner joints shall have all contact edges tightly closed with all trim faces mitered, welded, and finished smooth. The use of gussets will not be permitted.

3.3 DOOR INSTALLATION

A. Doors shall be installed plumb, square, and level. Doors shall operate freely, but not loosely. They shall be free from rattling while in a closed position.

B. The door clearances shall be plus 3/32-inch or minus 1/32-inch and shall not exceed the limits specified in the manufacturer's printed recommendations.

C. Any door that becomes warped more than 3/16-inch out-of-plane shall be replaced by the CONTRACTOR.

D. Doors and door's finish hardware shall have hardware protected prior to painting.

3.4 FINISH HARDWARE

A. Finish hardware shall be installed in accordance with hardware manufacturer's standard templates and printed instructions. Operable parts shall be adjusted for correct function and operation.

- END OF SECTION -

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall furnish all the materials for and shall properly erect and install all rolling service doors at the locations shown and as indicated on the Contract Drawings, and as specified herein.

B. Include all insulated rolling service doors including curtains, hoods, guides, counterbalance assembly, brackets, chain and gear operation, weatherstripping, wind locks, hardware and security locks and other required appurtenances.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **Codes:** All codes, as referenced herein, are specified in Section 01090 - Reference Standards.

B. In case of conflict between codes, reference standards, drawings, and these Specifications, the most stringent requirements shall govern. All conflicts shall be brought to the attention of the ENGINEER for clarification and directions prior to ordering or providing any materials or labor.

C. **Commercial Standards:**

ASTM A 525	Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process

1.3 CONTRACTOR SUBMITTALS

A. **Shop Drawings:** Detailed, dimensioned shop drawings and data conforming to the requirements of Section 1300 of the General Requirements shall be submitted to the Engineer and approved before fabrication, shipment or work specified under this Section begins.

PART 2 – PRODUCTS

2.1 INSULATED ROLLING SERVICE DOORS

A. **Type:** Insulated Rolling Service Doors are to be Model T23PS (Galvanized with baked coat of primer paint) as manufactured by **Atlas Roll-Lite Door Corporation**, products by **Kinnear Manufacturing Co.**, or **The Cookson, Co.**

B. **Operation:** to be chain hoist operated using gear reduction and galvanized hand chain.

C. **Mounting:** to be Interior Face Mounted on a prepared opening.

2.2 CURTAIN

A. **Slats:** assembled of interlocking clear galvanized steel slats front and back. Slats to be Type T-3, no less than 2-5/8" (66.68 mm) high x 7/8" (22.23 mm) thick, U-Valve 0.16 (0.91 $W/m^2 \circ K$).

B. **Insulation:** polyurethane foamed in place and to fill all voids providing continuos insulation protection the full height of slat. Insulation is to be self bonding to the two interior aluminum surfaces.

C. **Endlocks:** each end of alternate slats to be fitted with endlocks to act as a wearing surface in the guides and to maintain slat alignment.

D. **Windload:** door construction designed to satisfy windload of 20 PSF (0.96 Kpa) or M.P.H. (140 KPH).

E. **Gauge:** thickness of slat material to be as required by width of opening and windloading conditions.

F. **Bottom Bar:** curtain to be reinforced with a bottom bar consisting of two steel angles.

G. **Weather Seal:** provide interwoven neoprene astragal at the bottom bar to act as a weather seal at the floor.

H. **Galvanizing:** Zinc coated in accordance in ASTM A525-84.

2.3 SPRING COUNTERBALANCE

A. **Counterbalance:** housed in a steel pipe of diameter and wall thickness to restrict maximum deflection to .03" per foot (2.5 mm/m) of door width.

B. **Springs:** to be helical torsion type designed to include an overload factor of 25% and for optimum ease of operation. Springs are to be grease packed and are to be mounted on a cold rolled steel inner shaft.

C. **Hand Chain:** pull not to exceed 35 lbs. (156 N).

D. **Spring Tension:** adjustable from outside of end bracket plate.

E. **Ball Bearing:** sealed, to minimize wear of pipe shaft rotation around inner shaft.

2.4 BRACKET PLATES

A. **Bracket Plates:** carrying pipe counterbalancing shaft are to be no less than 1/4" (6.35 mm) thickness and to house ends of door coil.

B. **Drive End Bracket Plate:** fitted with a sealed ball bearing.

2.5 GUIDE AND WALL ANGLE ASSEMBLY

A. **Guides/Wall Angles:** structural steel angles of 3/16" (4.76 mm) minimum thickness.

B. **Depth of Guide:** to provide adequate slat penetration to satisfy specified windloading.

C. **Guide Weather Seal:** furnish guide weatherstripping to seal against T-3 slat.

2.6 HOODS

A. **Hoods:** to house coil are to be fabricated of #24 U.S. Gauge galvanized steel.

B. **Reinforcing:** to be laterally reinforced to prevent sag.

C. **Hood Baffle:** furnish neoprene hood baffle in hood to prevent air infiltration.

2.7 LOCKING

A. **Hand Chain Lock:** Locking bracket, mounted on guide angle, suitable for padlocking (padlock by others).

2.8 FINISH

A. **Ungalvanized Surfaces:** to consist of a shop coat of rust inhibiting metallic primer on exposed ferrous surfaces, except bearings.

PART 3 – EXECUTION

3.1 INSTALLATION

A. **Installation:** to be by manufacturer's authorized representative and in accordance with the manufacturer's standards and instructions.

- END OF SECTION -

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall furnish and install aluminum windows, complete with all frames, bracing, glazing attachments, screens, hardware and accessories for a complete installation, including attachments, erection accessories and all appurtenant work, all in accordance with the requirements of the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. **Codes:** All codes, as referenced herein, are specified in Section 01090, "Reference Standards."

B. **Commercial Standards:**

ASTM B 221	Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes
ASTM B 633	Specification for Electrodeposited Coatings of Zinc on Iron and Steel
ASTM C 509	Specification for Cellular Elastomeric Preformed Gasket and Sealing Material
ASTM C 864	Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks and Spacers
ASTM E 283	Test Method for Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors
ASTM E 331	Test Method for Water Penetration of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference

C. **Trade Standards:**

ANSI/AAMA 101	Voluntary Specification for Aluminum Sliding Doors and Windows
AAMA	Architectural Aluminum Manufacturers Association Standards

D. **Federal Standards:**

AN-P-31a	Army-Navy Aeronautical Specification for bituminous paint

E. **Manufacturer's Standards:** In addition to the standards listed above, the aluminum window products and their installation shall be in accordance with the manufacturer's published recommendations and specifications.

1.3 CONTRACTOR SUBMITTALS

A. **General:**

1. Submittals shall be in accordance with Section 01300, "Contractor Submittals."

B. **Test Reports:** Submit certified independent laboratory test reports verifying compliance with all test requirements and structural calculations prepared by registered structural engineer, and indicating adequacy of all installed materials to meet the uniform and structural load requirements as specified.

C. **Shop Drawings:** Submit shop drawings, showing anchors, glazing details, hardware, operators, and other components not included in manufacturer's standard data.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. **Delivery of Materials:** Manufactured products shall be delivered in original unbroken packages, containers, or crating, bearing the manufacturer's label with manufacturer's name, product description, and rating.

B. **Storage:** All products shall be carefully stored in an area that is protected from the elements, in a manner recommended by the product's manufacturer. Storage shall be in a manner that will prevent damage to the product and its finish.

PART 2 – PRODUCTS

2.1 GENERAL:

A. The Contractor shall furnish all framing systems, fixed and projected windows, complete with frames, sash operators, hardware, weather stripping and screens with wickets as are required for the proper completion of this Contract. All framing systems, windows, frames, hardware, etc., shall be of aluminum except as otherwise specified herein. In addition, the Contractor shall furnish all aluminum mullions, column facings, lintel cover plates and other aluminum extruded sections or sheet metal work required around the window frames, interior and exterior.

B. The Contractor shall prepare working and setting drawings for all work included under this Contract, complying with all requirements herein specified. Said detail drawings shall show jointing, construction, gauges, and thicknesses of material, engagement of the work with other materials, as well as all references and cross information to the window locations indicated on the Drawings. Framing systems generally shall consist of extruded aluminum construction with machined corners, double screw tightly assembled and sealed with foam gaskets and ductile type sealant.

2.2 FRAMING SYSTEM:

A. Furnish all necessary materials, labor and equipment for the complete installation of aluminum framing system as shown on the Drawings and specified herein.

B. **Quality Assurance:** Drawings and specifications are based upon the 451T framing system as manufactured by the **Kawneer Company, Inc.**

C. **Performance Requirements:**

1. Air infiltration shall be tested in accordance with ASTM E 283. Infiltration shall not exceed 06. CFM per square foot (.0003 m^3/sm^2) of fixed area.

2. Water infiltration shall be tested in accordance with ASTM E 331, No water penetration at a test pressure of 8 PSF Screw Spline and Shear Block Outside Glaze/Inside Glaze, Stick Outside Glaze; 6.24 PSF Stick Inside Glaze.

Structural performance shall be based on:

- Maximum deflection of 1/175 of the span

and

- Allowable stress with a safety factor of 1.65

The system shall perform to these criteria under a windload of 20 PSF.

D. **Materials:** Extrusions shall be 6063-T5 alloy and temper (ASTM B 221 alloy G.S. 10A-T5). Fasteners, where exposed, shall be aluminum, stainless steel or plated steel in accordance with ASTM A 164. Perimeter anchors shall be aluminum or steel, providing the steel is properly isolated from the aluminum. Glazing gaskets shall be elastomeric extrusions.

E. **Finish Specifications:** All exposed surfaces shall be free of scratches and other serious blemishes and shall receive an Architectural Class I Color Anodic Coating conforming with Aluminum Association Standard AA-M12C22A, clear.

F. **Fabrication:** The framing system shall provide for flush glazing on all sides with no projecting stops. Vertical and horizontal framing members shall have a nominal face dimension of 2" (50.8 mm). Overall depth shall be 4½" (114.3 mm).

G. **Installation:** All glass framing shall be set in correct locations as shown in the details and shall be level, square, plumb and in alignment with other work in accordance with the manufacturer's installation instructions and approved shop drawings. All joints between framing and the building structure shall be sealed in order to secure a watertight installation.

H. **Protection and Cleaning:** After installation, the General Contractor shall adequately protect exposed portions of aluminum surfaces from damage by grinding and polishing compounds, plaster, lime, acid, cement, or other contaminants. The General Contractor shall be responsible for final cleaning.

2.3 PROJECTED-OUT WINDOWS: (See Elevations for location)

A. **Quality Assurance:** Drawings and specifications are based upon the 8225T Isolock Window of the Kawneer Company, Inc.

B. **Testing and Performance:**

1. Specify one or more of the following:

   - All windows must meet or exceed testing and performance requirements of AAMA publication GS-001, Section 1.05 for the test values specified below.

   - All windows must meet or exceed the minimum requirements of performance class HC for the Design load specified below in accordance with ANSI/AAMA 101-85.

2. Design load shall be 8 PSF. Air infiltration shall not exceed .10 CFM/ft. for ventilators and .06 CFM/ft.^{2} for fixed lites. Water resistance shall be tested at a static air pressure difference of 8 PSF. Uniform load deflection test shall be conducted at a static air pressure difference of 20 PSF. Uniform load structural test shall be conducted at a static air pressure difference of 20 PSF. Condensation resistance factor (CRF) shall not be less than 57. Conductive thermal transmittance (U-value) shall not be more than .56.

C. **Materials:**

1. Extrusions shall be 6063-T5 alloy and temper (ASTM B221 alloy G.S. 10A-T5). Fasteners, where exposed, shall be 300 Series stainless steel. Perimeter anchors shall be aluminum or steel, providing the steel is properly insulated from the aluminum.

2. Glazing materials shall be of material compatible with aluminum and those sealants and sealing materials used in composite structure which have direct contact with the gasket. Standard exterior glazing gasket shall be a dry glazed closed cell elastomer in accordance with ASTM C509. Optional exterior glazing materials shall be glazing tapes in accordance with AAMA 806-1 or silicone sealant with a compatible backup. Interior glazing shall be with aluminum glazing beads of the snap-in type and compression wedge of dense elastomer per ASTM C864.

3. All glass pockets, fixed and ventilators, shall be weeped to provide positive drainage. Water shall be weeped to the exterior via frame weep slots protected by snap-in weep covers or integral drips.

4. Weatherstrip shall be a high quality material capable of meting environmental exposure and performance requirements.

D. **Finish:** All exposed surfaces shall be free of scratches and other serious blemishes and shall receive an Architectural Class I Color Anodic Coating conforming with Aluminum Association Standard AAM12C22A/41, clear.

E. **Fabrication:**

1. All window framing and vent members shall be 2¼" (57.2) in depth and of one part construction incorporating a 3/8" (9.5) thermal barrier, consisting of a two-part, chemically curing, high density polyurethane. Frame and ventilator extrusions shall be .125" (3.2), typical wall .050" (1.3) (in glazing retainer) with tubular vents and meeting rails.

2. Ventilators shall be tubular and corner construction shall be mitered with clip, epoxy, stake attachment. All frame corners and meeting rail intersections shall be coped and tenon joined and forged. All corners and intersections shall be made permanently leakproof. Minimum depth of glazing rabbet shall be 13/16" (20.6). Note: Frame joints shall be sigma arc welded over mortise and tenon. Ventilators shall be sigma arc welded over mitered corner clipped joint.

F. **Projected Hardware:**

1. Hinging hardware shall be heavy duty 4 bar hinges conforming to AAMA 904.1 . Hinges shall have a positive stop and an adjustable friction shoe.

2. Locking hardware, strikes, keepers and pole rings shall be cast bronze. Cast White Bronze hardware is standard. All hardware fasteners penetrating frame or inside plane of window shall be factory sealed with resilient non-hardening compound.

G. **Screens:** Insect screens shall be constructed with extruded frames, rigidly joined at their corners. Screen cloth shall be 18 x 16 mesh aluminum and shall be cleaned thoroughly to provide a uniform color. Screen frames shall be finished to match aluminum windows. Splines shall be extruded vinyl, removable to permit re-screening. Screens shipped separate from window order. Provide wickets.

H. **Installation:** Windows shall be installed, glazed and adjusted by experienced workmen in accordance with the manufacturer's installation instructions and/or approved shop drawings.

I. **Protection and Cleaning:** After installation all metal surfaces shall be cleaned to remove mortar, plaster, paint or other contaminants. After cleaning, all work shall be protected against damage until it is accepted by the General Contractor. Thereafter, it shall be the responsibility of the General Contractor to maintain protection and provide final cleaning.

PART 3 – EXECUTION

3.1 GENERAL:

A. All work shall be erected by competent mechanics, and shall be set plumb and true, properly aligned to meet surrounding conditions and securely anchored in place in a rigid and substantial manner as approved by the Engineer and to provide the proper clearances for caulking. All caulking and pointing between aluminum frames and masonry and between sash sections, where necessary to provide weather-tight construction, shall be performed under this Section.

3.2 INSTALLATION:

A. Windows shall be installed, glazed and adjusted by experienced workmen in accordance with the manufacturer's installation instruction and/or approved shop drawings.

B. Aluminum surfaces coming in contact with concrete, masonry, plaster or steel shall be given two (2) heavy coats of an alkali-resistant bituminous paint. The quality of the bituminous paint used shall be equal to that called for in the Army-Navy Aeronautical Specifications AN-P-31a. The paint shall be applied as it is received from the manufacturer, without the addition of thinner.

3.3 PROTECTION AND CLEANING:

A. After installation all metal surfaces shall be cleaned to remove mortar, plaster, paint or other contaminants and protected from damage by grinding and polishing compounds, plaster, lime, acid, cement, or other contaminants. Thereafter, it shall be the responsibility of the Contractor to maintain protection and provide final cleaning.

- END OF SECTION -

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall furnish and install all finish hardware and appurtenant work, complete, all in accordance with the requirements of the Contract Documents.

B. The work hereunder shall include all fabrication and mounting templates as needed for fabricators and for control of application of metal items.

C. In addition thereto, the CONTRACTOR shall provide and install all trim, attachments, and fastenings specified or required for proper and complete installation. The work of this Section shall include all hardware that is not specified in other sections, whether or not such hardware is herein specifically scheduled.

D. The CONTRACTOR shall protect the finish hardware from damage during construction, painting, and clean-up.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **Codes:** All codes, as referenced herein, are specified in Section 01090, "Reference Standards."

B. **Commercial Standards:**

Underwriters' Laboratories, Inc.	requirements and approvals.
Hardware Institute (DHI)	"Recommended Procedure for Processing Hardware Schedules and Templates" and "Architectural Hardware Scheduling and Format"
BHMA	Builders' Hardware Manufacturers' Association

C. **Manufacturers' Standards:** In addition to the standards listed above, the finish hardware and its installation shall be in accordance with the manufacturer's published recommendations and specifications.

1.3 CONTRACTOR SUBMITTALS

A. **General:** Submittals shall be in accordance with Section 01300, "Contractor Submittals."

B. **Samples:** The samples of all items requested by the ENGINEER shall be furnished by the hardware supplier no later than 10 days after said request is received.

C. **Manufacturer's Information:** The CONTRACTOR shall submit a complete detailed hardware list and a schedule along with manufacturer's literature on each item for approval. No hardware shall be delivered until the hardware schedule has been approved by the ENGINEER.

D. The hardware schedule submitted by the CONTRACTOR shall list the actual product series numbers. Manufacturer's catalog requirements for actual size of door closers, brackets, and holders shall be observed. All door sizes shall be noted on the hardware schedule and all hardware shall be in strict accordance with height, width, and thickness requirements.

E. The schedule shall indicate groups, type, manufacturer's name, catalog number, location, and finish of each item to be provided, all in accordance with the DHI "Architectural Hardware Scheduling Sequence and Format."

F. The schedule shall also include a complete template list showing template references and data for each item requiring preparation of metal doors and frames.

1.4 PROPRIETARY DESIGNATIONS

A. Manufacturer's product names, numbers, and models are given herein for the purpose of indicating the requirements for the type, general construction, material, and operation of the specific item, not with the intention of limiting the item to the manufacturer's listed product. Substitution of another manufacturer's product that is fully equivalent in all respects may be made subject to the approval of the ENGINEER. It shall be the CONTRACTOR's responsibility to supply detailed and complete data to the ENGINEER as required to facilitate appropriate evaluation of all proposed substitute items.

1.5 PACKING, MARKING, AND DELIVERY

A. All locks, exit devices, door closers, overhead door holders, hinges, kickplates, pulls and push plates, thresholds, and other similar items shall be individually packed in separate, suitable, original, containers as furnished by the hardware manufacturers. Each container shall be clearly marked with item numbers, article numbers, and names corresponding to those listed in the hardware schedule.

B. Small miscellaneous items that would not require specific location identifications, such as door stops, coat and hat hooks, and door silencers may be quantity packed if properly labeled with item numbers and other identification.

C. CONTRACTOR shall check the hardware upon delivery with the aid of a representative of the hardware supplier's firm. The CONTRACTOR shall be responsible for the proper storage of all hardware until ready for application.

PART 2 – PRODUCTS

2.1 GENERAL

A. Finish hardware shall be coordinated with all other work requiring builder's hardware or attaching to it. Copies of schedules, templates, etc., shall be furnished in ample time to avoid fabrication and construction delays. Each item of hardware shall be identified according to the approved list and schedule. All hardware shall be made to template.

B. All hardware furnished in connection with doors bearing Underwriters' Labels or where necessary to meet special requirements shall be in strict accordance with conditions established by the authority having jurisdiction and shall be subject to approval of that authority.

C. Hand of lock shall be as shown. If door hand is changed during construction, the CONTRACTOR shall make necessary changes at no extra cost to the OWNER.

D. Exit doors shall be openable at all times from the inside without the use of key or any special knowledge or effort.

E. The CONTRACTOR shall provide the hardware supplier with approved shop drawings from those trades with which hardware must be coordinated. After checking these shop drawings, the CONTRACTOR shall promptly supply necessary template information to all concerned as may be required to facilitate the progress of the job. All procedures for template information shall be in accordance with the handbook, "Recommended Procedure for Processing Hardware Schedules and Templates."

F. **Manufacturer:**

1. **Adams Rite, Los Angeles, CA**
2. **Builders Brass Works (BBW), Los Angeles, CA**
3. **Corbin Russwin, Berlin, CT**
4. **Door Control, Ann Arbor, MI**
5. **Dor-O-Matic, Chicago, IL**
6. **Glynn-Johnson, Chicago, IL**
7. **Grant, West Nyak, NY**
8. **Hager, St. Louis, MO**
9. **H.B. Ives, Wallingford, CT**
10. **Knape Vogt, Grand Rapids, MI**
11. **LCN-Closers, Princeton, IL**
12. **McKinney, Scranton, PA**
13. **National Guard, Memphis, TN**
14. **Norton, Charlotte, NC**
15. **Pemko Mfg. Co., Emeryville, CA**
16. **Quality Hardware, Hawthorne, CA**
17. **Rixson-Firemark, Franklin Park, IL**

18. **Sargent, New Haven, CT**

19. **Schlage, San Francisco, CA**

20. **The Stanley Works, New Britain, CT**

21. **Trimco, Los Angeles, CA**

22. **Von Duprin Inc., Indianapolis, IN**

23. **Zero Weatherstripping, Burbank, CA**

2.2 KEYING

A. All locks and cylinders shall be masterkeyed to the OWNER'S requirements as directed by the ENGINEER.

B. All lock cylinders shall be construction masterkeyed or provided with construction cylinders and construction keys. Five construction master keys shall be obtained by the CONTRACTOR, of which 3 may be retained by the CONTRACTOR for use during construction, and the remaining 2 construction keys shall be provided to the ENGINEER for its use.

C. The CONTRACTOR shall furnish 5 keys per cylinder keying combination. All keys along with 5 master keys shall be delivered to the ENGINEER at the completion of the job.

D. All keying (except when matching existing keying system or when less than 10 locksets are required) shall be done at the factory unless otherwise approved by the ENGINEER.

E. A keying schedule shall be worked out between the OWNER, the CONTRACTOR, and the hardware supplier. The CONTRACTOR shall have the hardware supplier submit a keying schedule for approval prior to placing an order for the locks and keying of cylinders.

2.3 FASTENERS

A. The CONTRACTOR shall provide all necessary screws, bolts, and other fasteners of suitable size and type to secure the hardware into position. The fasteners shall match the hardware in material and finish.

B. The hardware provided, such as expansion bolts, sex bolts, toggle bolts and other approved anchorages shall be coordinated with the job and to each setting condition.

C. Phillips head screws shall be used at exposed conditions. Machine screws shall be used at metal doors and frames.

2.4 HINGES

A. Two hinges shall be provided for each door leaf up to and including 5 feet in height, and an additional hinge shall be added for each 2-1/2 feet or fractions thereof of additional door height.

B. Width of hinges shall be determined by trim conditions.

C. Ball-bearing hinges shall be furnished on all doors having door closers and/or exit devices. All ball-bearing hinges shall have flush tips.

D. All hinges on exterior doors shall be provided with non-removable pins and security studs.

E. Hinges shall match hardware finish unless otherwise specified in the finish hardware schedule.

F. Hinges and sizes shall be as follows:

Door Thickness (inches)	Door Width (inches)	Hinge Width	Hinge Height (inches)
1-3/4	30 and under	Reg. Wt., interior use/exterior use	4-1/2
1-3/4	30 to 39	Reg. Wt., interior use Hvy. Wt., exterior use	4-1/2
1-3/4	40 and over	Reg. Wt., 4 ball bearing, interior use Hvy. Wt., 4 ball bearing, exterior use	4-1/2

G. Hinges shall be plain bearing type (regular weight) conforming to BHMA No. A 2133; ball bearing hinges (regular weight) conforming to BHMA No. A 2112 or No. A 5112; and/or ball bearing hinges (heavy weight) conforming to BHMA No. A 2111 or No. A 5112. Hinge manufacturers design options such as 3-knuckle hinges and concealed ball bearing hinges are acceptable. Plain hinges shall be provided with self lubricating bushings.

H. Hinges shall be manufactured by **Hager or McKinney.**

2.5 OVERHEAD CLOSERS

A. All overhead closers shall be the product of one manufacturer. Closers shall have high-strength cast-iron cases with rectangular covers, adjustable spring power and adjustable back-check, and full rack and pinion action. Closers shall have back-check regulating screws, with separate screws for closing and latching speeds.

B. Surface door closers shall be spray painted to match door hardware.

C. Soffit shoes shall be provided where corner brackets or regular arm closers are not used and where they are necessary for proper function of the hardware.

D. Where door closers or other items have lever or similar arms, attachment to doors shall be with sex bolts only.

E. Closers for outswinging exterior doors shall be top-jamb-mounted and furnished with adapter plates for doors under 7 feet-6 inches in height. If necessary, closers may be mounted on drop brackets on doors above 7 feet-6 inches in height.

F. Closers on flush panel doors shall be **Corbin Russwin DC 4000, Yale 3000 or LCN 4040 with full metal covers.**

G. Closers on entrance doors shall be overhead concealed type, **Yale TJ60A, LCN 5030 or Rixon Q808.**

H. The CONTRACTOR and its hardware supplier shall be responsible to provide the right arm with the closers. Arms shall be parallel with the closed door whenever possible.

I. Closers shall be provided with sex bolts for fastening through doors, frames and transoms.

2.6 LOCKSETS AND LATCHSETS

A. All locksets and latchsets shall be stainless steel mortise type with anti-friction 2-piece latchbolts with a minimum 3/4-inch-throw and 1-inch-throw dead bolts with hardened roller inserts. Locksets and latchsets at fire rated doors shall meet code requirements and shall be modified as necessary. All locksets, latchsets, privacy sets, and passage sets shall be provided with lever handles conforming to handicapped person requirements unless specified elsewhere. Exterior knobs, levers, and trim for cold weather locations shall be coated with a clear "Teflon" coating.

B. Function of locksets or latchsets shall be appropriate for doors use.

Lever Type Hardware (Meeting Handcap Requirements)		Knobtype Hardware	
Mfr.	Series	Mfr.	Series
1. **Yale**	**8700 CRE**	1. **Yale**	**8700 coe**
2. **Sargent**	**18-8100 LW1J**	2. **Sargent**	**18-8100 KW1**
3. **Corbin Russwin**	**ML2200 Lustra LWP**	3. **Corbin Russwin**	**ML2200 Global GSA**

C. Mortise deadlocks shall be of weight and quality comparable to locksets and latchsets specified.

D. Lock strikes shall be boxed type of sufficient length and having curved lips to protect the trim and jambs and be so shaped as to avoid the possibility of tearing clothing. All strikes shall be provided with metal strike boxes.

E. All locks shall be provided with the same cylinder and keyway for master keying. They shall be the product of the same manufacturer as the locksets unless otherwise specified. The correct cylinders with all necessary modifications and components such as cams, collars, rings, retainers, plates, fasteners, etc., shall be provided for other specialty hardware such as exit devices, store front locksets, and sliding door locks where the hardware manufacture specified is different than cylinder manufacturer.

F. Padlocks shall be heavy duty type, keyed as directed and shall be of same manufacturer as locksets.

2.7 EXIT DEVICES

A. All exit devices shall be the product of one manufacturer, **Yale 1500 or Von Duprin 88 or 55.** The design of outside trim, inside trim, and crossbar shall match. Exit device shall be (wherever possible) constructed of stainless steel unless otherwise specified. Exit devices shall be UL labeled and shall be of corrosive-resistant hardware.

B. The exit devices shall have side-mounted crossbars unless otherwise specified. They

shall be provided with stainless steel lever arms and investment-cast cases. Where bronze or aluminum lever arms are required they shall be drop-forged with pressure-cast cases.

C. The exit devices shall be provided with stainless steel exposed parts and wrought steel internal parts. The back plate shall be constructed of stainless steel or bronze. All screws, pins, socket head retaining screws, and other fasteners shall be stainless steel unless otherwise specified.

2.8 PUSH PLATES AND PULLS

A. Push plates shall be stainless steel, 4-inch by 16-inch by 0.050 thick, **Quality #40; BBW #47; or Rockwood #70.**

B. Pulls shall be thru-bolted **Quality 402; BBW 5034; or Rockwood 110 x 70.**

2.9 KICKPLATES

A. Kickplates shall be stainless steel, 0.050-gage, beveled on 3 sides, and 16 inches high, except where necessary to clear a louver in which case they shall be 10 inches high. Width shall be door size less 2 inches for single doors and door width less 1-1/2 inches for pairs of doors. Kickplates shall be **Builders Brass Works 37 Series; Quality Manufacturing 48 Series; or H.B. Ives 8400.**

2.10 DOOR STOPS

A. Door stops shall be of the type specified in the hardware schedule and shall be provided with the proper fasteners.

B. Stops shall be provided with machine screws and anchors at concrete and masonry conditions, and toggle bolts at plaster, gypsum board, and wood conditions.

	Floor Stop w/Holder	Floor Stop Dome	Wall Stop
BBW	F-823X	F-8061X/F-8063X	W-141X W-140
QUALITY	139	431 ES	136
H.B. Ives	450	438/436	445

	Wall Dome Stop	Wall Stop/Stem Type
BBW	W12X	W-145X
QUALITY	W 307	138
H.B. Ives	407	447

C. Finish shall be US26D.

2.11 HOLDERS (DOORS STAYS)

A. Overhead type door holders shall be concealed type of correct size for door, 90 degree openable unless 180 degree opening shown, and allowing for checkmating. Interior doors

shall be provided with overhead stops if wall type stops can not be used and floor stops make a tripping hazard. Finish shall be chrome plated bronze with satin finish, US 26D, unless otherwise specified. Door holders shall be one of the following:

Concealed Overhead	Surface Overhead
Glynn-Johnson 320 Series	**Corbin Russwin DH52005**
Rixon 5 Series	**Glynn-Johnson 90M**
	Rixon 55 Series

2.12 SILENCERS OR MUTES

A. All interior doors shall be provided with rubber silencers, 3 for each single door and 2 for each pair of doors. Silencers or mutes shall be either **Glynn-Johnson 64 or Sargent 3446:**

2.13 THRESHOLDS

A. All doors so detailed shall receive a threshold similar to that specified with a maximum of 1/2-inch rise at entry ways. Thresholds shall have a non-skid surface and a mill finish. Provide stainless steel screws for anchoring. Exterior outswinging door threshold shall be 5" wide with an abutment and return closed ends, either **Pemko 2005AP, National Guard 896, Hager 520S, Hager 412S, or Zero 665A.** Interior thresholds shall be **Pemko 156A, National Guard 425, Hager 412S, or Zero 655A.**

2.14 WEATHERSTRIPPING AND SEALS

A. Weatherstripping and seals shall be as manufactured by **Pemko Manufacturing Co.; National Guard Products Inc. (NGP); or Zero Weatherstripping Co.**

B. Exterior doors (except for roll-up doors and entrance doors) shall have head, jambs, and astragals weatherstripped with not less than 5/16-inch by 5/8-inch closed cell, neoprene sponge rubber, unless otherwise specified or shown.

C. Interior doors shall have head, jambs, and astragals sealed with self-adhesive bubble configuration door seal designed against smoke, air, sound, and weather infiltration. The seals shall be fire tested and labeled as a gasketing for use on steel frames with wood or steel doors for 20-minutes C-label, 1 hour B-label, and 1-1/2-hour B-label doors. Seals shall be **S88 by Pemko; or #TM 181 by NGP.**

2.15 ASTRAGALS

A. Astragals shall be by **National Guard or Zero** for all pairs of doors, stainless steel tee 1/8" thick, screwed to edge of door with machine screws 6" o.c.

2.16 FLUSHBOLTS

A. Manual flushbolts shall be **Glynn-Johnson FB6 or H.B. Ives,** for inactive door of pairs, top and bottom, with length of rod as required by door height. Units shall be brass with US26D finish.

B. Automatic flushbolts shall be **Glynn-Johnson FB7 or H.B. Ives 559,** for inactive door of

pairs, top and bott[redacted], with length of rod as required by do[redacted]eight. Units shall be brass with US26D finish.

C. Surface mounted flushbolts shall be **Glynn-Johnson 1600 Series or H.B. Ives 361.** Provide length of rod as required by door height. Units shall be brass with US26D finish.

2.17 COORDINATORS

A. Coordinators shall be **Glynn-Johnson COR Series or H.B. Ives 469 and 900 Series,** for pairs of doors to prevent active door leaf from closing ahead of inactive door.

2.18 DOOR BOTTOM SEALS

A. Door bottom seals shall be aluminum and neoprene, **National Guard No. 15** products by **Pemko or Zero.**

PART 3 – EXECUTION

3.1 GENERAL

A. All required items of hardware, including cylinders for locks, and all fitting, adjusting, and securing of each item neatly and firmly in place, shall be in perfect working order. Any work less than this shall form a basis for corrective measures.

B. All finish hardware shall be provided with paint protection prior to painting work. The paint protection shall be removed after completion of the painting work and the finish hardware cleaned and polished.

3.2 HARDWARE SCHEDULE

A. Refer to the Door Schedule in the Contract Drawings for hardware locations.

3.3 LATCHES AND BOLTS

A. Latches and bolts shall be installed to automatically engage in keepers, whether activated by closers or by manual push. In no case should additional manual pressure be required to engage latch or bolt in keepers.

3.4 CLOSERS AND HINGES

A. Closers and hinges shall be carefully adjusted to operate the doors noiselessly and evenly, and hinges shall be installed so as not to bind. Closers, closer arms, and hold-open arms shall be attached with sex bolts.

B. Except at exterior doors, closers shall not be mounted on corridor or vestibule side of door.

3.5 WEATHERSTRIPPING AND SEALS

A. All doors shall be provided with weatherstripping or seals unless mutes, product weatherstripping or other special seals are specified. Whenever two types of seals are shown on the Finish Hardware Schedule on a given door they both are to be provided.

3.6 PROTECTIVE TAPE AND COATINGS

A. The CONTRACTOR shall provide a strippable coating or removable tape protection or other approved means to prevent any damage or staining of hardware during construction. Such protective measures shall be removed prior to final cleaning and the hardware polished before OWNER'S acceptance of project.

- END OF SECTION -

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall furnish and install all glass, caulking materials, and appurtenant items required to provide all the glass and glazing work, complete, all in accordance with the requirements of the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **Codes:** All codes, as referenced herein, are specified in Section 01090, "Reference Standards."

B. **Federal Specifications:**

DD-G-451D	Glass, Float or Plate, Sheet, Figured (Flat for Glazing, Mirrors and Other Uses)
DD-G-1403C	Glass, Float, Sheet, Figured, Coated (Heat-Strengthened and Tempered)
TT-S-001543A	Sealing Compound, Silicone Rubber Base (For Caulking, Sealing and Glazing in Buildings and Other Structures)

C. **Commercial Standards:**

ASTM D 2287	Specification for Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
ANSI Z 97.1	Glazing Materials Used in Buildings, Safety Performance Specifications and Methods of Test

D. **Trade Standards:**

1. The Flat Glass Marketing Association.
2. "Glazing Manual" and "Glazing Sealing Systems Manual."
3. "Glazing Specifications for Sealed Insulating Glass Units" by the Sealed Insulating Glass Manufacturers Association (SIGMA).
4. The Safety Glazing Certification Council (SGCC).

E. **Manufacturers' Standards:** In addition to the standards listed above, the glass, caulking materials, and their installation, shall be in accordance with the manufacturer's published recommendations and specifications.

1.3 CONTRACTOR SUBMITTALS

A. **General:** Submittals shall be in accordance with the requirements of the Section 01300, "Contractor Submittals."

B. **Samples:** Samples of glass and glazing panels shall be submitted when requested by the ENGINEER.

C. **Manufacturer's Information:** Manufacturer's technical literature and installation instructions shall be submitted to the ENGINEER.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. **Delivery of Materials:** Manufactured products shall be delivered in original, unbroken, packages, containers or bundles bearing the manufacturer's label.

B. **Storage:** All products shall be carefully stored on wood blocking in an area that is protected from the elements in a manner recommended by the product manufacturer. Storage shall be in a manner that will prevent damage to the material or marring of its finish.

PART 2 – PRODUCTS

2.1 ACCESSORY MATERIALS

A. **Sealant:**

1. Sealant shall be a one-part silicone rubber conforming to Federal Specifications TT-S-001543A non-sag type as manufactured by **General Electric Corp. or Dow Chemical Co.**

2. Sealant for view windows shall be as recommended in the publications of the glass manufacturer, sealant manufacturer, gasket manufacturer, and glazer, for the intended use, such as 2-part polysulfides.

B. **Channels:** Setting channels and/or blocks shall be neoprene, 70-90 Shore "A" durometer hardness chemically compatible with sealant used and recommended in the printed publications of the glass manufacturer.

C. **Glazing Compound:** Glazing compound shall be as recommended in the published data of the glass manufacturer for job conditions. Glazing compound for use with wood shall be an elastomeric type designed for wood and glass use.

D. **Beads and Seals:** Glazing beads and seals shall be black neoprene or vinyl chloride conforming to ASTM D 2287.

E. **Tape:** Glazing tape shall be polymerized butyl, rubber tape coiled on release paper, or glazing tape as specified in the printed recommendations of the glazing sealant manufacturer.

2.2 GLAZING MATERIALS

A. **Glass Specifications:**

1. Glass shall conform to Federal Specifications DD-G-451D.

2. Tempered glass shall also conform to Federal Specifications DD-G-1403C (Tempered glass).

3. Insulating glass units shall conform to SIGMA 65-7-2 as well as the preceding Federal Specifications.

B. **Glazing Thickness:** Thicknesses of glass specified are minimum thicknesses. Thicker glass shall be provided when required to be thicker by the Building Code.

C. **Labelling:** Glass shall be factory-labeled. Non-labeled glass will be rejected.

D. **Manufacturers:**

1. **ASG Industries, Inc. (ASG)**

2. **Combustion Engineering, Inc. (CE)**

3. **General Electric Co. (GE)**

4. **Glasweld International**

5. **Libby Owens Ford Co. (LOF)**

6. **Manville**

7. **PPG Industries, Inc. (PPG).**

E. **Glass Types:** All glass shall conform to the following requirements:

1. Type A: Not used.

2. Type B: Not used.

3. Type C: Clear float glass shall conform to Federal Specification DD-G-451D and shall be not less than 3/16-inch thick. Type C glass shall be **PPG, "Pennvernon"; or LOF, "Monolithic Annealed Glass."**

4. Type D: Clear, tempered float glass shall be heat-tempered safety glass conforming to Federal Specification DD-G-1403C and shall be not less than 1/4-inch thick.

5. Type E: Not used.

6. Type F: Not used.

7. Type G: Tinted, colored, insulating glass shall be units of 1-inch minimum thickness, consisting of an outside lite of 1/4-inch thick, tinted, colored gray float glass; 1/2-inch air space; and 1/4-inch thick, clear float glass inside lite. Tinted, colored, insulating

glass in project-out window shall be same as above, except that units shall be 5/8-inch thick, consisting of 3/16-inch thick glass and 1/4-inch air space. Type G glass shall be **PPG, "Solargray Twindow"; or LOF, "Gray Thermopane."**

8. Type H: Tinted, colored, tempered insulating glass shall be units of 1-inch minimum thickness, consisting of an outside lite of 1/4-inch thick tinted, colored [gray], tempered float glass; 1/2-inch air space; and 1/4-inch thick, clear, tempered float glass inside. Type H glass shall be **PPG, "Solargray Tempered Twindow" LOF, or "Gray Tempered Thermopane"**

9. Type I: Not used.

PART 3 – EXECUTION

3.1 GLAZING APPLICATION SCHEDULE

A. Glass types for the various locations shall conform to the following schedule:

1. **Exterior Locations:**	**Glass Type**
Windows of heated or cooled spaces, unless otherwise noted	G
Door lites	H
2. Interior Locations:	
Windows, 18 inches above floor, typical	C
Door lites	D

3.2 GENERAL

A. **Reference Standards:** All work shall conform to the recommendations of the Building Code and glass manufacturer's published specifications. All glazing shall be done in accordance with applicable referenced standards.

B. **Complete System:** Glass and glazing system shall be installed complete with all stops, blocks, channels, beads, sealants, and glass to form a completely installed watertight installation.

C. **Pre-Inspection:** Areas to receive glass and glazing shall be inspected by the CONTRACTOR and all defects shall be reported to the ENGINEER prior to glazing.

3.3 PREPARATION

A. Preparation work such as priming and cleaning shall be done with materials and procedures specified in the printed recommendations of the manufacturer. Surfaces shall be dry and free from dust, dirt, and film. All priming shall be completed and thoroughly dried before glazing.

3.4 INSTALLATION

A. **Workmanship:** Concealed edges of glass shall be clean, straight cut, and free from chips and fissures. All glass shall be shop-cut, and allowances shall be made. Allow for

maximum grip on all edges. Nipping glass on the job will not be allowed. Glass shall be accurately cut to size of opening. Glass shall be set with equal bearing on entire width of pane. Large sheets of glass shall be positioned with setting blocks. Installed glass shall not move or rattle.

B. **Weather and Temperature Limitations:** No work shall be performed in damp, foggy, or rainy weather. Working temperatures shall be per manufacturer's printed recommendations.

C. **Glazing Beads:** Glass in glazing beads or channels shall be in accordance with manufacturer's printed installation instructions. Materials shall not be stretched.

D. **Metal Glazing Beads:** Where metal glazing beads or stops occur and where vinyl glazing beads are not used, the glass shall be set on setting blocks and be completely bedded in glazing compound. Metal glazing beads furnished by the manufacturer shall be installed in accordance with manufacturer's printed instructions. Compound shall be trimmed flush to sight line.

E. **Sealant Application:** Sealant shall be applied on inside glass surface below glazing bead. The void below vinyl to bottom of glazing reglet shall be filled to maintain weathertight seal.

F. **Safety Markings:** Glass, glazing panels, and glazing shall be protected by markings or devices which clearly indicate the presence of glass to other workers and material handlers. Taping or marking which would cause a permanent stain on the glass shall not be used. Labels shall remain on glass until final cleaning.

3.5 TESTING

A. After installation is complete, all exterior glazing, except for aluminum entrance doors, shall be given a leak test by flooding the glazing from bottom to top using 3/4-inch minimum hose with nozzle.

3.6 ACCEPTANCE AND CLEANING

A. **Cleaning and Acceptance:** Prior to acceptance of the work, broken, defective, or scratched glass shall be replaced, and damaged glazing shall be repaired. Glass and glazing shall be left in perfect condition and ready for final cleaning. All glass and glazing panels, new and existing, shall be cleaned within 2 weeks of final acceptance of the project in a manner recommended by the glass manufacturer.

- END OF SECTION -

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall furnish and install all acoustical ceiling systems, including all supporting systems and appurtenant work, complete, all in accordance with the requirements of the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **Codes:** All codes, as referenced herein, are specified in Section 01090, "Reference Standards."

B. **Federal Specifications:**

SS-S-118B	Sound Controlling (Acoustical) Tiles and Panels

C. **Commercial Standards:**

ASTM C 635	Specification for Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings

D. **Trade Standards:** "Specification for Acoustical Tile and Lay-in Panel Ceiling Suspension Systems" by the Acoustical Material Association (AMA).

E. **Manufacturers' Standards:** In addition to the standards listed above, the acoustical ceiling system products and their installation shall be in accordance with the manufacturer's published recommendations and specifications.

1.3 CONTRACTOR SUBMITTALS

A. Manufacturer's literature, installation instructions, and samples shall be submitted in accordance with Section 01300, "Contractor Submittals."

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. **Delivery of Materials:** Manufactured materials shall be delivered in original, unbroken, packages, containers, or bundles bearing the manufacturer's label.

B. **Storage:** All materials shall be carefully stored in an area that is protected from the elements in a manner recommended by the product manufacturer. Storage shall be in a manner that will prevent damage to the material or marring of its finish.

PART 2 – PRODUCTS

2.1 GRID SYSTEM MATERIALS

A. **Cross Tees:** Cross tees shall be properly sized, cold-rolled, electro-galvanized steel, with white baked enamel finish.

B. **Wall Molding:** Wall molding shall be 1-inch by 3/4-inch matching the beams and tees in material and finish.

C. **Hanger and Diagonal Bracing Wires:** Hanger and diagonal bracing wires shall be not lighter than 12-gage, pre-straightened, galvanized, annealed steel wire.

D. **Spacers:** Spacers shall be tempered spring steel and shall be fitted into wall molding to provide tension on the ceiling system.

2.2 EXPOSED GRID SYSTEMS

A. The exposed grid system shall be a "Heavy Duty" classified system as manufactured by **National Rolling Mills Series "G" or "FG"; or U.S.G. Interiors, Series "DX" or "DXL."** Exposed system shall be fire-rated where indicated.

B. Main beams shall be not less than 1-1/2-inch high by 1-inch wide, cold-rolled, electro-galvanized steel, with white baked enamel finish.

2.3 ACOUSTICAL PANEL AND TILE MATERIALS

A. **Acceptable Manufacturer:** Acoustical panels shall be as manufactured by **Armstrong; Acousti-Celotex; or U.S. Gypsum.**

B. **Flame Spread Rating:** Tiles or panels shall be mineral fiber tile or panel, as specified or shown, and shall have a Class 1, ASTM flame spread and a flame spread rating of under 25 per Federal Specifications SS-S-118B.

C. **Finish:** Finish shall be factory-applied white latex paint.

2.4 ACOUSTICAL PANEL AND TILE PATTERNS AND SIZES

A. Exposed grid system ceiling panels shall be 24-inch by 24-inch by 3/4-inch face rabbeted type, laid in panels of non-directional fissured or embossed design.

PART 3 – EXECUTION

3.1 GENERAL

A. The acoustical ceiling system shall consist basically of continuous main beams and intersecting cross tees, joined together to form the patterns specified or shown herein, and acoustical ceiling panels and tiles. The system shall be complete with all necessary components, anchors, and supports.

B. The system shall be designed so that the ceiling panels may be removed and replaced without damage, and so that main beams and cross tees can be removed or replaced without deforming the members or disturbing the balance of the grid system.

C. Suspension systems and tile work shall be coordinated with lighting fixtures, air diffusers, and other features so that all installations work together without interference.

3.2 INSTALLATION

A. Installation shall be in strict accordance with the manufacturer's published directions, installation instructions, and specifications.

3.3 PROBLEM AREAS

A. Manufacturer's published recommendations and specifications shall be followed for installation, materials, and treatment of problem areas; provided, that the manufacturer's published recommendations and specifications are not less than those required by "Specification for Acoustical Tile and Lay-In Panel Ceiling Suspension Systems" of the Acoustical Materials Association, and the Building Code.

3.4 DEFLECTIONS

A. The ceiling system shall be engineered to carry the applied dead and live loads with a deflection of less than 1/360 of the span and shall be level to within 1/8-inch in 12 feet. The ceiling system shall conform to ASTM C 635 (Heavy Duty classification) with a minimum load carrying capacity of the main runner of 16 lb/linear foot of span of 4 ft 0 in.

3.5 PREPARATION

A. The CONTRACTOR and its tradesman shall be responsible for inspecting all acoustical treatment receiving areas so as to ensure a proper installation. The CONTRACTOR shall not proceed with its work before all conditions are ready to receive the acoustical panel work.

3.6 PATTERN AND SYMMETRY

A. Unless otherwise shown, the layout scheme shall be such that all ceiling panels are symmetrical about the center of the rooms to provide the least number of cut panels. The panels shall be laid in a pattern with all edges in alignment and with all faces in a plane. There shall be no noticeable variations in the finish ceiling plane. Items located within the ceiling plane such as, but not limited to, the following: light fixtures, air diffusers, speakers, smoke detectors, and fire sprinklers shall be coordinated with other trades and shall be installed at the locations shown. Whenever the CONTRACTOR is not sure of an installation location he shall obtain directions from the ENGINEER.

B. Nondirectional tile shall be laid so no fissure pattern direction is established.

C. Tiles shall be held down by use of hold down clips where ceiling heights are less than 9'-0" above the finished floor.

3.7 BEAM SPLICES AND TEE INTERSECTIONS

A. **General:** All main beams shall be joined together by a splice clip which draws the members tightly together with bottom flanges flush. Cross tee intersections shall be joined together by interlock methods, by positioning the ends of the cross tees snugly against the main beam and in holding the cross tees in vertical alignment with bottom flanges flush. All main beam splices and cross tee intersections shall be capable of withstanding at least 100 lb tension or compression.

B. **Termination at Walls:** The main beams and cross tees which terminate at the walls shall

be attached to a perimeter wall molding, which shall be continuous along at least 2 intersecting walls, with spring steel clips. Wall molding shall be securely attached to the walls at approximately 16-inch intervals in an approved manner.

3.8 HANGER WIRES

A. Hanger wires shall be spaced at maximum 48-inch o.c. along the main beams and at the corners of lay-in-fixtures and elsewhere as required for a fire-rated system.

B. Hanger wires shall be secured to the supporting structure with approved fastenings. Hangers and fastenings shall be capable of carrying at least 4 times the design load but not less than 100 lbs.

3.9 MOLDINGS

A. All outside edges such as against walls shall be provided with wall moldings.

3.10 HORIZONTAL RESTRAINT

A. Ceiling systems shall be provided with diagonal bracing wires. Horizontal restraints shall be effected by 4 No. 12-gage wires secured to the main beams within 2 inches of the cross tee intersection and splayed 90 degrees from each other at an angle not exceeding 45 degrees from the plane of the ceiling. These horizontal restraint points shall be placed 12 feet on center in both directions with the first point within 4 feet from each wall. The restraint wire attachment to the supporting structure shall be adequate for the loads imposed.

3.11 FIRE-RATING

A. Where a fire rating is specified, the complete ceiling system shall meet the requirements for the specified rating.

3.12 FINISHED CONDITION

A. After installation, the acoustical ceiling system shall be free from any discoloration, dirt, smudges, scratches, chips, blemishes, and/or any misalignment. All damaged materials shall be replaced so that a new uniform acoustical ceiling system is provided.

- END OF SECTION -

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide protective coatings, complete and in place, in accordance with the Contract Documents.

B. Definitions

1. The term "paint," "coatings," or "finishes" as used herein, shall include surface treatments, emulsions, enamels, paints, epoxy resins, and all other protective coatings, excepting galvanizing or anodizing, whether used as a pretreatment, primer, intermediate coat, or finish coat.

2. The term "DFT" means minimum dry film thickness, without any negative tolerance.

C. The following surfaces shall not be protective coated hereunder unless indicated.

1. Stainless steel

2. Machined surfaces

3. Grease fittings

4. Glass

5. Equipment nameplates

6. Platform gratings, stair treads, door thresholds, and other walk surfaces

D. The coating system schedules summarize the surfaces to be coated, the required surface preparation, and the coating systems to be applied. Coating notes on the drawings are used to show exceptions to the schedules, to show or extend the limits of coating systems, or to clarify or show details for application of the coating systems.

E. Where protective coatings are to be performed by a Subcontractor, the Contractor shall provide 5 references which show that the painting Subcontractor has previous successful experience with the indicated or comparable coating systems. Include the name, address, and the telephone number for the owner of each installation for which the painting subcontractor provided the protective coating.

F. The provisions of this Section shall apply to all Sections where referred to, except where otherwise specified or shown.

1.2 CONTRACTOR SUBMITTALS

A. **General:** Submittals shall be furnished in accordance with Section 01300 - Contractor Submittals, unless indicated otherwise below.

B. Submittals shall include the following information and be submitted at least 30 days prior to

protective coating work:

1. **Coating Materials List:** Eight copies of a coating materials list showing the Manufacturer and the coating number, keyed to the coating systems herein. The list shall be submitted prior to or at the time of submittal of samples.

2. **Paint Manufacturer's Information:** For each coating system to be used, the following data:

   a. Paint Manufacturer's data sheet for each product proposed, including statements on the suitability of the material for the intended use.

   b. Technical and performance information that demonstrates compliance with the system performance and material requirements.

   c. Paint Manufacturer's instructions and recommendations on surface preparation and application.

   d. Colors available for each product (where applicable).

   e. Compatibility of shop and field applied coatings (where applicable).

   f. Material Safety Data Sheet for each product used.

C. **Samples**

1. Samples of all paint, finishes, and other coating materials shall be submitted on 8-1/2-inch by 11-inch sheet metal. Each sheet shall be completely coated over its entire surface with one protective coating material, type, and color.

2. Two sets of color samples to match each color selected by the ENGINEER from the Manufacturer's standard color sheets. If custom mixed colors are indicated, the color samples shall be made using color formulations prepared to match the color samples furnished by the ENGINEER. The color formula shall be shown on the back of each color sample.

3. One fifteen pound sample of each abrasive proposed to be used for surface preparation for submerged and severe service coating systems.

1.3 SPECIAL CORRECTION OF DEFECTS REQUIREMENTS

A. **Warranty Inspection:** A warranty inspection may be conducted during the eleventh month following completion of all coating and painting work. The CONTRACTOR and a representative of the coating material Manufacturer shall attend this inspection. All defective work shall be repaired in accordance with these specifications and to the satisfaction of the OWNER. The OWNER may, by written notice to the CONTRACTOR, reschedule the warranty inspection to another date within the one-year correction period, or may cancel the warranty inspection altogether. If a warranty inspection is not held, the CONTRACTOR is not relieved of its responsibilities under the Contract Documents.

PART 2 – PRODUCTS

2.1 GENERAL

A. **Suitability:** The CONTRACTOR shall use suitable coating materials as recommended by the Manufacturer.

B. **Compatibility:** In any coating system only compatible materials from a single Manufacturer shall be used in the work. Particular attention shall be directed to compatibility of primers and finish coats. If necessary, a barrier coat shall be applied between existing prime coat and subsequent field coats to ensure compatibility.

C. **Containers:** Coating materials shall be sealed in containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, and name of manufacturer, all of which shall be plainly legible at the time of use.

D. **Colors:** All colors and shades of colors of all coats of paint shall be as indicated or selected by the ENGINEER. Each coat shall be of a slightly different shade, to facilitate inspection of surface coverage of each coat. Finish colors shall be as selected from the manufacturer's standard color samples by the ENGINEER.

2.2 INDUSTRIAL COATING SYSTEMS

A. **Material Sources:** Each of the following manufacturers is capable of supplying many of the industrial coating materials indicated herein. Where manufacturers and paint numbers are listed, it is to show the type and quality of coatings that are required. Proposed substitute materials will be considered as indicated above. All industrial coating materials shall be materials that have a record of satisfactory performance in industrial plants, manufacturing facilities, and water and wastewater treatment plants.

1. **Ameron**
2. **Carboline Coatings Company**
3. **Inorganic Coatings, Inc.**
4. **International (Courtaulds)**
5. **Tnemec Company**

B. **System 1 - Alkyd Enamel:** High quality, gloss or semi-gloss, medium long oil alkyd finish shall have a minimum solids content of 49 percent by volume. Primer shall be as recommended by manufacturer.

1. Prime coat DFT = 3 mils **Ameron 5105, or Tnemec P4-55 Versare Primer.**
2. Finish coats (two or more, DFT = 3 mils), **Ameron 5401 HSA or 5405 or Tnemec 2H Hi-Build Tneme-Gloss.**
3. Total system DFT = 6 mils.

C. **System 2 - Not Used**

D. **System 3 – Not Used**

E. **System 4 – Aliphatic Polyurethane:** Two component aliphatic acrylic polyurethane coating material shall provide superior color and gloss retention, resistance to splash from acid and alkaline chemicals, resistance to chemical fumes and severe weathering and with a minimum solids content of 58 percent by volume. Primer shall be a rust inhibitive two component epoxy coating with a minimum solids content of 65 percent by volume.

1. Prime coat DFT = 4 mils, **Ameron 385, Carboline 893 or Tnemec N27 S.T. Typoxy.**

2. Finish coat (one or more, DFT = 3 mils), **Ameron Amershield, Carboline 134 HS or Tnemec 73 Endurashield.**

3. Total system DFT = 7 mils.

4. More than one finish coat shall be applied as necessary to produce a finish with uniform color and texture.

F. **System 5 – Not Used**

G. **System 6 - Inorganic Zinc, Water Based:** Water based, self curing, zinc silicate coating material shall be a two component inorganic coating material that contains at least 85 percent of metallic zinc by weight in the dried film.

1. Prime coat and finish coat (One, DFT = 3 mils), **Ameron Dimetcote 21-5 or Inorganic Coatings 531.**

2. Total system DFT = 3 mils.

H. **System 7 - Acrylic Latex:** Single component, water based acrylic latex with a fungicide additive shall have a minimum solids content of 35 percent by volume. Prime coat shall be as recommended by manufacturer. The coating material shall be available in the ANSI safety colors.

1. Prime coat DFT = 2 mils, as recommended by manufacturer.

2. Finish coats (2 or more, DFT = 6 mils), **Ameron Amercoat 220, Carboline 3359, or Tnemec 6 Tneme-Cryl.**

3. Total system DFT = 8 mils.

I. **System 8 - Epoxy, Equipment:** Two component, rust inhibitive polyamide cured epoxy coating material shall provide a recoatable finish that is available in a wide selection of colors. The coating material shall have a minimum solids content of 65 percent by volume and be resistant to service conditions of condensing moisture, splash and spillage of lubricating oils, and frequent washdown and cleaning. Interior exposure only.

1. Prime coat DFT = 3 mils, **Ameron 385, or Tnemec N27 S.T. Typoxy.**

2. Prime coat, where shop applied. (DFT = 3 mils), universal primer, **Ameron 185 HS, Tnemec 50-330 Poly-Ura-Prime or Tnemec Series Tneme-Fascure.**

3. Finish coats (2 or more, DFT = 6 mils), **Ameron 385 or Tnemec 66 Hi-Build Epoxoline.**

4. Total system DFT = 9 mils.

J. **System 9 – Not Used**

K. **System 10 – Not Used**

L. **System 11 – Not Used**

M. **System 12 - Aliphatic Polyurethane, Fiber Glass:** Two-component aliphatic polyurethane coating material shall provide superior color and gloss retention, resistance to splash from acid and alkaline chemicals, and resistance to chemical fumes and severe weathering. A primer, tie coat, or mist coat shall be used as recommended by the manufacturer.

1. Prime coat (Tie coat), **Ameron 385 or Tnemec 66 Hi-Build Epoxoline.**

2. Finish coats (2 or more, DFT = 3 mils), **Ameron Amershield or Tnemec Series 73 Endura-Shield.**

2.3 SUBMERGED AND SEVERE SERVICE COATING SYSTEMS

A. **Materials Sources:** The manufacturers' products listed in this paragraph are materials which satisfy the material descriptions of this paragraph and have a documented successful record for long term submerged or severe service conditions. Proposed substitute products will be considered as indicated above.

B. **System 100 - Amine Cured Epoxy:** High build, amine cured, epoxy resin shall have a solids content of at least 80 percent by volume, and shall be suitable for long-term immersion service in potable water and municipal wastewater. For potable water service, the coating material shall be listed by the NSF International as in compliance with NSF Standard 61 - Drinking Water System Components - Health Effects.

1. Prime coat and finish coats (3 or more, DFT = 16 mils)

   a. First Coat: (DFT = 3 mils) **Ameron 395 or Tnemec Series 91 H2O Hydro-Zinc.**
   b. Second Coat: (DFT = 5 mils) **Tnemec Series FC 20-1255 Pota-Pox FC.**
   c. Third Coat: (DFT = 8 mils) **Themec Series 140-WH02 Pota-Pox.**

2. For coating of valves and non-submerged equipment, DFT = 12 mils.

C. **System 101 – Not Used**

D. **System 102 - Polyamide Cured Epoxy:** High build, polyamide epoxy resin shall have a solids content of at least 56 percent by volume, and shall be suitable for long-term immersion in potable water and municipal wastewater. For potable water service, the coating material shall be listed by the NSF International as in compliance with NSF Standard 61.

1. Prime coat and finish coats (3 or more, DFT = 12 mils), **Tnemec 20 Pota-Pox or Series FC20 Pota-Pox.**

E. **System 103 - Not Used**

F. **System 104 - Not Used**

G. **System 105 – Not Used**

H. **System 106 - Fusion Bonded Epoxy:** The coating material shall be a 100 percent powder epoxy, certified as compliant with NSF Standard 61, applied in accordance with the ANSI/AWWA C213 - Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines, except that the surface preparation shall be as specified in the coating system schedule of this Section. The coating shall be applied using the fluidized bed or electrostatic spray process.

1. Coating DFT = 16 mils, **Scotchkote 134 or 206N.**

2. For coating of valves, DFT - 12 mils.

3. Liquid Epoxy: For field repairs, the use of a liquid epoxy will be permitted, applied in not less than 3 coats to provide a DFT of 15 mils. The liquid epoxy shall be a 100 percent solids epoxy recommended by the powder epoxy manufacturer.

I. **System 107 – Not Used**

J. **System 108 - Concrete Waterproofing:** Furnish a surface applied capillary waterproofing material consisting of a combination of chemicals, cement and treated quartz which waterproofs by nonsoluble crystalline growth in the concrete substrate. Follow concrete waterproofing manufacturer's instructions throughout unless otherwise called for in these Specifications. Provide finished surfaces which are uniform. All chemical concrete waterproofing materials shall be suitable and approved for use in potable water by the U.S. Environmental Protection Agency.

Furnish XYPEX Concrete Waterproofing by **Crystallization or VANDEX Capillary Waterproofing Systems.** Have the manufacturer of the chemical concrete waterproofing system furnish all materials, including materials required to properly prepare surface of concrete to receive waterproofing, in accordance with the concrete waterproofing manufacturer's recommendations.

K. **System 109 - Not Used**

L. **System 110 - Not Used**

M. **System 111 – Not Used**

N. **System 112 - Vinyl Ester, Concrete:** Vinyl ester resin coating material with an inert flake pigment suitable for immersion service in hydrochloric acid and sulfuric acid solutions. The filler-sealer shall be a 100 percent solids amine-cured epoxy or vinyl ester material with silica and inert fillers. The filler-sealer is applied to the entire concrete surface. A 100 percent solids epoxy or vinyl ester surfacer shall be used to fill holes and patch the

concrete surface after abrasive blasting. High temperature Dow 470 system.

1. Prime coat (filler-sealer) applied to achieve a smooth void-free surface, **Plasite 9028 MI or Tnemec 120-5003 Vinester.**

2. Finish coats (two or more, DFT = 40 mils), **Plasite 4100 or Tnemec Series 120 Vinester.**

2.4 SPECIAL COATING SYSTEMS

A. **System 200 - PVC Tape:** Prior to wrapping the pipe with PVC tape, the pipe and fittings first shall be primed using a primer recommended by the PVC tape manufacturer. After being primed, the pipe shall be wrapped with a 20-mil adhesive PVC tape, half-lapped, to a total thickness of 40 mils.

B. **System 201 - Rich Portland Cement Mortar:** Rich portland cement mortar coating shall have a minimum thickness of 1/8-inch, followed by enclosure in an 8-mil thick polyethylene sheet with all joints and edges lapped and sealed with tape.

C. **System 203 – Not Used**

D. **System 204 – Not Used**

E. **System 205 - Polyethylene Encasement:** Application of polyethylene encasement shall be in accordance with ANSI/AWWA C105 using Method C.

F. **System 206 – Not Used**

G. **System 207 - Not Used**

H. **System 208 - Aluminum Metal Isolation:** Two coats of a high build polyamide epoxy paint, such as **Tnemec 66,** (8 mils). Total thickness of system DFT = 8.0 mils.

I. **System 209 - Alkyd-Wood:** Industrial quality, gloss or semi-gloss, medium long oil alkyd coating material with a minimum solids content of 49 percent by volume. Primer shall be an alkyd primer as recommended by the manufacturer.

1. Prime coat DFT = 3 mils.

2. Finish coats (two or more, DFT = 3 mils), **Amercoat 5401 or Tnemec 2H.**

3. Total system DFT = 6 mils.

J. **System 210 – Not Used**

K. **System 211 – Not Used**

PART 3 – EXECUTION

3.1 MANUFACTURER'S SERVICES

A. The CONTRACTOR shall require the protective coating manufacturer to furnish a qualified technical representative to visit the project site for technical support as may be necessary to resolve field problems attributable or associated with the manufacturer's products.

B. For submerged and severe service coating systems, the CONTRACTOR shall require the paint manufacturer to furnish the following services:

1. The manufacturer's representative shall provide at least 6 hours of on-site instruction in the proper surface preparation, use, mixing, application, and curing of the coating systems.

2. The manufacturer's representative shall observe the start of surface preparation, mixing, and application of the coating materials for each coating system.

3.2 WORKMANSHIP

A. Skilled craftsmen and experienced supervision shall be used on all WORK.

B. Coating shall be done in a workmanlike manner so as to produce an even film of uniform thickness. Edges, corners, crevices, and joints shall receive special attention to insure thorough cleaning and an adequate thickness of coating material. The finished surfaces shall be free from runs, drops, ridges, waves, laps, brush marks, and variations in color, texture, and finish. The hiding shall be so complete that the addition of another coat would not increase the hiding. Special attention shall be given to insure that edges, corners, crevices, welds, and similar areas receive a film thickness equivalent to adjacent areas, and installations shall be protected by the use of drop cloths or other precautionary measures.

C. All damage to surfaces resulting from the WORK shall be cleaned, repaired, and refinished to original condition.

3.3 STORAGE, MIXING, AND THINNING OF MATERIALS

A. **Manufacturer's Recommendations:** Unless otherwise indicated, the coating manufacturer's printed recommendations and instructions for thinning, mixing, handling, applying, and protecting its coating materials, for preparation of surfaces for coating, and for all other procedures relative to coating shall be strictly observed.

B. All protective coating materials shall be used within the manufacturer's recommended shelf life.

C. **Storage and Mixing:** Coating materials shall be stored under the conditions recommended by the Material Safety Data Sheets, and shall be thoroughly stirred, strained, and kept at a uniform consistency during application. Coatings of different manufacturers shall not be mixed together.

3.4 PREPARATION FOR COATING

A. **General:** All surfaces to receive protective coatings shall be cleaned as indicated prior to application of coatings. The CONTRACTOR shall examine all surfaces to be coated, and shall correct all surface defects before application of any coating material. All marred or

abraded spots on shop-primed and on factory-finished surfaces shall receive touch-up restoration prior to any coating application. Surfaces to be coated shall be dry and free of visible dust.

B. **Protection of Surfaces Not to be Coated:** Surfaces which are not to receive protective coatings shall be protected during surface preparation, cleaning, and coating operations.

C. All hardware, lighting fixtures, switchplates, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not to be painted shall be removed, masked or otherwise protected. Drop cloths shall be provided to prevent coating materials from falling on or marring adjacent surfaces. The working parts of all mechanical and electrical equipment shall be protected from damage during surface preparation and coating operations. Openings in motors shall be masked to prevent entry of coating or other materials.

D. Care shall be exercised not to damage adjacent work during blast cleaning operations. Spray painting shall be conducted under carefully controlled conditions. The CONTRACTOR shall be fully responsible for and shall promptly repair any and all damage to adjacent work or adjoining property occurring from blast cleaning or coating operations.

E. **Protection of Painted Surfaces:** Cleaning and coating shall be coordinated so that dust and other contaminants from the cleaning process will not fall on wet, newly-coated surfaces.

3.5 SURFACE PREPARATION STANDARDS

A. The following referenced surface preparation specifications of the Steel Structures Painting Council shall form a part of this specification:

1. Solvent Cleaning (SSPC-SP1): Removal of oil, grease, soil, salts, and other soluble contaminants by cleaning with solvent, vapor, alkali, emulsion, or steam.

2. Hand Tool Cleaning (SSPC-SP2): Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by hand chipping, scraping, sanding, and wire brushing.

3. Power Tool Cleaning (SSPC-SP3): Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by power tool chipping, descaling, sanding, wire brushing, and grinding.

4. White Metal Blast Cleaning (SSPC-SP5): Removal of all visible rust, oil, grease, soil, dust, mill scale, paint, oxides, corrosion products and foreign matter by blast cleaning.

5. Commercial Blast Cleaning (SSPC-SP6): Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 33 percent of each square inch of surface area.

6. Brush-Off Blast Cleaning (SSPC-SP7): Removal of all visible oil, grease, soil, dust, loose mill scale, loose rust, and loose paint.

7. Near-White Blast Cleaning (SSPC-SP10): Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 5 percent of each square inch of surface area.

3.6 METAL SURFACE PREPARATION (UNGALVANIZED)

A. The minimum abrasive blasting surface preparation shall be as indicated in the coating system schedules included at the end of this Section. Where there is a conflict between these specifications and the coating manufacturer's printed recommendations for the intended service, the higher degree of cleaning shall apply.

B. Workmanship for metal surface preparation shall be in conformance with the current SSPC Standards and this Section. Blast cleaned surfaces shall match the standard samples available from the National Association of Corrosion Engineers, NACE Standard TM-01-70 - Visual Standard for Surfaces of New Steel Airblast Cleaned with Sand Abrasive and TM-01-75 - Visual Standard for Surfaces of New Steel Centrifugally Blast Cleaned with Steel Grit.

C. All oil, grease, welding fluxes, and other surface contaminants shall be removed by solvent cleaning per SSPC-SP1 - Solvent Cleaning prior to blast cleaning.

D. All sharp edges shall be rounded or chamfered and all burrs, and surface defects and weld splatter shall be ground smooth prior to blast cleaning.

E. The type and size of abrasive shall be selected to produce a surface profile that meets the coating manufacturer's recommendation for the particular coating and service conditions. Abrasives for submerged and severe service coating systems shall be clean, hard, sharp cutting crushed slag. Automated blasting systems shall not be used for surfaces that will be in submerged service. Metal shot or grit shall not be used for surfaces that will be in submerged service, even if subsequent abrasive blasting is planned to be one with hard, sharp cutting crushed slag.

F. The abrasive shall not be reused unless an automated blasting system is used for surfaces that will be in non-submerged service. For automated blasting systems, clean oil-free abrasives shall be maintained. The abrasive mix shall include at least 50 percent grit.

G. The CONTRACTOR shall comply with the applicable federal, state, and local air pollution control regulations for blast cleaning.

H. Compressed air for air blast cleaning shall be supplied at adequate pressure from well maintained compressors equipped with oil and moisture separators which remove at least 95 percent of the contaminants.

I. Surfaces shall be cleaned of all dust and residual particles of the cleaning operation by dry air blast cleaning, vacuuming, or another approved method prior to painting.

J. Enclosed areas and other areas where dust settling is a problem shall be vacuum cleaned and wiped with a tack cloth.

K. Damaged or defective coating shall be removed by the specified blast cleaning to meet the

clean surface requirements before recoating.

L. If the specified abrasive blast cleaning will damage adjacent work, the area to be cleaned is less than 100 square feet, and the coated surface will not be submerged in service, then SSPC-SP2 or SSPC-SP3 be used.

M. Shop applied coatings of unknown composition shall be completely removed before the indicated coatings are applied. Valves, castings, ductile or cast iron pipe, and fabricated pipe or equipment shall be examined for the presence of shop-applied temporary coatings. Temporary coatings shall be completely removed by solvent cleaning per SSPC-SP1 before the abrasive blast cleaning work has been started.

N. Shop primed equipment shall be solvent cleaned in the field before finish coats are applied.

3.7 SURFACE PREPARATION FOR GALVANIZED FERROUS METAL

A. Galvanized ferrous metal shall be alkaline cleaned per SSPC-SP1 to remove oil, grease, and other contaminants detrimental to adhesion of the protective coating system to be used, followed by brush off blast cleaning per SSPC-SP7.

B. Pretreatment coatings of surfaces shall be in accordance with the printed recommendations of the coating manufacturer.

3.8 SURFACE PREPARATION OF FERROUS SURFACES WITH EXISTING COATINGS, EXCLUDING STEEL RESERVOIR INTERIORS

A. **General:** All grease, oil, heavy chalk, dirt, or other contaminants shall be removed by solvent or detergent cleaning prior to abrasive blast cleaning. The generic type of the existing coatings shall be determined by laboratory testing.

B. **Abrasive Blast Cleaning:** The CONTRACTOR shall provide the degree of cleaning specified in the coating system schedule for the entire surface to be coated. If the degree of cleaning is not indicated in the schedule, deteriorated coatings shall be removed by abrasive blast cleaning to SSPC-SP6. Areas of tightly adhering coatings shall be cleaned to SSPC-SP7, with the remaining thickness of existing coating not to exceed 3 mils.

C. **Incompatible Coatings:** If coatings to be applied are not compatible with existing coatings the CONTRACTOR shall apply intermediate coatings per the paint manufacturer's recommendation for the indicated coating system or shall completely remove the existing coating prior to abrasive blast cleaning. A small trial application shall be conducted for compatibility prior to painting large areas.

D. **Unknown Coatings:** Coatings of unknown composition shall be completely removed prior to application of new coatings.

E. **Water Abrasive or Wet Abrasive Blast Cleaning:** Where specified or where job site conditions do not permit dry abrasive blasting for industrial coating systems due to dust or air pollution considerations, water abrasive blasting or wet abrasive blasting may be used. In both methods, paint-compatible corrosion inhibitors shall be used, and coating application shall begin as soon as the surfaces are dry. Water abrasive blasting shall be done using high pressure water with sand injection. In both methods, the equipment used

shall be commercially produced equipment with a successful service record. Wet blasting methods shall not be used for submerged and severe service coating systems unless indicated.

3.9 CONCRETE AND CONCRETE BLOCK MASONRY SURFACE PREPARATION

A. Surface preparation shall not begin until at least 30 days after the concrete or masonry has been placed.

B. All oil, grease, and form release and curing compounds shall be removed by detergent cleaning per SSPC-SP1 before abrasive blast cleaning.

C. Concrete, concrete block masonry surfaces and deteriorated concrete surfaces to be coated shall be abrasive blast cleaned to remove existing coatings, laitance, deteriorated concrete, and to roughen the surface equivalent to the surface of the No. 80 grit flint sandpaper.

D. If acid etching is required by the coating application instructions, the treatment shall be made after abrasive blasting. After etching, rinse surfaces with water and test the pH. The pH shall be between neutral and 8.

E. Surfaces shall be clean and as recommended by the coating manufacturer before coating is started.

F. Unless required for proper adhesion, surfaces shall be dry prior to coating. The presence of moisture shall be determined with a moisture detection device such as **Delmhorst Model DB.**

3.10 PLASTIC, FIBER GLASS AND NONFERROUS METALS SURFACE PREPARATION

A. Plastic and fiber glass surfaces shall be sanded or brush off blast cleaned prior to solvent cleaning with a chemical compatible with the coating system primer.

B. Non-ferrous metal surfaces shall be solvent-cleaned SSPC-SP1 followed by sanding or brush-off blast cleaning SSPC-SP7.

C. All surfaces shall be clean and dry prior to coating application.

3.11 ARCHITECTURAL CONCRETE BLOCK MASONRY SURFACE PREPARATION

A. The mortar surfaces shall be cured at least 14 days before surface preparation work is started.

B. Dust, dirt, grease, and other foreign matter shall be removed prior to abrasive blasting.

C. The masonry surfaces shall be prepared in accordance with the material manufacturer's printed instructions.

3.12 SHOP COATING REQUIREMENTS

A. Unless otherwise indicated, all items of equipment, or parts of equipment which are not submerged in service, shall be shop primed and then finish coated in the field after

installation with the indicated or selected color. The methods, materials, application equipment and all other details of shop painting shall comply with this section. If the shop primer requires topcoating within a specified period of time, the equipment shall be finish coated in the shop and then touch-up painted after installation.

B. All items of equipment, or parts and surfaces of equipment which are submerged or inside an enclosed hydraulic structure when in service, with the exception of pumps and valves, shall have all surface preparation and coating work performed in the field.

C. The interior surfaces of steel water reservoirs, except for Part A surfaces, shall have all surface preparation and coating work performed in the field.

D. For certain pieces of equipment it may be undesirable or impractical to apply finish coatings in the field. Such equipment may include engine generator sets, equipment such as electrical control panels, switchgear or main control boards, submerged parts of pumps, ferrous metal passages in valves, or other items where it is not possible to obtain the indicated quality in the field. Such equipment shall be primed and finish coated in the shop and touched up in the field with the identical material after installation. The CONTRACTOR shall require the manufacturer of each such piece of equipment to certify as part of its shop drawings that the surface preparation is in accordance with these specifications. The coating material data sheet shall be submitted with the shop drawings for the equipment.

E. For certain small pieces of equipment the manufacturer may have a standard coating system which is suitable for the intended service conditions. In such cases, the final determination of suitability will be made during review of the shop drawing submittals. Equipment of this type generally includes only indoor equipment such as instruments, small compressors, and chemical metering pumps.

F. Shop painted surfaces shall be protected during shipment and handling by suitable provisions including padding, blocking, and the use of canvas or nylon slings. Primed surfaces shall not be exposed to the weather for more than 2 months before being topcoated, or less time if recommended by the coating manufacturer.

G. Damage to shop-applied coatings shall be repaired in accordance with this Section and the coating manufacturer=s printed instructions.

H. The CONTRACTOR shall make certain that the shop primers and field topcoats are compatible and meet the requirements of this Section. Copies of applicable coating manufacturer's data sheets shall be submitted with equipment shop drawings.

3.13 APPLICATION OF COATINGS

A. The application of protective coatings to steel substrates shall be in accordance with SSPC-PA1 - Paint Application Specification No. 1.

B. Cleaned surfaces and all coats shall be inspected prior to each succeeding coat. The CONTRACTOR shall schedule such inspection with the ENGINEER in advance.

C. Blast cleaned ferrous metal surfaces shall be painted before any rusting or other deterioration of the surface occurs. Blast cleaning shall be limited to only those surfaces that can be coated in the same working day.

D. Coatings shall be applied in accordance with the manufacturer's instructions and recommendations, and this Section, whichever has the most stringent requirements.

E. Special attention shall be given to edges, angles, weld seams, flanges, nuts and bolts, and other places where insufficient film thicknesses are likely to be present. Use stripe painting for these areas.

F. Special attention shall be given to materials which will be joined so closely that proper surface preparation and application are not possible. Such contact surfaces shall be coated prior to assembly or installation.

G. Finish coats, including touch-up and damage repair coats shall be applied in a manner which will present a uniform texture and color matched appearance.

H. Coatings shall not be applied under the following conditions:

1. Temperature exceeding the manufacturer's recommended maximum and minimum allowable.

2. Dust or smoke laden atmosphere.

3. Damp or humid weather.

4. When the substrate or air temperature is less than 5 degrees F above dewpoint.

5. When air temperature is expected to drop below 40 degrees F or less than 5 degrees F above the dewpoint within 8 hours after application of coating.

6. When wind conditions are not calm.

I. Dewpoint shall be determined by use of a sling psychrometer in conjunction with U.S. Dept. of Commerce, Weather Bureau psychometric tables.

J. Unburied steel piping shall be abrasive blast cleaned and primed before installation.

K. The finish coat on all work shall be applied after all concrete, masonry, and equipment installation is complete and the work areas are clean and dust free.

3.14 CURING OF COATINGS

A. The CONTRACTOR shall maintain curing conditions in accordance with the conditions recommended by the coating material manufacturer or by this Section, whichever is the most stringent, prior to placing the completed coating system into service.

B. In the case of enclosed areas, forced air ventilation, using heated air if necessary, may be required until the coatings have fully cured.

C. **Forced Air Ventilation of Steel Reservoirs and Enclosed Hydraulic Structures:** Forced air ventilation is required for the application and curing of coatings on the interior surfaces of steel reservoirs and enclosed hydraulic structures. During application and curing periods, continuously exhaust air from a manhole in the lowest shell ring, or in the

case of an enclosed hydraulic structure, from the lowest level of the structure using portable ducting. After all interior coating operations have been completed, provide a final curing period for a minimum of 10 days, during which the forced ventilation system shall operate continuously. For additional requirements, refer to the specific coating system requirements in Part 2 above.

3.15 IDENTIFICATION OF PIPING

A. Identification of piping shall be in accordance with Section 15005 - Piping Identification Systems.

B. Every valve or connection, where it may be possible for a worker to be exposed to a hazardous substance, shall be labelled per OSHA Occupational Safety and Health Standards 29CFR1910.1200.

C. All unburied pipe in structures and in chemical pipe trenches shall be color-code painted. Colors shall be as selected by the ENGINEER, or as indicated.

3.16 SHOP AND FIELD INSPECTION AND TESTING

A. General: The CONTRACTOR shall give the ENGINEER a minimum of 3 days advance notice of the start of any field surface preparation work or coating application work, and a minimum of 7 days advance notice of the start of any shop surface preparation work.

B. All such work shall be performed only in the presence of the ENGINEER, unless the ENGINEER has granted prior approval to perform such work in its absence.

C. Inspection by the ENGINEER, or the waiver of inspection of any particular portion of the WORK, shall not relieve the CONTRACTOR of its responsibility to perform the work in accordance with these Specifications.

D. Scaffolding shall be erected and moved to locations where requested by the ENGINEER to facilitate inspection. Additional illumination shall be furnished to cover all areas to be inspected.

E. **Inspection Devices:** The CONTRACTOR shall furnish, until final acceptance of such coatings, inspection devices in good working condition for the detection of holidays and measurement of dry-film thicknesses of protective coatings. Dry-film thickness gauges shall be made available for the ENGINEER'S use at all times while coating is being done, until final acceptance of such coatings. The CONTRACTOR shall furnish the services of a trained operator of the holiday detection devices until the final acceptance of such coatings. Holiday detection devices shall be operated only in the presence of the ENGINEER.

F. **Holiday Testing:** The CONTRACTOR shall holiday test all coated ferrous surfaces inside a steel reservoir, other surfaces which will be submerged in water or other liquids, or surfaces which are enclosed in a vapor space in such structures and surfaces coated with any of the submerged and severe service coating systems. Areas which contain holidays shall be marked and repaired or recoated in accordance with the coating manufacturer's printed instructions and then retested.

1. Coatings With Thickness Exceeding 20 Mils: For surfaces having a total dry film

coating thickness exceeding 20 mils: pulse-type holiday detector such as **Tinker & Rasor Model AP-W or D.E. Stearns Co. Model 14/20** shall be used. The unit shall be adjusted to operate at the voltage required to cause a spark jump across an air gap equal to twice the specified coating thickness.

2. Coatings With Thickness of 20 Mils or Less: For surfaces having a total dry film coating thickness of 20 mils or less: **Tinker & Rasor Model M1 non-destructive type holiday detector or K-D Bird Dog,** shall be used. The unit shall operate at less than 75-volts. For thicknesses between 10 and 20 mils, a non-sudsing type wetting agent, such as **Kodak Photo-Flo,** shall be added to the water prior to wetting the detector sponge.

G. **Film Thickness Testing:** On ferrous metals, the dry film coating thickness shall be measured in accordance with the SSPC "Paint Application Specification No. 2" using a magnetic-type dry film thickness gauge such as **Mikrotest model FM or Elcometer model 111/1EZ.** Each coat shall be tested for the correct thickness. No measurements shall be made until at least 8 hours after application of the coating. On non-ferrous metals and other substrates, the coating thicknesses shall be measured at the time of application using a wet film gauge.

H. **Surface Preparation:** Evaluation of blast cleaned surface preparation work will be based upon comparison of the blasted surfaces with the standard samples available from the NACE, using NACE standards TM-01-70 and TM-01-75.

3.17 COATING SYSTEM SCHEDULES - FERROUS METALS

A. **Coating System Schedule, Ferrous Metal - Not Galvanized:**

	Item	Surface Prep.	System No.
FM-1	All surfaces indoors and outdoors, exposed or covered, except those included below.	Commercial blast cleaning SSPC-SP6	(4) aliphatic polyurethane
FM-2	Surfaces in chlorination room, chlorine storage room.	Not Used	Not Used

	Item	Surface Prep.	System No.
FM-3	Surfaces of equipment and ferrous surfaces submerged or intermittently submerged in water and utility water, including all surfaces lower than 2 feet above high water level in hydraulic structures, and all surfaces inside enclosed hydraulic structures and vents (excluding shop-coated valves, couplings, pumps).	White metal blast cleaning SSPC-SP5	(100) amine-cured epoxy
FM-4	Surfaces exposed to high temperature (between 150 and 600 degrees F).	Near white metal blast cleaning SSPC-SP10	(6) inorganic zinc, water-based
FM-5	Surfaces exposed to high temperature (between 600 and 1000 degrees F).	Not Used	Not Used
FM-6	Buried small steel pipe.	Removal of dirt, grease, oil	(200) PVC tape
FM-7	Where indicated, ferrous surfaces in water passages of all valves 4-inch size and larger, exterior surfaces of submerged valves.	White metal blast cleaning SSPC-SP5	(102) polyamide-cured epoxy
FM-8	Where indicated, ferrous surfaces in water passages and submerged surfaces of all pumps which have discharge size of 4 inches or larger.	White metal blast cleaning SSPC-SP5	(100) amine-cured epoxy
FM-9	Ferrous surfaces of sleeve-couplings.	Solvent cleaning SSPC-SP1, followed by white metal blast cleaning SSPC-SP10	(106) fusion-bonded epoxy
FM-10	All ferrous surfaces of sluice gates, flap gates, and shear gates, including wall thimbles.	White metal blast cleaning SSPC-SP5	(102) polyamide-cured epoxy

	Item	Surface Prep.	System No.
FM-11	Buried surfaces that are not indicated to be coated elsewhere.	Near white metal blast cleaning SSPC-SP10	(100) amine-cured epoxy
FM-12	Interior surfaces of all chemical tanks, including tank nozzles, manholes, nozzle necks, flange faces.	Not Used	Not Used
FM-13	External surfaces of buried steel tanks.	Not Used	Not Used
FM-14	Structural steel, miscellaneous metalwork, and supports for prefabricated metal buildings.	Not Used	Not Used
FM-15	Structural steel, miscellaneous metalwork, and supports for roof and facia support systems for buildings.	Not Used	Not Used
FM-16	Surfaces of indoor equipment, not submerged	Commercial blast cleaning SSPC-SP6	(8) epoxy, equipment
FM-17	Not Used	Not Used	Not Used
FM-18	Buried pipe couplings, valves, fittings, and flanged joints (where piping is plastic).	Removal of dirt, grease, oil	(201) rich portland cement mortar
FM-19	Buried pipe couplings, valves, and flanged joints (where piping is ductile or cast iron, not tape-coated), including epoxy-coated surfaces.	As specified by reference specification	(205) polyethylene encasement
FM-20	Buried pipe couplings, valves, and flanged joints (where piping is mortar-coated steel or reinforced concrete), including epoxy-coated surfaces.	Not Used	Not Used

B. **Coating System Schedule, Ferrous Metal - Galvanized:** Pretreatment coatings, barrier coatings, or washes shall be applied as recommended by the coating manufacturer. All galvanized surfaces shall be coated except for the following items

which shall be coated only if required by other Sections: (1) Floor gratings and frames, (2) Handrails, (3) Stair treads, (4) Chain link fencing and appurtenances.

	Item	Surface Prep.	System No.
FMG-1	All exposed surfaces indoors and outdoors, except those included below.	Solvent cleaning SSPC-SP1	(1) alkyd enamel
FMG-2	Surfaces in chlorinator room, chlorine storage room.	Not Used	Not Used
FMG-3	Buried small steel pipe.	Removal of dirt, grease, oil	(200) PVC tape
FMG-4	Surfaces buried or submerged in water or wastewater, including all surfaces lower than two feet above high water level and all surfaces inside enclosed hydraulic structures and vents.	Solvent cleaning SSPC-SP1 followed by brush-off grade blast cleaning SSPC-SP7	(100) amine-cured epoxy

3.18 COATING SYSTEM SCHEDULE, NON-FERROUS METAL, PLASTIC, FIBER GLASS

A. Where isolated non-ferrous parts are associated with equipment or piping, the CONTRACTOR shall use the coating system for the adjacent connected surfaces. Do not coat handrails, gratings, frames or hatches. Only primers recommended by the coating manufacturer shall be used.

	Item	Surface Prep.	System No.
NFM-1	All exposed surfaces, indoors and outdoors, except those included below.	Solvent cleaned SSPC-SP1	(1) alkyd enamel
NFM-2	Chlorination room, chlorine storage room.	Not Used	Not Used
NFM-3	Aluminum surfaces in contact with concrete, or with any other metal except galvanized ferrous metal.	Solvent cleaned SSPC-SP1	(208) aluminum metal isolation

	Item	Surface Prep.	System No.
NFM-4	Polyvinyl chloride plastic piping, indoors and outdoors, or in structures, not submerged.	Solvent cleaned SSPC-SP1	(7) acrylic latex
NFM-5	Fiber glass surfaces.	Per paragraph 3.10	(12) aliphatic polyurethane fiber glass
NFM-6	Buried non-ferrous metal pipe.	Removal of dirt, grease, oil	(200) PVC tape

3.19 COATING SYSTEM SCHEDULE-CONCRETE

	Item	Surface Prep.	System No.
C-1	Exposed outdoor surfaces down to one foot below grade – No painting required under Section 09800	Final Finish of grout wash as per Section 03300	Thoroseal Waterproofing under Section 07150
C-2	Concrete Walls: (Interior)	Per paragraph 3.9	One coat Sanitile P.C. Base, plus one coat of Sanitile 550 Aliphatic Polyurethane system @ total DFT of 5 mils
C-3	Concrete Block: (Interior)	Per paragraph 3.9	Two coats Sanitile C.B. Base, plus one coat Sanitile 550 Aliphatic Polyurethane system @ total DFT of 25 mils
C-4	All surface submerged in water or wastewater including bottoms and sidewalls.	Per paragraph 3.9	(108) Concrete Waterproofing

3.20 COATING SYSTEM SCHEDULE - MISCELLANEOUS SURFACES

	Item	Surface Prep.	System No.
MS-1	Wood, indoors and outdoors.	Per manufacturer's printed instructions	(209) alkyd-wood
MS-2	Drywall	Not Used	Not Used

- END OF SECTION -

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall prepare surfaces for painting and shall paint all surfaces not specifically included under the requirements of Section 09800 - Protective Coating, as required or shown, all in accordance with the requirements of the Contract Documents.

B. Materials not to be painted hereunder shall include the following:

1. Work having complete factory finish other than prime coat.

2. Surfaces whose coatings are for the specific purpose of protection from abrasion, wear and tear, or from corrosion, oxidation, decomposition, or other effects of exposure.

3. Stainless steel, aluminum brass, bronze, and plated finished metals (not zinc or cadmium).

4. Finish hardware except prime-coated items, and fusible links, UL labels, nameplates, numbers, and identifying data.

5. Walking surfaces.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. **Section 09800 - Protective Coating:** For the purposes of definition, all surfaces listed in the coating schedule of the Protective Coating Schedule shall be deemed to be surfaces requiring such special coating, and in case of conflict between the provisions of the Protective Coating Section and the Architectural Paint Finishes specified herein, the provisions of Section 09800 - Protective Coating shall take precedence.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **Codes:** All codes, as referenced herein, are specified in Section 01090 - Reference Standards.

B. In case of conflict between codes, reference standards, drawings, and these Specifications, the most stringent requirements shall govern. All conflicts shall be brought to the attention of the ENGINEER for clarification and directions prior to ordering or providing any materials or labor.

1.4 CONTRACTOR SUBMITTALS

A. **General:** All CONTRACTOR submittals shall be in accordance with the requirements for "Samples" in Section 01300 - Contractor Submittals.

B. **List of Paint Materials:** Prior to submittal of color and gloss samples, the CONTRACTOR shall submit for acceptance, a complete list of all paint materials proposed

for use, identifying each material by manufacturer's name, product name, and number. The list shall include all primers, thinners, and coloring agents, together with manufacturer's catalog data fully describing each material as to contents, recommended usage, and preparation and application methods. The CONTRACTOR shall identify surfaces to receive various paint materials and shall make no deviations from accepted list. THE LIST SHALL BE SUBMITTED WITHIN 60 DAYS AFTER EXECUTION OF THE AGREEMENT, AS SPECIFIED IN SECTION 01600 - PRODUCTS, MATERIALS, EQUIPMENT, AND SUBSTITUTIONS.

C. Color samples and stain samples shall be submitted as required by the ENGINEER. Submittals shall conform to the provisions of Section 01300 - Contractor Submittals. Stain samples shall be provided on the same material as the stain will be applied in the final installation.

D. **Extra Stock:** Upon completion of the project, the CONTRACTOR shall provide the OWNER with one gallon of each type and color of paint, depending on quantity used on the project. The cost thereof shall be included as a part of the work required under this Section.

1.5 QUALITY ASSURANCE

A. The CONTRACTOR shall verify with the authorities having jurisdiction over air pollution control, the use of any materials containing organic chemical compounds of which use at the date of installation may be prohibited or restricted by any regulations then in effect.

B. Materials are subject to such tests as the ENGINEER may direct. All costs of such testing shall be as specified in Section 01400 - Quality Control.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. The paint materials shall be delivered to the job site in the manufacturer's unopened containers and a list of all batch numbers shall be furnished to the ENGINEER prior to the start of work.

B. Stored paints and liquids shall be kept covered, and precautions shall be taken for the prevention of fire. Empty containers and paint-soiled or oily rags shall be removed from the site at the end of each day's work. Paint thinner shall not be stored in a room scheduled to receive resilient flooring.

1.7 ATMOSPHERIC CONDITIONS

A. No coating shall be applied: (1) when the surrounding air temperature or the temperature of the surface to be coated is below 40 degrees F; (2) to wet or damp surfaces or in rain, fog or mist; (3) when the temperature is less than 5 degrees F above the dewpoint; or (4) when it is expected the air temperature will drop below 40 degrees F, or less than 5 degrees F above the dewpoint within 8 hours after application of coating. Dewpoint shall be measured by use of a sling psychrometer in conjunction with U.S. Department of Commerce Weather Bureau psychrometric tables.

1.8 SAFETY AND HEALTH REGULATIONS

A. **General:** In accordance with requirements of OSHA Safety and Health Standards for Construction (29CFR1926) and the applicable requirements of regulatory agencies having

jurisdiction, as well as manufacturer's printed instructions and appropriate technical bulletins and manuals, the CONTRACTOR shall provide and require use of personnel protective lifesaving equipment for persons working in or about the project site.

B. **Head and Face Protection and Respiratory Devices:** Equipment shall include protective helmets which shall be worn by all persons while in the vicinity of the WORK. In addition, workers engaged in or near the work during sandblasting shall wear OSHA approved eye and face protection devices and air purifying, halfmask or mouthpiece respirators. Barrier creams may be used on any exposed areas of skin.

C. **Ventilation:** Where ventilation is used to control hazardous exposure, all equipment shall be explosion-proof. Forced air ventilation shall be provided to reduce the concentration of air contaminant to a safe limit. Air circulation and exhausting of solvent vapors shall be continued until coatings have fully cured.

D. **Sound Levels:** Whenever the occupational noise exposure exceeds maximum allowable sound levels, the CONTRACTOR shall implement a Hearing Conservation Program including furnishing and requiring the use of approved ear protective devices.

E. **Illumination:** Adequate illumination shall be provided while work is in progress, which may include explosion-proof lights and electrical equipment. Whenever required by the ENGINEER, the CONTRACTOR shall provide additional illumination to cover all areas to be inspected. The level of illumination for inspection purposes shall be determined by the ENGINEER.

F. **Temporary Ladders and Scaffolding:** All temporary ladders and scaffolding shall conform to applicable safety requirements. They shall be erected where requested by the ENGINEER to facilitate inspection and shall be moved by the CONTRACTOR to locations as requested by the ENGINEER.

1.9 CLEANUP

A. Upon completion of the work, all staging, scaffolding and containers shall be removed from the site or destroyed in a manner approved by the ENGINEER. Coating spots and oil or stain upon adjacent surfaces shall be removed and the job site cleaned. All damage to adjacent surfaces or facilities resulting from the WORK performed under the contract shall be cleaned, repaired or refinished to the satisfaction of the ENGINEER at no additional cost to the OWNER.

1.10 WARRANTY INSPECTION

A. A warranty inspection shall be conducted during the eleventh month following completion of all coating and painting work. The CONTRACTOR or its authorized representative shall attend this inspection. All defective work shall be repaired in accordance with the requirements of the Contract Documents and to the satisfaction of the OWNER or ENGINEER. The OWNER may, by written notice to the CONTRACTOR, reschedule the warranty inspection within the contract guarantee period, or may cancel the warranty inspection altogether.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Where alternative painting systems are specified, selection from among the alternatives is at the CONTRACTOR's option.

B. The CONTRACTOR may substitute other paint materials for those specified herein provided that it first receives written approval from the ENGINEER stating that said proposed substituted materials are equal to those specified and are approved for use in the WORK.

C. Unless otherwise approved by the ENGINEER in writing, all coatings applied under a single paint system shall be the products of a single manufacturer.

2.2 FACTORY MIXING

A. To the maximum extent practicable and, unless otherwise approved by the ENGINEER, each paint shall be factory-mixed to the specified color, gloss, and consistency required for application.

2.3 PAINTING GUIDE

A. All paint materials shall be of the following grades or brands, in each case:

	Kop-Coat Div. Carboline, Inc. St. Louis, MO	Tnemec Co., Inc. North Kansas City, MO
1. Non-submerged Metal, except Aluminum, Bronze and Stainless Steel Surfaces	Surface Prep: SSPC-SP6 Commercial Blast	
	Shop Primer: 1 coat Kop-Coat 340 Gold Primer @ 2-3.5 mils dry	Shop Primer: 1 coat P37-77 Chem-Prime @ 2-3.5 mils dry
	Field Primer: 1 coat Kop-Coat 340 Gold Primer 2-3.5 mils dry	Field Primer: 1 coat P37-77 Chem-Prime @ 2-3.5 mils dry
	Finish: 2 coats Kop-Coat Super Hi-Gard Epoxy 2-3 mils dry per coat	Finish: 2 coats 66 Color H.B. Epoxoline in Selected Color @ 4-6 mils dry per coat
2. Concrete Walls: (interior)	1 coat Sanitile P.C. Base, plus 1 coat of Sanitile 550 Aliphatic Polyurethane system @ total dry mil thickness of 5 mils.	
3. Concrete Block: (interior)	2 Coats Sanitile C.B. Base, plus 1 coat Sanitile 550 Aliphatic Polyurethane system @ total dry mil thickness of 25 mils.	

4. HVAC Coatings: The CONTRACTOR for HVAC work under Section 15500 shall paint all metal surfaces as noted with a chemical resistant coating system Sanitile Systems as manufactured by Sanitile Division of Carboline Company as follows:

Shop Primer: (Bare Steel)	1 coat Sanitile Chromolox 210 Primer @ 2.0-2.5 mils dry
Shop Primer: (Galvanized Steel, Stainless Steel or Aluminum)	1 coat Sanitile Galoseal 212 Primer @ 0.6-0.8 mils dry
Finish:	2 coats Sanitile E-H 550-210 or 550-212 @ 2.5 mils dry coat, respectively.

PART 3 – EXECUTION

3.1 GENERAL REQUIREMENTS

A. **Workmanship:** Unless otherwise specified, all paint materials shall be applied by brush or roller in strict accordance with the manufacturer's printed instructions. SPRAY PAINTING IS NOT ALLOWED WITHOUT SPECIFIC APPROVAL IN EACH CASE. Each coat shall be applied at proper consistence, and shall be free of brush or roller marks, sags, runs or any other evidence of poor workmanship. The splattering of paint on glass, hardware, tile, trim, and other surfaces not to be painted shall be avoided. Masking tape shall be applied as required. The CONTRACTOR shall sand between all enamel coats.

B. **Coverage Rates:** In no case shall paint application exceed the paint manufacturer's published coverage rate based upon unthinned material. In the event that paint has been extended beyond the recommended coverage, or the "hide" produced is inadequate, as determined by the ENGINEER, the CONTRACTOR shall apply one or more additional coats as determined by the ENGINEER at no additional cost to OWNER. The manufacturer's recommended amount of thinner shall not be exceeded. Unless otherwise approved, finish coat material shall be applied as taken from manufacturer's container.

C. **Protection:** Floors, fixtures, equipment, and similar surfaces shall be protected with impervious protective covers and/or drop cloths.

D. **Removal of Finish Hardware:** Finish hardware shall be removed prior to painting and finishing and re-installed according to hardware manufacturer's requirements.

E. **Barricades:** The CONTRACTOR shall maintain barricades and wet paint signs for duration of period needed.

F. **Scaffolds:** The CONTRACTOR shall provide and transfer scaffolds, staging, and planking as necessary for proper performance of work.

3.2 PREPARATION

A. **General:** The CONTRACTOR shall properly prepare surfaces to receive finishes as indicated and specified.

B. **Ferrous and Galvanized Metal:** Ferrous metal surfaces shall be cleaned of rust, scale, grease, oil, and other deleterious matter by wire brushing, scraping, washing with solvent, sandblasting, or other means necessary to properly prepare surfaces for painting. Shop painted ferrous metal surfaces that show rusting when initially installed shall be touched up with a rust inhibitor similar to Porter Metalprep No. 40 or an equal. Rust inhibitor shall meet the requirements of MIL-M-10578B for Phosphoric Acid rust inhibitor, and shall be applied only after wire brushing to a sound surface, and then coated with a compatible universal primer. Galvanized metals shall be cleaned with suitable organic solvent.

C. **Masonry and Concrete to be Painted:** Surfaces of masonry and concrete to be painted shall be dry and free of dust, dirt, grease, oil, and other foreign matter such as loose or granular material. Holes, cracks, joints and any surface defects shall be repaired and filled out flush and smooth with appropriate products, except where a priming coat may be recommended first by the manufacturer of the paint. Glaze and loose particles shall be removed by wire brushing. No evidence of curing compounds, release agents and the like will be acceptable.

3.3 APPLICATION

A. **General:** Paint shall not be applied in extreme heat, nor in dust or smoke laden air, nor in damp or humid weather.

B. Drying times shall be not less than called for in manufacturer's printed instructions.

C. Drop cloths shall be placed where required to protect floors and equipment from splatter and droppings.

D. Spray painting, where allowed, shall be conducted under controlled conditions, and the CONTRACTOR shall be fully responsible for any damage to adjacent work or adjoining property occurring from spray painting.

E. Each coat will be inspected by the ENGINEER prior to application of the next coat. Areas found to contain runs, overspray, roughness, or other signs of improper application shall be required to be recoated in accordance with the ENGINEER's instructions.

F. Drying time shall be in accordance with the manufacturer's printed recommendations.

G. The CONTRACTOR shall apply complete paint system required for exposed surfaces behind permanent cabinets, cases, counters, and similar work before such items are installed.

H. **Coats and Colors:** The number of coats specified to be applied are

minimum only. Paint finishes shall be even, uniform color, and free from cloudy or mottled appearance in surfaces and evident thinness of coatings. Each coat shall be tinted a sufficiently different shade of finish color to permit identification, in accordance with accepted samples.

3.4 OUTLINE OF PAINTING AND FINISHING WORK

A. **Interior:** In general, exposed surfaces of the [building] shall be painted and finished in accordance with the requirements herein specified for paint and finish materials and surface:

1. Exposed surfaces of gypsum wallboard, plaster, and doors and frames, shall be primed and painted as specified.

2. Metal items in partitions and ceilings such as registers, grilles, and similar items shall be painted to match finish of room or area in which they occur, unless directed otherwise by the ENGINEER.

3. Painted doors opening into rooms or spaces having different finishes or colors shall have the edges finished as directed by the ENGINEER. Closet and storage room doors shall be finished on both sides to match the room into which they open.

B. **Mechanical and Electrical Work:** Mechanical and electrical products requiring painting shall conform to the requirements of Section 09800 - Protective Coating, except for the following:

1. Areas behind grilles, baffles, ventilators, and louvers: exposed surfaces, not factory finished, visible from inside and outside of the building shall be painted with appropriate primers and one coat of black semi-gloss (low sheen) enamel paint far enough to conceal such areas and spaces when looking towards them from the floor and ground levels.

2. Pipe Identification: Piping shall be identified by means of stencils of various sizes to suit size of pipes and by flow arrows. Piping shall be stenciled with letters and flow arrows at each point of entry or exit to a room or space, at junctions of piping, and in long runs at intervals not exceeding 20 feet. Stencils shall correspond with pipe abbreviations shown on mechanical drawings. Color coding is [not] required.

3.5 ADJUSTMENT AND CLEANING

A. **General:** The CONTRACTOR shall make a detailed inspection of paint finishes after painting work has been completed, and shall carefully remove splatterings of paint material from adjoining work of others (particularly plumbing fixtures, trim, tile, and finish metal surfaces), and shall make good any damage thereto that may be caused by such cleaning operations. The CONTRACTOR shall carefully touch-up all abraded, stained, or otherwise disfigured painting work and shall leave the entire painting work in first-class condition.

B. **Clean-up and Disposal:** During and upon completion of work, the CONTRACTOR shall remove unused tools and equipment, surplus materials,

rubbish, debris, dust and shall leave areas affected by work of this section in clean approved condition in accordance with the requirements of Section 01700 - Project Closeout.

- END OF SECTION -

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall furnish all the materials for and shall properly erect and install all building specialties at the locations shown and as indicated on the Contract Drawings, and as specified herein. This shall include all laminated rubber dock bumpers, all unit kitchens and cabinets, all gable louvers, and all labor, materials, tools, and appurtenances required to complete the work of this Contract.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **Codes:** All codes, as referenced herein, are specified in Section 01090, "Reference Standards."

1.3 WORKMANSHIP AND MATERIALS

A. All equipment and materials furnished under this Contract shall be new, suitable for the conditions on service to which they will be subject, and equal to the best of their respective classes. Grade and quality shall meet the applicable cited specifications and standards.

B. Workmanship shall be of the highest quality and shall be carried out by competent and experienced workmen.

1.4 CONTRACTOR SUBMITTALS

A. **Shop Drawings:** Detailed, dimensioned shop drawings and data conforming to the requirements of Section 01300 of the General Requirements shall be submitted to the Engineer and approved before fabrication, shipment or work specified under this Section begins.

PART 2 – PRODUCTS

2.1 METAL SHELVING

A. The CONTRACTOR shall furnish, as shown on the Drawings, heavy duty steel shelving with steel angle posts punched to allow for adjustable shelving heights, by **Penco Products, Inc.**

B. **Sizes:** Unit configuration shall be as shown on the Drawings.

PART 3 – EXECUTION

3.1 The CONTRACTOR shall install all of the building specialties items according to manufacturer' standards. The work shall be performed by experienced craftsmen and shall be approved by the OWNER.

- END OF SECTION -

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall furnish all the materials for and shall properly erect and install all enclosures at the locations shown and as indicated on the Contract Drawings, and as specified herein. This shall include all fiberglass enclosures, anchor bolts, accessories, and all labor, materials, tools, and appurtenances required to complete the work of this Contract.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Additional References:

1. ASTM C518 - Standard test method for steady-state heat flux measurements and thermal transmission properties by means of the heat flow meter apparatus.

2. ASTM D256 - Standard test method for determining the pendulum impact resistance of notched specimens of plastics.

3. ASTM D638 - Standard test method for tensile properties of plastics.

4. ASTM D732 - Standard test method for shear strength of plastics by punch tool.

5. ASTM D790 - Standard test methods of flexural properties of unreinforced and reinforced plastics and electrical insulating materials.

6. ASTM D792 - Standard test method for specific gravity (relative density) and density of plastics by displacement.

7. ASTM D1622 - Standard test method for apparent density of rigid cellular plastics.

8. ASTM D2583 - Standard test method for indentation hardness of rigid plastics by means of a Barcol impressor.

9. ASTM E84 - Standard test method for surface burning characteristics of building materials.

1.3 WORKMANSHIP AND MATERIALS

A. All equipment and materials furnished under this Contract shall be new, suitable for the conditions on service to which they will be subject, and equal to the best of their respective classes. Grade and quality shall meet the applicable cited specifications and standards.

B. Workmanship shall be of the highest quality and shall be carried out by competent and experienced workmen.

C. Design factory-fabricated, pre-engineered structure of one-piece molded construction with composite walls and roof to withstand 125 mile per hour wind load and 30 PSF snow load.

1.4 CONTRACTOR SUBMITTALS

A. Shop Drawings: Detailed, dimensioned shop drawings and data conforming to the requirements of Section 01300 of the General Requirements shall be submitted to the Engineer and approved before fabrication, shipment or work specified under this Section begins.

PART 2 – PRODUCTS

2.1 FIBERGLASS ENCLOSURES

A. Under this Section of the specification, there shall be furnished and installed one-piece fiberglass enclosures as provided by the manufacturer and as shown on the contract drawings and specified. The enclosure specified below shall be equal to the Model 200-041 Gullwing enclosure as manufactured by TRACOM Inc.

B. Major Equipment: The following equipment shall be included in the requirements of this Section:

Supernatant return vault No. 2

The two fiberglass enclosures for LSR-P- 00.01 and -00.02 of supernatant return vault No. 2 shall be a molded structure of fiberglass reinforced polyester measuring 36"W x 36"L x 60"H. The exterior surface shall have a ten (10) to fifteen (15) mil ultraviolet-resistant gel-coat backed by a rich layer of resin and chopped glass forming a water and chemical resistant surface. The remainder of the laminate shall be fiberglass reinforced polyester containing not less than thirty percent (30%) glass content by weight. The thickness of the enclosure shall not be less than one-eighth inch (1/8"). The unit shall be of single piece construction. The integral floor for the enclosures shall be field drilled along the interior of the exterior walls in the field by the contractor. A closed cell neoprene gasket is provided to place under the building along the exterior walls. The boltholes are to be sealed with silicon caulk to seal the exposed fiberglass and minimize any seepage of water into the enclosure. Each base corner shall be pre-drilled for ¾" mounting holes.

The door shall be 30"W x42"H and fitted with a stainless steel piano hinge and locking hasp, with lock provided.

The enclosure shall be provided with:

1. Rigid polyurethane foam insulation, one inch (1") thick in top sides and door.

C. MATERIALS OF CONSTRUCTION

1. Molded composite: exterior and interior resin-fiberglass laminate with foam core.

   a. Laminate: fiberglass laminate will consist of polyester resin reinforced with a minimum of 25% by weight E-Glass.

(1) Exterior surface: exterior surface shall be white gel coat, smooth and free from fiber pattern, roughness, or other irregularities.

(2) Exterior laminate: 1/8" thick, minimum, chemically bonded to gel coat.

(3) Interior laminate: white color with encapsulated core in place.

(4) Laminate properties:

Tensile strength (ASTM D638)	11,000 psi
Flexural strength (ASTM D790)	18,000 psi
Shear strength (ASTM D732)	12,000 psi
Barcol hardness (ASTM D2583)	40
Impact (ASTM D256)	12 ft lbs/inch
Density/specific gravity (ASTM D792)	93.6 pcf/1.5
Surface burning characteristics (ASTM E84)	
flame spread	less than 150
smoke density	less than 1000
Class A	flame spread 20-25
Class B	flame spread 70-75

b. Core:

(1) Rigid closed cell, self extinguishing, polyisocyanurate foam with a density of 2.0 pounds per cubic foot.

(2) Core properties:

Thermal conductivity (ASTM C518)	0.13 BTU inch/Hr. SF F
Density/specific gravity (ASTM D1622)	2.0 PCF/0.3
Surface burning characteristics (ASTM E84)	flame spread 35 smoke density 240

c. Coupons prepared in accordance with ASTM D618 test method.

D. Manufacturer:

1. TRACOM, Inc.

PART 3 – EXECUTION

3.1 The CONTRACTOR shall install all of the enclosures according to manufacturer's recommended and approved procedures submitted with shop drawings. The work shall be performed by experienced craftsmen and shall be approved by the OWNER.

3.2 Store product on flat surface and protect from construction traffic and damage. Follow all manufacturer's directions for the loading and off-loading of the product.

- END OF SECTION -

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide signs and other identifying devices and all appurtenant work, complete and in place, in accordance with the Contract Documents.

B. Identifying devices required by other Sections of the Specifications shall also comply with this Section.

1.2 CONTRACTOR SUBMITTALS

A. **General:** The CONTRACTOR shall furnish submittals in accordance with the requirements of Section 01300 - Contractor Submittals.

B. **Shop Drawings:** Full-size or scaled layouts of signs showing sign size, color, fasteners and mounting, and location. A typical of repetitive sign layouts may be submitted. Most restrictive conditions shall be depicted.

C. **Samples:** Samples of all the materials and colors proposed for the WORK, clearly marked to show the manufacturer's name and product identification along with the manufacturer's technical data and application instructions.

PART 2 – PRODUCTS

2.1 GENERAL

A. Identification devices shall be installed where directed by the ENGINEER. All wording shall be as indicated and shall be verified before fabrication.

2.2 SIGNS

A. **General:** Signs or warnings shall be enamel painted on semi-rigid butyrate. Signs shall conform to OSHA Standards and directions. Lettering sizes shall be 3-inch in height unless indicated otherwise.

B. The following sign shall be provided on all hose bibbs where water is non-potable:

CAUTION
NON-POTABLE WATER
DO NOT DRINK

C. Automatic startup: All pumps which can be started either automatically or remotely shall have the following sign attached:

WARNING
THIS PIECE OF EQUIPMENT
MAY START AUTOMATICALLY

D. The following signs shall be posted on the outside wall, in the area of the polymer quick disconnect fill station:

1. FILL LOCATION FOR GRAVITY THICKENER POLYMER
2. FILL LOCATION FOR BELT PRESS POLYMER

2.2 LETTERS

A. **Metal:** Letters shall be 3 anodic finish aluminum of medium bronze 312E color. The letters shall be of **"Futura"** design as manufactured by **James H. Matthews and Co.** Letters shall be provided complete with fasteners for concrete wall installation at the locations indicated.

B. **Plastic:** Plastic letters shall be 4-inch Helvetica Medium lower case cut from 1/4-inch thick acrylic plastic, finished with auto paint coating of color selected by the ENGINEER.

PART 3 – EXECUTION

3.1 GENERAL

A. All installations of identifying devices shall be vandal-resistant. Fasteners shall be concealed, non-corrosive fasteners appropriate for materials being fastened and as required.

3.2 LETTERS

A. Installation of metal letters shall be 3/4-inch projection mounted from surface with threaded studs and space collars. The center of each row shall align. Letters shall be installed per manufacturer's published instructions.

- END OF SECTION -

SECTION 10500 - LOCKERS

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall furnish and install steel lockers and all appurtenant work, all in accordance with the requirements of the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **Codes:** All codes, as referenced herein, are specified in Section 01090 - Reference Standards.

1.3 CONTRACTOR SUBMITTALS

A. **Shop Drawings:** The CONTRACTOR shall provide shop drawings of all products in accordance with the requirements in Section 01300 - Contractor Submittals.

B. **Samples:** The CONTRACTOR shall submit to the ENGINEER for approval, samples of all the materials and colors proposed for use on the WORK. The samples shall be clearly marked to show the manufacturer's name and product identification and shall be submitted along with the manufacturer's technical data and application instructions. All sample submittals shall conform to the requirements for "Samples" in Section 01300 - Contractor Submittals.

PART 2 – PRODUCTS

2.1 GENERAL

A. Lockers shall be as manufactured by **Lyon Metal Products, Inc., Republic Steel Corporation or Interior Steel Equipment Company.** Colors shall be selected by the ENGINEER from manufacturer's standard colors. Shop drawings and color selections shall be submitted for each product.

B. Lockers shall be constructed of 24-gage steel body and 16-gage steel semi-flexible type door with inverted louvers. Legs shall be provided if curb is not shown on drawings.

C. Hardware shall be provided and shall consist of not less than the following:

1. Live rubber silencers for doors, handles, locking device, and hinges.

2. Each locker shall be provided with one rustproof steel single prong hook; coat rod and non-corrosive number plates with 3/8-inch black filled figures in sequence.

3. Built-in combination with master key locks shall be provided for each locker.

D. Lockers, steel parts, and accessories shall be thoroughly cleaned, given a bonding and rust inhibitive phosphate treatment, and coated with a heavy coat of epoxy resin or synthetic enamel. Enamel shall be baked-on to a hard durable finish of not less than one mil minimum dry thickness. Doors, frames, panel tops, and ends shall receive the same

finish to provide a total minimum dry enamel thickness of 1.5 mils.

2.2 LOCKER UNITS

A. Locker units shall conform to the following requirements:

1. Lockers shall consist of one-person, single tier lockers, 15 inches by 18 inches by 72 inches high, furnished complete with sloping hood, number plates, and built-in combination with master key type locks, and pad lockable handles.

PART 3 – EXECUTION

3.1 LOCKERS

A. Lockers shall be fastened to the structures in accordance with manufacturer's printed recommendations and in conformance with applicable codes. Frames and doors shall form a flush exterior when installed. Lockers shall be securely fastened in banks.

- END OF SECTION -

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide fire protection equipment and appurtenant WORK, complete and in place, in accordance with the requirements of the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. **Codes:** All codes, as referenced herein, are specified in Section 01090, "Reference Standards."

B. **Trade Standards:**

1. Uniform Fire Code (UFC) as published by the Western Fire Chiefs Association Inc. and the International Conference of Building Officials.

2. National Fire Protection Association publications (NFPA), as referenced herein.

C. **Manufacturer's Standards:** In addition to the standards listed above, the fire protection products and their installation shall be in accordance with the manufacturer's published recommendations and specifications.

1.3 CONTRACTOR SUBMITTALS

A. **General:** Submittals shall be in accordance with Section 01300 - Contractor Submittals.

B. **Literature:** Manufacturer's literature, installation instructions, and details shall be submitted.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. **Delivery of Materials:** Manufactured materials shall be delivered in original unbroken packages, or containers, bearing the manufacturer's label with manufacturer's name, product description and rating.

B. **Storage:** All materials shall be carefully stored in an area which is protected from the elements as recommended by the material manufacturer. Storage shall be in a manner that will prevent damage to the material and its finish.

PART 2 – PRODUCTS

2.1 GENERAL

A. All fire prevention equipment shall be from the same manufacturer unless otherwise specified and shall meet the requirements of NFPA "Pamphlet No. 10."

B. **Manufacturers:**

1. **General Fire Extinguisher Corp.**

2. **Larsen's Manufacturing Co.**

3. **Potter-Roemer**

2.2 MATERIALS

A. **Fire Extinguisher:** Fire extinguishers shall be 20 lb minimum capacity, A.B.C. dry-chemical type, with minimum UL rating of 120 BC.

B. **Bracket:** Mounting brackets shall be specially designed for extinguisher.

C. **Other Materials:** All other materials, not specifically described, but required for a complete and proper installation of fire fighting devices shall be as selected by the CONTRACTOR, subject to the review of the ENGINEER.

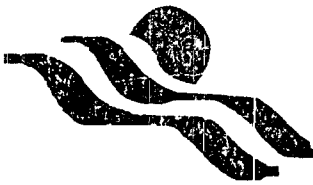
PART 3 – EXECUTION

3.1 INSTALLATION

A. **Brackets:** All fire extinguishers shall be provided with and installed on brackets or brackets within cabinets. The CONTRACTOR shall block and reinforce walls to support the fire extinguishers.

B. **Locations:** Fire prevention equipment locations shall be verified with the ENGINEER and Fire Marshall before installation and shall be installed where directed per NFPA Pamphlet No. 10. A minimum of three (3) fire extinguishers shall be installed.

— END OF SECTION —



Kentucky-American Water Company

Lexington, Kentucky

KENTUCKY RIVER STATION ADDITIONAL RESIDUALS PROCESSING FACILITIES

Contract Documents
Bidding Requirements, Contract Forms, Conditions of the Contract, and Technical Specifications

VOLUME 2 OF 2

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SECTION 11000 - EQUIPMENT GENERAL PROVISIONS

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide all equipment and appurtenant work, complete and operable, in accordance with the Contract Documents.

B. The provisions of this Section shall apply to all equipment except where otherwise indicated.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. All equipment shall be in accordance with the following standards, as applicable and as indicated in each Section of these specifications:

1. American Society for Testing and Materials (ASTM).
2. American Public Health Association (APHA).
3. American National Standards Institute (ANSI)
4. American Society of Mechanical Engineers (ASME).
5. American Water Works Association (AWWA).
6. American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE).
7. American Welding Society (AWS).
8. National Fire Protection Association (NFPA).
9. Federal Specifications (FS).
10. National Electrical Manufacturers Association (NEMA).
11. Manufacturer's published recommendations and specifications.
12. General Industry Safety Orders (OSHA).

B. The following standards are referenced in this Section:

ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250, and 800
ANSI B16.5	Pipe Flanges and Flanged Fittings, Steel, Nickel Alloy, and Other Special Alloys
ANSI B46.1	Surface Texture

ANSI S12.6	Method for the Measurement of the Real-Ear Attenuation of Hearing Protectors
ANSI/ASME B1.20.1	General Purpose Pipe Threads (Inch)
ANSI/ASME B31.1	Power Piping
ANSI/AWWA D100	Welded Steel Tanks for Water Storage
AWWA C206	Field Welding of Steel Water Pipe
ASTM A 48	Gray Iron Castings
ASTM A 108	Steel Bars, Carbon, Cold-Finished, Standard Quality

1.3 CONTRACTOR SUBMITTALS

A. **Shop Drawings:** The CONTRACTOR shall furnish complete Shop Drawings for all equipment, piping, valves, and controls in accordance with Section 01300 - Contractor Submittals.

B. **Tools:** The CONTRACTOR shall supply one complete set of special wrenches and other special tools necessary for the assembly, adjustment, and dismantling of the equipment. All tools shall be of best quality hardened steel forgings with bright, finish wrench heads shall have work faces dressed to fit nuts. All tools shall be suitable for professional work and manufactured by a recognized supplier of professional tools such as **Snap On, Crescent or Stanley**. The set of tools shall be neatly mounted in a labeled tool box of suitable design provided with a hinged cover.

C. **Spare Parts:** The CONTRACTOR shall obtain from the manufacturer and submit a list of suggested spare parts for each piece of equipment. After approval, CONTRACTOR shall furnish such spare parts suitably packaged, identified with the equipment number, and labeled. CONTRACTOR shall also furnish the name, address, and telephone number of the nearest distributor for each piece of equipment. All spare parts are intended for use by the OWNER, only, after expiration of the guaranty period.

D. **Torsional Analysis**

1. The CONTRACTOR shall submit to the ENGINEER a torsional and lateral vibration analysis of the following equipment, in accordance with Section 01300. The analysis shall be performed by a specialist experienced in this type of work and approved by the ENGINEER.

   a. All engine drives.

   b. All blowers and compressors with drives of 100 horsepower and over.

   c. All vertical pumps with universal joints and extended shafts.

   d. All other equipment where indicated.

2. The torsional natural frequency of the drive train must be avoided by ± 25 percent by any exciting frequency of the equipment, throughout the entire operating range.

E. **Vibration Analysis:** In its Bid, the CONTRACTOR shall include at least two Site visits of the abovementioned specialist during construction and testing of the equipment, to analyze and measure the amount of equipment vibration and make a written recommendation for keeping the vibration at a safe limit.

1.4 QUALITY ASSURANCE

A. **Inspection, Startup, and Field Adjustment:** The CONTRACTOR shall demonstrate that all equipment meets the performance requirements. CONTRACTOR shall furnish the services of an experienced, competent, and authorized service representative of the manufacturer of each item of major equipment who shall visit the Site to perform the following tasks:

1. Assist the CONTRACTOR in the installation of the equipment.

2. To inspect, check, adjust if necessary and approve the equipment installation.

3. To start-up and field-test the equipment for proper operation, efficiency, and capacity.

4. To perform necessary field adjustments during the test period until the equipment installation and operation are satisfactory to the ENGINEER.

5. To instruct the OWNER's personnel in the operation and maintenance of the equipment. Instruction shall include step-by-step trouble shooting procedures with all necessary test equipment.

B. **Costs:** The costs of all inspection, startup, testing, adjustment, and instruction work performed by said factory-trained representatives shall be borne by the CONTRACTOR at no increased cost to the OWNER. The OWNER will pay for costs of power and water. When available, the OWNER'S operating personnel will provide assistance in the field testing.

C. **Public Inspection:** It shall be the responsibility of the CONTRACTOR to inform the local authorities, such as building and plumbing inspectors, fire marshall, OSHA inspectors, and others, to witness all required tests for piping, plumbing, fire protection systems, pressure vessels, safety systems, etc., to obtain all required permits and certificates, and pay all fees.

D. **Tolerances:** Tolerances and clearances shall be as shown on the Shop Drawings and shall be closely adhered to. Machine work shall in all cases be of high-grade workmanship and finish, with due consideration to the special nature or function of the parts. Members without milled ends and which are to be framed to other steel parts of the structure may have a variation in the detailed length of not greater than 1/16-inch for members 30 feet or less in length, and not greater than 1/8-inch for members over 30 feet in length.

E. **Machine Finish:** The type of finish shall be the most suitable for the application and shall be shown in micro-inches in accordance with ANSI B46.1. The following finishes shall be used:

1. Surface roughness not greater than 63 micro-inches shall be required for all surfaces in sliding contact.

2. Surface roughness not greater than 250 micro-inches shall be required for surfaces in contact where a tight joint is not required.

3. Rough finish not greater than 500 micro-inches shall be required for other machined surfaces.

4. Contact surfaces of shafts and stems which pass through stuffing boxes and contact surfaces of bearings shall be finished to not greater than 32 micro-inches.

F. **Manufacturer's Experience:** Equipment shall have a record of at least 5 years of successful, troublefree operation in similar applications, from the same manufacturer.

PART 2 – PRODUCTS

2.1 GENERAL REQUIREMENTS

A. **High Noise Level Location:** The CONTRACTOR shall provide one personal hearing protection station, as indicated herein, at each high noise level location. Locations are defined as follows:

1. Outdoor Location: Any single equipment item or any group of equipment items that produce noise exceeding OSHA noise level requirements for a 2-hour exposure. Where such equipment is separated by a distance of more than 20 feet, measured between edges of footings, each group of equipment shall be provided with a separate hearing protection station.

2. Indoor Location:

a. Any single equipment item, or any group of equipment items, located within a single room not normally occupied, that produces noise exceeding OSHA noise level requirements for a 2-hour exposure.

b. Any single equipment item, or any group of equipment items, located within a single room normally occupied by workers, that produces noise exceeding OSHA noise level requirements for an 8-hour exposure.

B. **Personal Hearing Protection:** The CONTRACTOR shall furnish three pairs of high attenuation hearing protectors in the original unopened packaging. The ear protectors shall be capable of meeting the requirements of ANSI S12.6 and shall produce a noise level reduction of 25 dBA at a frequency of 500 Hz. The hearing protectors shall have fluid filled ear cushions and an adjustable, padded headband. The protectors shall be stored in a weatherproof, labeled, steel cabinet, furnished by the CONTRACTOR and mounted in an approved location near the noise producing equipment.

C. **Service Factors:** Service factors shall be applied in the selection or design of mechanical power transmission components. Unless otherwise indicated, the following load classifications shall apply in determining service factors:

Type of Equipment	Load Classification
Blower:	
Centrifugal or vane	Uniform
Lobe	Moderate Shock
Reciprocating Air Compressor:	
Multi-Cylinder	Moderate Shock
Single-Cylinder	Heavy Shock
Pump:	
Centrifugal or Rotary	Uniform
Reciprocating	Moderate Shock
Mixer:	
Constant Density	Uniform
Variable Density	Moderate Shock
Flocculator or Clarifier	Uniform
Sludge Thickener	Moderate Shock
Crane or Hoist	Moderate Shock

D. For service factors of electric motors, see Section 16460 - Electric Motors. Where load classifications are not indicated, best modern practice shall be used.

E. **Welding:** Unless otherwise indicated, all welding shall conform to the following:

1. Latest revision of ANSI/AWWA D100.

2. Latest revision of AWWA C206.

3. All composite fabricated steel assemblies which are to be erected or installed inside a hydraulic structure, including any fixed or movable structural components of mechanical equipment, shall have continuous seal welds to prevent entrance of air or moisture.

4. All welding shall be by the metal-arc method or gas-shielded arc method as described in the American Welding Society's "Welding Handbook" as supplemented by other pertinent standards of the AWS. Qualification of welders shall be in accordance with the AWS Standards governing same.

5. In assembly and during welding, the component parts shall be adequately clamped, supported, and restrained to minimize distortion and for control of dimensions. Weld reinforcement shall be as specified by the AWS code. Upon completion of welding, all weld splatter, flux, slag, and burrs left by attachments shall be removed. Welds shall be repaired to produce a workmanlike appearance, with uniform weld contours and dimensions. All sharp corners of material which is to be painted or coated shall be ground to a minimum of 1/32-inch on the flat.

F. **Protective Coating:** All equipment shall be painted or coated in accordance with Section

09800 - Protective Coating, unless otherwise indicated. Non-ferrous metal and corrosion-resisting steel surfaces shall be coated with grease or lubricating oil. Coated surfaces shall be protected from abrasion or other damage during handling, testing, storing, assembly, and shipping.

G. **Protection of Equipment:** All equipment shall be boxed, crated, or otherwise protected from damage and moisture during shipment, handling, and storage. All equipment shall be protected from exposure to corrosive fumes and shall be kept thoroughly dry at all times. Pumps, motors, drives, electrical equipment, and other equipment having anti-friction or sleeve bearings shall be stored in weathertight storage facilities prior to installation. For extended storage periods, plastic equipment wrappers should be avoided, to prevent accumulation of condensate in gears and bearings.

H. **Identification of Equipment Items:** Each item of equipment shipped shall have a legible identifying mark corresponding to the equipment number for the particular item.

I. **Vibration Level:** All equipment subject to vibration shall be provided with restrained spring-type vibration isolators or pads per manufacturer's written recommendations.

J. **Shop Fabrication:** Shop fabrication shall be performed in accordance with the Contract Documents and the ENGINEER-approved shop drawings.

K. **Controls:** All equipment and system controls shall be in accordance with Section 17100 - Process Control and Instrumentation Systems.

2.2 EQUIPMENT SUPPORTS AND FOUNDATIONS

A. **Equipment Supports:** All equipment supports, anchors, and restrainers shall be adequately designed for static, dynamic, wind, and seismic loads. The design horizontal seismic force shall be the greater of: that noted in the general structural notes or as required by the governing building code, or 10 percent of gravity. Submitted design calculations for equipment supports must bear the signature and seal of an engineer registered in the State wherein the project is to be built, unless otherwise indicated.

B. **Equipment Foundations:** Equipment foundations shall be as per manufacturer's written recommendations. All mechanical equipment, tanks, control cabinets, etc., shall be mounted on minimum 3.5-inch high concrete bases, as shown on standard structural details, unless otherwise indicated.

C. **Shop Drawings:** Shop Drawings shall be submitted for review in accordance with the requirements of Section 01300 - Contractor Submittals. Shop Drawings will be considered incomplete unless clear, concise calculations are presented showing equipment anchorage forces and the capacities of the anchorage elements proposed by the CONTRACTOR.

2.3 PIPE HANGERS, SUPPORTS, AND GUIDES

A. All pipe connections to equipment shall be supported, anchored, and guided to avoid stresses and loads on equipment flanges and equipment. Supports and hangers shall be in accordance with Section 15006 - Pipe Supports.

2.4 FLANGES AND PIPE THREADS

A. All flanges on equipment and appurtenances provided under this Section shall conform to ANSI B16.1, Class 125; or B16.5, Class 150, unless otherwise indicated. All pipe threads shall be in accordance with ANSI/ASME B1.20.1, and with Section 15000 - Piping, General.

2.5 COUPLINGS

A. Flexible couplings shall be provided between the driver and the driven equipment to accommodate slight angular misalignment, parallel misalignment, end float, and to cushion shock loads. Where required for vertical shafts, 3-piece spacer couplings or universal type couplings for extended shafts shall be installed.

B. The CONTRACTOR shall have the equipment manufacturer select or recommend the size and type of coupling required to suit each specific application.

C. Taper-lock bushings may be used to provide for easy installation and removal on shafts of various diameters.

D. Universal type couplings shall be of the needle bearing type construction, equipped with commercial type grease fittings.

2.6 SHAFTING

A. **General:** All shafting shall be continuous between bearings and shall be sized to transmit the power required. Keyways shall be accurately cut in line. Shafting shall not be turned down at the ends to accommodate bearings or sprockets whose bore is less than the diameter of the shaft. All shafts shall rotate in the end bearings and shall be turned and polished, straight, and true.

B. **Materials:** Shafting materials shall be appropriate for the type of service and torque transmitted. Environmental elements such as corrosive gases, moisture, and fluids shall be taken into consideration. Materials shall be as indicated unless furnished as part of an equipment assembly.

1. Low carbon cold-rolled steel shafting shall conform to ASTM A 108, Grade 1018.

2. Medium carbon cold-rolled shafting shall conform to ASTM A 108, Grade 1045.

3. Corrosion-resistant shafting shall be stainless steel or Monel, whichever is most suitable for the intended service.

C. **Differential Settlement:** Where differential settlement between the driver and the driven equipment may be expected, a shaft of sufficient length with 2 sets of universal type couplings shall be provided.

2.7 BEARINGS

A. **General:** Bearings shall conform to the standards of the Anti-Friction Bearing Manufacturers Association, Inc. (AFBMA).

B. To assure satisfactory bearing application, fitting practice, mounting, lubrication, sealing,

static rating, housing strength, and other important factors shall be considered in bearing selection.

C. All re-lubricatable type bearings shall be equipped with a hydraulic grease fitting in an accessible location and shall have sufficient grease capacity in the bearing chamber.

D. All lubricated-for-life bearings shall be factory-lubricated with the manufacturer's recommended grease to insure maximum bearing life and best performance.

E. **Bearing Life:** Except where otherwise indicated, all bearings shall have a minimum L-10 life expectancy of 5 years or 20,000 hours, whichever occurs first. Where so specified, bearings shall have a minimum rated L-10 life expectancy corresponding to the type of service, as follows:

Type of Service	Design Life (years)	L-10 Design Life (hours) (whichever comes first)
1. 8-hour shift	10	20,000
2. 16-hour shift	10	40,000
3. Continuous	10	60,000

F. Bearing housings shall be of cast iron or steel and bearing mounting arrangement shall be as indicated or as recommended in the published standards of the manufacturer. Split-type housings may be used to facilitate installation, inspection, and disassembly.

G. Sleeve-type bearings shall have a Babbitt or bronze liner.

2.8 GEARS AND GEAR DRIVES

A. Unless otherwise indicated, gears shall be of the helical or spiral-bevel type, designed and manufactured in accordance with AGMA Standards, with a minimum service factor of 1.7, a minimum L-10 bearing life of 60,000 hours, and a minimum efficiency of 94 percent. Worm gears shall not be used, unless specifically approved by the ENGINEER.

B. All gear speed reducers or increasers shall be of the enclosed type, oil- or grease-lubricated and fully sealed, with a breather to allow air to escape but keep dust and dirt out. The casing shall be of cast iron or heavy duty steel construction with lifting lugs and an inspection cover for each gear train. An oil level sight glass and an oil flow indicator shall be provided, arranged for easy reading.

C. Gears and gear drives as part of an equipment assembly shall be shipped fully assembled for field installation.

D. Material selections shall be left to the discretion of the manufacturer, provided the above AGMA values are met. Input and output shafts shall be adequately designed for the service and load requirements. Gears shall be computer-matched for minimum tolerance variation. The output shaft shall have 2 positive seals to prevent oil leakage.

E. Oil level and drain location relative to the mounting arrangement shall be easily accessible. Oil coolers or heat exchangers with all required appurtenances shall be furnished when necessary.

F. Where gear drive input or output shafts have to connect to couplings or sprockets supplied by others, the CONTRACTOR shall have the gear drive manufacturer supply matching key taped to the shaft for shipment.

2.9 DRIVE CHAINS

A. Power drive chains shall be commercial type roller chains and meet ANSI Standards.

B. A chain take-up or tightener shall be provided in every chain drive arrangement to provide easy adjustment.

C. A minimum of one connecting or coupler link shall be provided with each length of roller chain.

D. Chain and attachments shall be of the manufacturer's best standard material and suitable for the process fluid.

2.10 SPROCKETS

A. **General:** Sprockets shall be used in conjunction with all chain drives and chain-type material handling equipment.

B. **Materials:** Unless otherwise indicated, materials shall be as follows:

1. Sprockets with 25 teeth or less, normally used as a driver, shall be made of medium carbon steel in the 0.40 to 0.45 percent carbon range.

2. Type A and B sprockets with 26 teeth or more, normally used as driven sprockets, shall be made of minimum 0.20 percent carbon steel.

3. Large diameter sprockets with Type C hub shall be made of cast iron conforming to ASTM A 48, Class 30.

C. All sprockets shall be accurately machined to ANSI Standards. Sprockets shall have deep hardness penetration in tooth sections.

D. Finish bored sprockets shall be furnished complete with keyseat and set screws.

E. To facilitate installation and disassembly, sprockets shall be of the split type or shall be furnished with taper-lock bushings as required.

F. Idler sprockets shall be furnished with brass or Babbitt bushings, complete with oil hole and axial or circumferential grooving. Steel collars with set screws may be provided in both sides of the hub.

2.11 V-BELT DRIVES

A. V-belts and sheaves shall be of the best commercial grade and shall conform to ANSI, MPTA, and RMA Standards.

B. Unless otherwise indicated, sheaves shall be machined from the finest quality gray cast iron.

C. All sheaves shall be statically balanced. In some applications where vibration is a problem, sheaves shall be dynamically balanced. Sheaves operating at belt speeds exceeding 6,500 fpm may be required to be of special materials and construction.

D. To facilitate installation and disassembly, sheaves shall be furnished complete with taper-lock or QD bushings as required.

E. Finish bored sheaves shall be furnished complete with keyseat and set screws.

F. Sliding motor bases shall be provided to adjust the tension of V-belts.

2.12 DRIVE GUARDS

A. All power transmission, prime movers, machines, shaft extensions, and moving machine parts shall be guarded to conform with the OSHA Safety and Health Standards (29CFR1910). The guards shall be constructed of minimum 10 gage expanded, flattened steel with smooth edges and corners, galvanized after fabrication and securely fastened. Where required for lubrication or maintenance, guards shall have hinged and latched access doors.

2.13 FLEXIBLE CONNECTORS

A. **General:** Flexible connectors shall be installed in all piping connections to engines, blowers, compressors, and other vibrating equipment and in piping systems in accordance with the requirements of the Section 15000.

2.14 INSULATING CONNECTIONS

A. **General:** Insulating bushings, unions, couplings, or flanges, as appropriate, shall be used in accordance with the requirements of the Section 15000.

2.15 GASKETS AND PACKINGS

A. Gaskets shall be in accordance with the requirements of Section 15000.

B. Packing around valve stems and reciprocating shafts shall be of compressible material, compatible with the fluid being used. Chevron-type "V" packing shall be **Garlock No. 432 or John Crane "Everseal."**

C. Packing around rotating shafts (other than valve stems) shall be "O"-rings, stuffing boxes, or mechanical seals, as recommended by the manufacturer and approved by the ENGINEER, in accordance with Section 11100 - Pumps, General.

2.16 NAMEPLATES

A. Equipment nameplates of stainless steel shall be engraved or stamped and fastened to the equipment in an accessible location with No. 4 or larger oval head stainless steel screws or drive pins. Nameplates shall contain the manufacturer's name, model, serial number, size, characteristics, and appropriate data describing the machine performance ratings.

2.17 SAFETY REQUIREMENTS

A. Where work areas are located within a flammable or toxic gas environment, suitable gas detection, ventilating, and oxygen deficiency equipment shall be provided. Workers shall be equipped with OSHA approved breathing apparatus.

2.18 OVERLOAD PROTECTION

A. **General:** Unless otherwise indicated, equipment drives incorporating overload protection shall be provided with an overload protection device as shown on the Contract Documents.

B. Electronic System

1. The overload protection shall be an Electronic Torque Monitoring Control System capable of displaying torque, rpm's, and two levels of overload of the drive system. It shall incorporate a time-delay for start-up and a voltage monitoring and compensation circuit for up to ±15 percent variation.

2. The overload device shall have an enclosure suitable for outdoor installation at temperatures of 0-70 degrees C, and relative humidity up to 95 percent. The overload device shall be housed in an enclosure with NEMA rating in accordance with the area designations of Section 16050 - Electrical Work, General. A visual torque dial shall be oriented so that it can be easily read from the walkway.

3. The torque monitoring system shall be calibrated to: alarm and shut down the system in the event the torque drops to 50 percent of normal running; alarm at 85 percent of maximum continuous running torque; and shut down the motor at maximum continuous running torque of the equipment. The system shall be calibrated at the factory of the equipment manufacturer, and it shall be capable of monitoring twice the maximum continuous running torque of the equipment.

C. **Manufacturers:**

1. **American Autogard Corporation;**

2. **Ferguson Machine Company.**

PART 3 – EXECUTION

3.1 COUPLINGS

A. The CONTRACTOR shall have the equipment manufacturer select or recommend the size and type of coupling required to suit each specific application; installation shall be per equipment manufacturer's printed recommendations.

3.2 INSULATING CONNECTIONS

A. All insulating connections shall be installed in accordance with the manufacturer's printed instructions.

3.3 PIPE HANGERS, SUPPORTS, AND GUIDES

A. Hangers, supports, and guides shall be spaced in accordance with ANSI/ASME B.31.1 standard, and with tables in Section 15006.

3.4 PACKAGED EQUIPMENT

A. When any system is furnished as pre-packaged equipment, the CONTRACTOR shall coordinate all necessary space and structural requirements, clearances, utility connections, signals, and outputs with subcontractors to avoid later change orders.

B. If the packaged system has any additional features (as safety interlocks, etc.), other than required by the Contract Documents, the CONTRACTOR shall coordinate such features with the ENGINEER and furnish all material and labor necessary for a complete installation as required by the manufacturer, at no additional cost to the OWNER.

- END OF SECTION -

SECTION 11100 - PUMPS, GENERAL

PART 1 – GENERAL.

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide all pumps and pumping appurtenances, complete and operable, in accordance with the Contract Documents.

B. The provisions of this Section shall apply to all pumps and pumping equipment except where otherwise indicated in the Contract Documents.

C. **Unit Responsibility:** A single manufacturer shall be made responsible for furnishing the WORK and for coordination of design, assembly, testing, and installation of the WORK of each pump Section; however, the CONTRACTOR shall be responsible to the OWNER for compliance with the requirements of each pump Section. Unless otherwise indicated, the single Manufacturer shall be the Manufacturer of the pump.

D. **Single Manufacturer:** Where two or more pump systems of the same type or size are required, the pumps shall all be produced by the same Manufacturer.

1.2 CONTRACTOR SUBMITTALS

A. **General:** Submittals shall be furnished in accordance with Section 01300 - Contractor Submittals.

B. **Shop Drawings:** Shop Drawings shall contain the following information:

1. Pump name, identification number, and specification Section number.

2. Performance data curves showing head, capacity, horsepower demand, NPSH required, and pump efficiency over the entire operating range of the pump. The equipment Manufacturer shall indicate separately the head, capacity, horsepower demand, overall efficiency, and minimum submergence required at the design flow conditions and the maximum and minimum flow conditions. A family of performance curves at intervals of 100 rpm from minimum speed to maximum speed shall be provided for each centrifugal pump equipped with a variable speed drive.

3. The CONTRACTOR shall require the Manufacturer to indicate the limits on the performance curves recommended for stable operation without surge, cavitation, or excessive vibration. The stable operating range shall be as wide as possible based on actual hydraulic and mechanical tests.

4. Assembly and installation drawings including shaft size, seal, coupling, bearings, anchor bolt plan, part nomenclature, material list, outline dimensions, and shipping weights.

5. Data, in accordance with Section 16460 - Electric Motors, for the electric motor proposed for each pump.

6. Elevation of proposed Local Control Panel showing panel-mounted devices, details

of enclosure type, single line diagram of power distribution, and current draw of panel, and list of all terminals required to receive inputs or to transmit outputs from the Local Control Panel.

7. Wiring diagram of field connections with identification of terminations between Local Control Panels, junction terminal boxes, and equipment items.

8. Complete electrical schematic diagram.

C. **Owner's Manual:** The Owner's Manual shall contain the required information for each pump Section.

D. **Spare Parts List:** A Spare Parts List shall contain the required information for each pump Section.

E. **Factory Test Data:** Signed, dated, and certified factory test data for each pump system which requires factory testing, submitted before shipment of equipment.

F. **Certifications:**

1. Manufacturer's certification of proper installation.

2. CONTRACTOR'S certification of satisfactory field testing.

PART 2 – PRODUCTS

2.1 GENERAL

A. Compliance with the requirements of the individual pump Sections may necessitate modifications to the Manufacturer's standard equipment.

B. **Performance Curves:** All centrifugal pumps shall have a continuously rising curve. In no case shall the required horsepower at any point on the performance curve exceed the rated horsepower of the motor or engine, or encroach on the service factor.

C. All components of each pump system provided under the pump Sections shall be entirely compatible. Each unit of pumping equipment shall incorporate all basic mechanisms, couplings, electric motors or engine drives, variable speed controls, necessary mountings, and appurtenances.

2.2 MATERIALS

A. All materials shall be suitable for the intended application; materials not specified shall be high-grade, standard commercial quality, free from all defects and imperfection that might affect the serviceability of the product for the purpose for which it is intended, and shall conform to the following requirements:

1. Cast iron pump casings and bowls shall be of close-grained gray cast iron, conforming to ASTM A 48 - Gray Iron Castings, Class 30.

2. Bronze pump impellers shall conform to ASTM B 62 - Composition Bronze or Ounce Metal Castings, or B 584 - Copper Alloy Sand Castings for General Applications,

where dezincification does not exist.

3. Stainless steel pump shafts shall be Type 416 or 316. Miscellaneous stainless steel parts shall be of Type 316, except in a septic environment.

4. Anchor bolts, washers, and nuts in Standard Service (Non-Corrosive Application) shall be galvanized steel in accordance with the requirements of Section 05500 - Miscellaneous Metalwork. Anchor bolts, washers, and nuts in Corrosive Service as defined in Section 05500 shall be stainless steel in accordance with that Section.

2.3 PUMP COMPONENTS - GENERAL

A. **Flanges:** Suction and discharge flanges shall conform to ANSI/ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800 or B16.5 - Pipe Flanges and Flanged Fittings dimensions.

B. **Lubrication:** Vertical pump shafts of clean water pumps shall be product water-lubricated, unless otherwise indicated. Pumps for sewage, sludge, and other process fluids shall be lubricated as indicated.

C. **Handholes:** Handholes on pump casings shall be shaped to follow the contours of the casing to avoid any obstructions in the water passage.

D. **Vortex Suppressors:** Vertical pumps with marginal submergence shall be provided with vortex suppressors.

E. **Drains:** All gland seals, air valves, cooling water drains, and drains from variable speed drive equipment shall be piped to the nearest floor sink, or drain, with galvanized steel pipe or copper tube, properly supported with brackets.

F. **Grease Lubrication:** For all vertical propeller, mixed-flow, and turbine pumps of bowl sizes 10-inches and larger, the CONTRACTOR shall provide a stainless steel tube attached to the column for grease lubrication of the bottom bearing.

G. **Stuffing Boxes:** Where stuffing boxes are specified for the pump seal, they shall be of the best quality, using the Manufacturer's suggested materials best suited for the specific application. For sludge, drainage, and liquids containing sediments, the seals shall be fresh-water flushed, using lantern rings.

1. Unless otherwise indicated, the packing material shall be interlaced Teflon braiding, containing 50 percent ultrafine graphite impregnation to satisfy the following:

   a. Shaft speeds - up to 2500 fpm
   b. Temperature - up to 500 degrees F
   c. pH range - 0-14

2. If fresh water is not available, the seal shall be flushed with product water cleaned by a solids separator as manufactured by **John Crane Co. or Lakos (Claude Laval Corp.)**.

H. **Mechanical Seals:** Mechanical seals shall be fresh water-flushed unless indicated otherwise; in which case product water cleaned by a solids separator as above shall be used. Mechanical seals shall be as manufactured by the following:

1.	Sludge, or Wastewater Pumps	-	Double seals: **John Crane Type I Double; Borg-Warner Type L Double**
2.	Chemicals or Corrosive Liquid Pumps	-	Single seals: **John Crane Type 8-1, 9; Borg-Warner Type Q, QB**
3.	Water Pumps Hot and Cold	-	Single seals: **John Crane, Type I, 21; Borg-Warner Type L**

I. Where indicated, a buffer fluid must be circulated a minimum 20 psi above discharge pressure, or as required by the Manufacturer, in order to maintain reliable seal performance.

J. Mechanical seals for all services other than chemicals and corrosives shall be equipped with nonclogging, single coil springs and nonsliding, internal, secondary elastomers. Metal parts shall be Type 316 stainless steel, Alloy 20, or Hastelloy B or C.

2.4 PUMP APPURTENANCES

A. **Nameplates:** Each pump shall be equipped with a stainless steel nameplate indicating serial numbers, rated head and flow, impeller size, pump speed, and Manufacturer's name and model number.

B. **Solenoid Valves:** The pump Manufacturer shall provide solenoid valves on the water or oil lubrication lines and on all cooling water lines. Solenoid valve electrical ratings shall be compatible with the motor control voltage.

C. Gauges

1. Pumps shall be provided with pressure gauges as spelled out on the Contract Documents. Gages shall be located in a representative location, where not subject to shock or vibrations, in order to achieve true and accurate readings.

2. Where subject to shock or vibrations, the gages shall be wall-mounted or attached to galvanized channel floor stands and connected by means of flexible connectors.

3. Pressure and compound gages shall be provided in accordance with Section 17220 – Field Instruments.

2.5 FACTORY TESTING

A. The following tests shall be conducted on each indicated pump system:

1. **Pump Systems:** All centrifugal pump systems 10 hp and larger shall be tested at the pump factory in accordance with the American National Standard for Centrifugal Pump Tests (ANSI/HI 1.6) or the American National Standard for Vertical Pump Tests (ANSI/HI 2.6) as approved by ANSI and published by the Hydraulic Institute. Tests shall be performed using the complete pump system to be furnished, including the motor. For motors smaller than 100 hp, the Manufacturer's certified test motor shall be acceptable. Testing of prototype models will not be acceptable. The following minimum test data shall be submitted:

a. Hydrostatic test data

b. A minimum of five hydraulic test readings between shutoff head and 25 percent beyond the maximum indicated capacity, recorded on data sheets as defined by the Hydraulic Institute.

c. Pump curves showing head, flow, bhp, efficiency, and NPSH requirements.

d. Certification that the pump horsepower demand did not exceed the rated motor hp beyond the 1.0 service rating at any point on the curve.

2. **Acceptance:** In the event of failure of any pump to meet any of the requirements, the CONTRACTOR shall make all necessary modifications, repairs, or replacements to conform to the requirements of the Contract Documents and the pump shall be re-tested at no additional cost to the OWNER until found satisfactory.

PART 3 – EXECUTION

3.1 SERVICES OF MANUFACTURER

A. **Inspection, Startup, and Field Adjustment:** Where required by the individual pump Sections, an authorized service representative of the Manufacturer shall visit the site for the number of days indicated in those Sections to witness the following and to certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted, and readied for operation.

1. Installation of the equipment

2. Inspection, checking, and adjusting the equipment

3. Startup and field testing for proper operation

4. Performing field adjustments to ensure that the equipment installation and operation comply with requirements

B. **Instruction of the Owner's Personnel:**

1. Where required by the individual pump Sections, an authorized training representative of the Manufacturer shall visit the site for the number of days indicated in those Sections to instruct the OWNER'S personnel in the operation and maintenance of the equipment, including step-by-step troubleshooting with necessary test equipment. Instruction shall be specific to the models of equipment provided.

2. The representative shall have at least two year's experience in training. A resume for the representative shall be submitted.

3. Training shall be scheduled a minimum of three weeks in advance of the first session.

4. Proposed training material and a detailed outline of each lesson shall be submitted for review. Comments shall be incorporated into the material.

5. The training materials shall remain with the trainees.

6. The OWNER may videotape the training for later use with the OWNER'S personnel.

3.2 INSTALLATION

A. **General:** Pumping equipment shall be installed in accordance with the Manufacturer's written recommendations.

B. **Alignment:** All equipment shall be field tested to verify proper alignment, operation as specified, and freedom from binding, scraping, vibration, shaft runout, or other defects. Pump drive shafts shall be measured just prior to assembly to ensure correct alignment without forcing. Equipment shall be secure in position and neat in appearance.

C. **Lubricants:** The CONTRACTOR shall provide the necessary oil and grease for initial operation.

3.3 PROTECTIVE COATING

A. Materials and equipment shall be coated as required in Section 09800 - Protective Coating.

3.4 FIELD TESTS

A. Where required by the individual pump Sections, each pump system shall be field tested after installation to demonstrate satisfactory operation without excessive noise, vibration, cavitation, or overheating of bearings.

B. The following field testing shall be conducted:

1. Startup, check, and operate the pump system over its entire speed range. Vibration shall be within the amplitude limits recommended by the Hydraulic Institute Standards at a minimum of four pumping conditions defined by the ENGINEER.

2. Obtain concurrent readings of motor voltage, amperage, pump suction head, and pump discharge head for at least four pumping conditions at each pump rotational speed. Check each power lead to the motor for proper current balance.

3. Determine bearing temperatures by contact type thermometer. A run time of at least 20 minutes shall precede this test, unless insufficient liquid volume is available.

4. Electrical and instrumentation tests shall conform to the requirements of the Sections under which that equipment is specified.

C. Field testing will be witnessed by the ENGINEER. The CONTRACTOR shall furnish three days advance notice of field testing.

D. In the event any pumping system fails to meet the test requirements, it shall be modified and retested as above until it satisfies the requirements.

E. After each pumping system has satisfied the requirements, the CONTRACTOR shall certify in writing that it has been satisfactorily tested and that all final adjustments have

been made. Certification shall include the date of the field tests, a listing of all persons present during the tests, and the test data.

F. The CONTRACTOR shall bear all costs of field tests, including related services of the Manufacturer's representative, except for power and water which the OWNER will bear. If available, the OWNER'S operating personnel will provide assistance in field testing.

- END OF SECTION -

SECTION 11104 – LAGOON SUPERNATANT RETURN PUMPS

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall remove and retrofit two (2) existing 40 horsepower Worthington Vertical Turbine Pumps (Model 15H226-1) from existing Wash Water Waste Holding Tank No. 2 (WWWHT 2). The pumps shall be converted to open lineshaft with tailbushing and bowl. In addition, packing glands and discharge bowls shall be installed on each pump. The retrofitted pumps will be installed in the new Lagoon Supernatant Return Vault No. 2 with drives, controls, wiring, associated piping, and appurtenances, complete and operable, for service as lagoon supernatant return pumps, in accordance with the Contract Documents. In addition, the third existing 40 horsepower vertical turbine pump from WWWHT and two existing 50 horsepower vertical turbine pumps will be removed, salvaged and turned over to the OWNER.

B. This work shall be completed in accordance with Section 01313 – Sequence of Construction. The requirements of Section 02050 – Demolition and Salvage, Section 11100 – Pumps, General, also apply to this Section.

C. The MANUFACTURER shall examine the site conditions, intended application, and operation of the pump system and recommend the pump modifications which will best satisfy the indicated requirements.

PART 2 – PRODUCTS

2.1 GENERAL DESCRIPTION

A. **Identification:**

1.	Pump Name	-	Lagoon Supernatant Return Pump
2.	Equipment Numbers	-	LSR-P-00.01 & LSR-P-00.02
3.	Quantity	-	Two (2)
4.	Location	-	Lagoon Supernatant Return Vault No. 2

B. **Operating Conditions:** The WORK of this Section shall be suitable for long term operation under the following conditions:

1.	Duty	-	Continuous
2.	Drive	-	Constant speed
3.	Ambient environment	-	Outdoors
4.	Ambient temperature (deg. F),	-	15° to 90°

5. Fluid service - Lagoon Supernatant

6. Fluid viscosity (absolute) (centipoises at 60 deg. F) - 1.13

7. Project site elevation (m.s.l) - 855.00

8. Minimum available NPSH (ft) - 32

C. **Performance Requirements:**

1. Maximum shutoff head (ft) - 80

2. Design flow capacity (gpm) - 1040

3. Design flow pump head TDH (ft) - 62

4. Design flow minimum bowl efficiency (percent) - 54

D. **Existing Pump Dimensions:**

1. Length from base plate to suction bell (ft) - 16.50

2. Minimum column diameter (in) - 10

3. Minimum discharge diameter (in) - 10

4. Discharge flange rating ANSI (psi) - 125

5. Maximum bowl diameter (in) - 14

6. Inside diameter of barrel (in) - 10

2.2 PUMP REQUIREMENTS

A. **Pump Reconstruction:** Retrofitting of the existing vertical turbine pumps shall consist of modifying the following existing components, or as determined by the MANUFACTURER, to meet the performance requirements listed in Section 2.1.C, above:

1. Bowls - Cast-iron, vitreous-enameled 10 inches in diameter. The exterior surfaces of the bowl units shall be coated with 8 mils of epoxy in accordance with Section 09800 - Protective Coating

2.	Impeller	-	Bronze - statically and dynamically balanced
3.	Impeller shaft	-	Type 416 Stainless Steel
4.	Wear rings	-	Bronze, replaceable
5.	Bowl shaft	-	Stainless Steel, Type 416
6.	Suction bell	-	Cast iron bell
7.	Column	-	Steel pipe, not less than Schedule 30, epoxy-lined and coated, in maximum 10-ft lengths, flanged with registered fit and through bolting.

B. **Drive:**

1. Each pump shall be installed with its existing drive. Any required modification or adjustment to the drive shall be coordinated in the field by the MANUFACTURER.

2.3 PUMP CONTROLS

A. Pumps shall be controlled in accordance with Section 17300 – Control Descriptions. A factory pre-wired pump control shall be furnished in a NEMA 4 enclosure according to the Contract Drawings and Section 16485.

2.4 SPARE PARTS: Furnish the following spare parts for each pump:

A. One set of all bowl and discharge case bearings

B. One set of all wear rings

C. One set of all pump shaft bearings

D. One set of all pump shaft bearings

E. One mechanical seal

F. Two sets of all gaskets and o-rings

2.5 MANUFACTURER:

A. **Worthington (Ingersoll-Dresser Pump Company).**

PART 3 – EXECUTION

3.1 SERVICES OF MANUFACTURER

A. **Inspection, Retrofit, Startup, and Field Adjustment:** The service representative of the Manufacturer shall be present at the Site for four (4) work days, to furnish the services required by Section 11100.

B. **Instruction of OWNER'S Personnel:** The training representative of the Manufacturer shall be present at the Site for one (1) work day to furnish the services required by Section 11100.

C. For the purposes of this paragraph, a work day is defined as an eight hour period at the Site, excluding travel time.

D. The ENGINEER may require that the inspection, startup, and field adjustment services above be furnished in three separate trips.

- END OF SECTION -

SECTION 11106 - BOOSTER PUMPS

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide single stage end suction pumps, including horizontal electric motors, drives, controls, wiring, and associated piping, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 11100 - Pumps, General apply to this Section.

C. The Supplier shall examine the Site conditions, intended application, and operation of the pump system and recommend the pump which will best satisfy the indicated requirements.

PART 2 – PRODUCTS

2.1 GENERAL DESCRIPTION

A. **Identification:**

1.	Pump Name	-	Plant Water Booster Pump
2.	Equipment Number	-	PW-P-00.01, PW-P-00.02
3.	Quantity	-	2
4.	Location	-	Dewatering Building

B. **Operating Conditions:** The WORK of this Section shall be suitable for long term operation under the following conditions:

1.	Duty	-	Continuous
2.	Drive	-	Constant speed
3.	Ambient environment	-	Indoors
4.	Fluid service	-	Plant Water
5.	Fluid temperature, (degrees F)	-	Ambient
6.	Fluid specific gravity	-	1.00
7.	Minimum inlet pressure (psi)	-	50
8.	Required outlet pressure (psi)	-	140

C. **Performance Requirements:**

1.	Design flow capacity (gpm)	-	300
2.	Design flow pump head TDH (ft)	-	207
3.	Design flow minimum pump efficiency (percent)	-	75
4.	Maximum motor speed (rpm)	-	3600
5.	Minimum motor size (hp)	-	25

D. **Pump Dimensions:**

1.	Suction flange, min size (in)	-	2-1/2
2.	Discharge flange, min size (in)	-	3

2.2 PUMP REQUIREMENTS

A. **Construction:** Construction of end suction pumps shall conform to the following requirements:

1.	Casing (with drains and vents)	-	Close-grained cast iron, computer machined, tested to 150 percent of maximum head, with integral bearing supports
2.	Support	-	Heavy cast-iron or steel base, with integral drip rim or pan and drain
3.	Impeller	-	Enclosed single suction-type, hand finished, statically and dynamically balanced, and keyed to shaft
4.	Impeller and Casing Wear Rings	-	Bronze ASTM B 62 renewable
5.	Shaft	-	Type 316 stainless steel, machined and ground, designed for minimum deflection
6.	Shaft Sleeves	-	Bronze ASTM B 62
7.	Seals	-	Mechanical seals
8.	Bearings	-	Heavy-duty, grease-or oil-lubricated ball and double row thrust bearings. Minimum L-10 bearing life: 100,000 hours at any point within the operating range

9. Bearing Housing - Cylindrical or cartridge

10. Shaft coupling - Heavy-duty flexible coupling and galvanized steel or aluminum OSHA safety guard

B. **Drive:** Direct drive from horizontal, heavy-duty, high efficiency, ODP electric motor, suitable for 480-volt, 3-phase, 60-Hz power supply in accordance with Section 16460 - Electric Motors.

2.3 PUMP CONTROLS

A. Pump shall be controlled in accordance with Sections 17100 and 17300.

2.4 SPARE PARTS: The following spare parts shall be furnished for each pump:

A. One set of all bearings

B. Two shaft sleeves

C. One set of all wear rings

D. Two mechanical seals

E. Two sets of all gaskets and o-rings

2.5 MANUFACTURERS:

A. **Aurora Pumps, Series 340**

PART 3 -- EXECUTION

3.1 SERVICES OF MANUFACTURER

A. **Inspection, Startup, and Field Adjustment:** The service representative of the Manufacturer shall be present at the Site for 2 work days, to furnish the services required by Section 11100.

B. **Instruction of OWNER'S Personnel:** The training representative of the Manufacturer shall be present at the Site for 2 work days to furnish the services required by Section 11100.

C. For the purposes of this paragraph, a work day is defined as an eight hour period at the Site, excluding travel time.

- END OF SECTION -

SECTION 11136 - VERTICAL SOLIDS HANDLING PUMPS

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide wet pit vertical solids handling pumps and drives with associated piping, controls, wiring and appurtenant work, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 11100 - Pumps, General apply to this Section.

C. The Supplier shall examine the Site conditions, intended application, and operation of the pump system and recommend the pump which will best satisfy the indicated requirements.

PART 2 – PRODUCTS

2.1 GENERAL DESCRIPTION

A. **Identification:**

1.	Pump Name	-	Vertical Solids Handling Pump
2.	Equipment Number	-	SS-P-00.01, SS-P-00.02
3.	Quantity	-	2
4.	Location	-	Sludge Well (wet pit installation)

B. **Operating Conditions:** The WORK of this Section shall be suitable for long term operation under the following conditions:

1.	Duty	-	Intermittent
2.	Drive	-	Constant speed
3.	Ambient environment	-	Outdoors
4.	Fluid service	-	Sludge from the purification units with a 0.4% to 1.5% solids concentration.
5.	Project site elevation	-	898.00
6.	Maximum size of spheres to pass (in. dia)	-	3

C. **Performance Requirements:**

1.	Maximum shutoff head (ft)	-	54
2.	Design flow capacity (gpm)	-	720
3.	Design flow pump head TDH (ft)	-	30
4.	Design flow minimum pump efficiency (percent)	-	61
5.	Maximum flow capacity at maximum speed (gpm)	-	900
6.	Maximum flow pump head TDH (ft) plus and minus 5 feet	-	21
7.	Maximum pump speed (rpm)	-	1180 rpm
8.	Maximum motor speed (rpm)	-	1180 rpm
9.	Minimum motor size (hp)	-	10 hp

D. **Pump Dimensions:**

1.	Impeller diameter, min (in)	-	10.75
2.	Pump shaft diameter, min (in)	-	1.5
3.	Min size of discharge flange (in)	-	6
4.	Discharge flange rating ANSI (psi)	-	125

2.2 PUMP REQUIREMENTS

A. **Pump Construction:** Construction of vertical solids handling pumps shall conform to the following requirements:

1.	Casing and frame	-	Cast iron.
2.	Impeller	-	Cast iron. Statically balanced.
3.	Pump shaft	-	Type 410 stainless steel.
4.	Bearings	-	Bronze type sleeve
5.	Coupling	-	Lovejoy Type L

6.	Seal (for vapor)	-	Split stuffing box with lantern ring.
7.	Lubrication	-	Grease, with addition and relief fittings
8.	Pump base	-	Steel

B. **Drive:** Each pump shall be provided with a direct drive with vertical, heavy-duty, high efficiency electric motor suitable for 460-volt, 3-phase, 60-Hz power supply, in accordance with Section 16460 - Electric Motors. The motor shall be supported on the included support plate on the concrete slab covering the sludge well. The support plate will be mounted on support beams.

C. **Pump Mounting:** The pump motors shall be mounted as a duplex unit on a single cover plate. The cover plate shall be of heavy, cast iron, vapor-tight construction fit for mounting NEMA C-flange vertical motors. The cover plate shall be square measuring 66" x 66" with a thickness of 0.5". The plate shall have 4 bolt holes sufficient for tying down mounting plate to existing concrete.

2.3 PUMP CONTROLS

A. Pumps shall be controlled in accordance with Sections 17100/17300. A factory pre-wired control shall be furnished in a NEMA 4 enclosure according to the Contract Drawings and Section 16485.

2.4 SPARE PARTS: The following spare parts shall be furnished for each pump:

A. One set of all bearings

B. One set of packing rings

C. Two sets of all gaskets and O-rings

2.5 MANUFACTURERS:

A. **Crane - Deming**

PART 3 – EXECUTION

3.1 SERVICES OF MANUFACTURER

A. **Inspection, Startup, and Field Adjustment:** The service representative of the Manufacturer shall be present at the site for 1 day, to furnish the services required by Section 11100.

B. **Instruction of OWNER'S Personnel:** The training representative of the Manufacturer shall be present at the site for 1day to furnish the services required by Section 11100.

C. For the purposes of this paragraph, a workday is defined as an eight-hour period, excluding travel time.

- END OF SECTION -

SECTION 11144 - PROGRESSING CAVITY PUMPS

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide progressing cavity pumps and appurtenances, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 11100 - Pumps, General apply to this Section.

C. The Supplier shall examine the Site conditions, intended application, and operation of the pump system and recommend the pump which will best satisfy the indicated requirements.

PART 2 – PRODUCTS

2.1 GENERAL DESCRIPTION

A. **Identification:**

1.	Pump Name	-	Belt Filter Press Feed Pumps
2.	Equipment Number	-	TS-P-10.01, TS-P-20.01
3.	Quantity	-	2
4.	Location	-	Dewatering Building

B. **Operating Conditions:** The WORK of this Section shall be suitable for long term operation under the following conditions.

1.	Duty	-	Constant
2.	Drive	-	Variable speed
3.	Ambient environment	-	Indoors
4.	Fluid service	-	Thickened Solids (polyaluminum chloride sludge)
5.	Percent of Solids	-	0.5% to 10%
6.	Fluid ternperature (degree F)	-	Ambient
7.	Type of suction port	-	Flanged

C. **Performance Requirements:**

1.	Design flow capacity (gpm)	-	190
2.	Design flow pump head TDH (ft)	-	25
3.	Maximum pump speed (rpm)	-	215
4.	Minimum motor size (hp)	-	20
5.	Suction Lift (ft)	-	5

D. **Pump Dimensions:**

1.	Min size of suction flange (in)	-	10
2.	Min size of discharge flange (in)	-	10
3.	Suction flange rating ANSI (psi)	-	125
4.	Discharge flange rating, ANSI (psi)	-	125
5.	Maximum pump length, including space required for disassembly (ft)	-	12

2.2 PUMP REQUIREMENTS

A. **Construction:**

1.	Pump body (with inspection port and hand hole)	-	Cast iron, class 30 with flushing and drain connections in suction end
2.	Stator	-	Buna- N shore durometer hardness of 70
3.	Rotor	-	Chrome-plated (nominal thickness 0.010 inch) high-carbon tool steel with minimum plating Brinell hardness of 550 (0.010 inches oversize)
4.	Seal	-	6-ring stuffing box with split packing and lantern ring
5.	Shaft	-	Solid one-piece shaft through bearings and seal; same material as rotor

6.	Shaft Sleeve	-	Type 316 stainless seal
7.	Bearings	-	Ball and tapered roller bearings, minimum 60,000 hours L-10 life, grease-lubricated
8.	Joints	-	Grease-lubricated, crown gear-type universal joints of chrome alloy steel, completely sealed and grease-filled
9.	Connecting rod	-	Same material as rotor, designed to maintain maximum angularity of 1.5 degrees
10.	Water flush connection (for rotor and seal)	-	1/2-inch tapping in suction end and in stuffing box, or seal, with solenoid operated water connection.
11.	Pump base	-	Cast-iron or steel pan with drain, with factory-mounted pump and drive unit.
12.	Number of stages	-	one
13.	Antirotational device	-	Differential friction-type antireversal holdback or other acceptable device to prevent flow reversals

B. **Drive:** Variable speed drive in TEFC enclosure with heavy duty, energy efficient, inverter duty, electric motor, suitable for 480-volt, 3- phase, 60 Hz power supply, in accordance with Section 16460 - Electric Motors. Where speed reduction is indicated, gear motors or gear reducers shall be used in accordance with AGMA 6019 - E - Standard for Spur, Helical, Herringbone, and Straight or Spiral Bevel Enclosed Drives (Class II) or AGMA 6019 - E - Standard for Spur, Helical, Herringbone, and Bevel Enclosed Drives, with a service factor of 1.20.

2.3 PUMP CONTROLS

A. Pumps shall be controlled in accordance with Sections 17100/17300 – Instrumentation.

2.4 FLOW THROUGH RUPTURE DISK

A. Furnish and install flow through rupture disks in the sizes and locations as shown on the Contract Documents. Flow through rupture disks shall be designed for overpressure protection for systems handling high viscosity liquids. Flow through rupture disks shall be furnished complete with viscous rupture disk holder and rupture disk. Flow through rupture disks shall be cast iron, and shall be Viscous Tee Type Series as manufactured by **Fike or the Lo-To-Flow Safety head as manufactured by BS&B.**

2.5 SPARE PARTS: The following spare parts shall be furnished for each pump:

A. One stator

B. One rotor

C. One connecting rod

D. One set connecting rod joint assembly

E. One bearing assembly

F. Two sets of drive pins, washers, and screws

G. Two sets of packings or seals, gaskets, and o-rings

H. Ten Rupture Disks

2.6 MANUFACTURERS:

A. **Robbins and Myers, Moyno, 2000 Series, 1H175G1**

B. **Netzsch, Inc. (NEMO Pump Division)**

PART 3 – EXECUTION

3.1 SERVICES OF MANUFACTURER

A. **Inspection, Startup, and Field Adjustment:** The service representative of the Manufacturer shall be present at the Site for 3 work days, to furnish the services required by Section 11100.

B. **Instruction of OWNER'S Personnel:** The training representative of the Manufacturer shall be present at the Site for 2 work days to furnish the services required by Section 11100.

C. For the purposes of this paragraph, a work day is defined as an eight hour period at the Site, excluding travel time.

- END OF SECTION -

SECTION 11149 - SUBMERSIBLE SUMP PUMPS

PART 1 – GENERAL.

1.1 THE REQUIREMENT

A. The CONTRACTOR shall furnish and install: (1) one portable submersible sump pump for use in the chemical containment area; and (2) one fixed installation submersible sump pump for use in the new supernatant return vault No. 2. All sump pumps shall be furnished with enclosed, submersible electric motors and all appurtenant work, complete and operable, in accordance with the requirements of the Contract Documents.

B. The Supplier shall examine the site conditions, intended application, and operation of the pump systems and recommend the pumps which will satisfy the indicated requirements.

PART 2 – PRODUCTS

2.1 SUPERNATANT RETURN VAULT SUMP PUMP

A. **Identification:**

1.	Equipment Number	-	DRN-P-00.01
2.	Quantity	-	1
3.	Location	-	Supernatant Return Vault No. 2

B. **Operating Conditions:** The WORK of this Section shall be suitable for long term operation under the following conditions:

1.	Duty	-	Intermittent
2.	Drive	-	Constant speed
3.	Ambient environment	-	Indoors
4.	Fluid service	-	Lagoon Supernatant

C. **Performance Requirements:**

1.	Design flow capacity (gpm)	-	20
2.	Design flow pump head (TDH ft)	-	15
3.	Design flow minimum pump efficiency (percent)	-	60
4.	Maximum motor speed (rpm)	-	1800
5.	Minimum motor size (hp)	-	1/4

D. **Pump Dimensions:**

1.	Sump dimensions (in)	-	24 X 12
2.	Sump depth (in)	-	12
3.	Sump top	-	open
4.	Pump discharge size (inches)	-	1-1/4
5.	Discharge flange rating (psi)	-	150

E. **Construction:** Construction of supernatant return vault sump pumps shall conform to the following requirements:

1.	Pump Casing	-	Cast iron
2.	Impeller	-	Recessed cast iron
3.	Bearings	-	Permanantly lubricated ball and sleeve type
4.	Shaft	-	Stainless steel, series 400
5.	Seal	-	Mechanical seal
6.	Pump connection	-	Flange

F. **Drive:** Enclosed, submerged, electric 1800 rpm motor, suitable for 120-volt, single phase, 60-Hz ac power supply, with submersible cable, in accordance with Section 16460 - Electric Motors.

G. **Control:** The CONTRACTOR shall provide a complete control system housed in a weatherproof cabinet with hinged, gasketed door and mounting brackets or pedestal, complying with the area designation in Section 16050 - Electrical, General Provisions:

1. Plunger type non-mercury level control switches with sealed cables and stainless steel wall bracket.

2.2 PORTABLE CHEMICAL SUMP PUMP

A. **Identification:**

1.	Equipment Number	-	POL-P-00.01
2.	Quantity	-	1
3.	Location	-	Chemical Feed Room

B. **Operating Conditions:** The WORK of this Section shall be suitable for long term operation under the following conditions:

1.	Duty	-	Continuous
2.	Drive	-	Constant speed

3.	Ambient environment	-	Indoors
4.	Fluid service	-	Hydrofluosilicic Acid 25%
		-	Phosphoric Acid 75%
		-	Sodium Bisulfite 38%
		-	Chlorine room sump (janitorial grey water from equipment and room washdown)

C. **Performance Requirements:**

1.	Design flow capacity (gpm)	-	20
2.	Design flow pump head (TDH ft)	-	30
3.	Min. suction lift (ft)	-	6
4.	Max. specific gravity of liquids	-	1.6
5.	Minimum motor size (hp)	-	1/4

D. **Pump Dimensions:**

1.	Sump dimensions (in)	-	24 X 24
2.	Sump depth (in)	-	36
3.	Sump top	-	open
4.	Pump discharge size (in)	-	2" NPT
5.	NPT Pump suction size (in)	-	2" NPT
6.	Discharge flange rating (psi)	-	150

E. **Construction:** Construction of submersible sump pumps shall conform to the following requirements:

5.	Body	-	Non-metallic
6.	Manifolds/wetted parts & seat	-	Polypropylene
7.	Valve type and diaphragm	-	Teflon or Viton

F. **Drive:** Enclosed, submerged, electric 1800 rpm motor, suitable for 120-volt, single-phase, 60-Hz ac power supply, with submersible cable, in accordance with Section 16460 - Electric Motors.

G. **Control:** The CONTRACTOR shall provide a complete control system housed in a weatherproof cabinet with hinged, gasketed door and mounting brackets or pedestal, complying with the area designation in Section 16050 - Electrical, General Provisions:

1. Plunger type non-mercury level control switches with sealed cables and stainless steel wall bracket.

2.3 PROTECTIVE COATING

A. Pumps shall be coated in accordance with Section 09800, "Protective Coating."

2.4 MANUFACTURERS of Supernatant Return Vault Sump Pump

A. Aurora Pumps;

B. Flygt Corporation;

C. Goulds Pumps, Inc.

2.4 MANUFACTURERS of Portable Chemical Sump Pump

A. Ingersoll-Rand Pump Co.;

B. Vanton Pump & Equipment Co.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Pumping equipment shall be installed in accordance with approved procedures submitted with the shop drawings and as shown, unless otherwise approved.

B. General installation requirements shall be as specified for "Execution" in Section 11100 - Pumps, General.

- END OF SECTION -

SECTION 11205 - VERTICAL-SHAFT MIXERS

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide vertical-shaft flocculating assemblies and appurtenant equipment, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 11000 - Equipment General Provisions, apply to this Section.

1.2 CONTRACTOR SUBMITTALS

A. Submittals shall be in accordance with Section 01300 – Contractor Submittals.

B. **Calculations:** The CONTRACTOR shall submit the Manufacturer's calculations, certified by a professional engineer, for the gear rating and bearing life of the unit.

PART 2 – PRODUCTS

2.1 GENERAL

A. **Design:** All mixers shall be high efficiency, low shear, axial-flow type impeller units of the same design and manufacture. All parts shall be designed and proportioned for ample strength, stability, and stiffness for the intended purpose. Ample space and access shall be provided for inspection, repairs, lubrication, and adjustment. Each Mixer and drive assembly shall be designed for 24-hour-a-day continuous service and shall be built in accordance with the current AGMA Standards. The assemblies shall be suitable for out-of-doors service and shall be of weatherproof construction.

B. **Motors:** All motors shall be of the heavy-duty TEFC type, in accordance with Section 16460 - Electric Motors.

C. **Anchorage:** The CONTRACTOR shall provide equipment Manufacturer recommended stainless steel anchor bolts, nuts, and washers, but the Manufacturer shall furnish templates necessary for setting the equipment. Placement of the anchor bolts shall be performed by the CONTRACTOR from certified dimension prints supplied by the equipment Manufacturer. Anchor bolts shall be in accordance with Section 05500 - Miscellaneous Metalwork.

2.2 MIXERS

A. **General:** Each Mixer unit shall consist of an impeller mounted on a vertical shaft, suspended from a pedestal, and shall include a speed reducing drive unit with shaft bearings, coupling, electric motor, a mounting flange and a CONTRACTOR furnished cover plate, and a base. No underwater bearings will be permitted.

B. **Criteria:** The mixers shall meet the following design criteria:

1. Identification numbers - TS-MX-10.01 & TS-MX-20.01

2.	Total number of units	-	Two (2)
3.	Compartment dimensions for each mixer (ft x ft)	-	20 x 20
4.	Approximate water depth (ft)	-	16.00
5.	Top of slab to bottom of tank (ft)	-	18.50
6.	Minimum water temperature (deg. F)	-	35
7.	Ratio of impeller diameter to tank diameter (min.)	-	0.35
8.	Maximum impeller tip speed (fps)	-	8.0
9.	Direction of flow	-	Upflow
10.	Minimum motor horsepower per unit	-	3.0
11.	Maximum length of shaft sections (ft)	-	6.0
12.	Horsepower	-	3.0

C. **Drive:** Mixers shall be driven by a heavy-duty, high-efficiency TEFC constant speed electric motor, coupled to the gear reducer.

1. Each drive assembly shall be of ample capacity to supply the required power and torque output at all speed settings within the speed range. Motor and gear reducer shall be equipped with lifting lugs.

D. **Gear Reducer:** Each gear reducer shall be of the horizontal right-angle type, ruggedly encased in a cast iron or fabricated steel heavy duty housing designed for the conditions it will encounter. Gears shall be helical or spiral bevel type or a combination of both. Worm gear arrangements will not be acceptable. The reducer shall be designed and manufactured in accordance with the AGMA Standard and shall have a service factor of 1.5 based upon the full motor nameplate horsepower at maximum operating speed. Bearings shall be grease- or oil-lubricated with a minimum L-10 life of 100,000 hours, sufficiently sized to stabilize the impeller assembly under all operating conditions.

E. **Setting:** Each drive assembly shall be furnished with a CONTRACTOR supplied and Manufacturer approved steel base for mounting to the supporting structure, and with a cover plate to support the unit. The cover plate shall be drilled and cut to match the mixer base, and it shall have anchor bolts set into the concrete slab.

F. **Lubrication:** Lubrication of each speed reducer shall be by means of an efficient oil splash mechanism. The drive shall be provided with a dip stick to observe oil level. Each drive must have an effective drywell feature to eliminate oil leakage down the output shaft. Output shaft bearings may be grease lubricated, including a high quality lip seal to retain grease. All oil fill and drain lines and grease fittings shall be in easily accessible locations, at a minimum of 10 inches above the mixer mounting surface.

G. **Impeller and Shaft:** Mounted at the end of each mixer shaft shall be a stainless steel impeller bolted to a cast hub. All submerged nuts, bolts, and washers shall be Type 316

stainless steel. The hub shall be of sufficiently large diameter, and impellers shall be designed to assure maximum efficiency by preventing central backflow. The impeller assembly shall be securely keyed to the shaft. Shaft stresses shall be limited to 9,000 psi and impeller stresses to 12,000 psi. The shaft shall be sectioned with lengths being less than 6'-0" to allow for removal of shaft within the given head room.

H. **Impeller Adjustment:** The impeller shaft shall be of Type 316 stainless steel. The impeller shall be connected to the shaft with a hook key for security. An extended keyway shall be provided to allow for vertical adjustment of each impeller in 3-inch increments 12 inches from its recommended position. Each shaft shall have two impellers which shall be mounted inside of the tanks.

I. **Shaft & Coupling:** The lower mixer shaft shall be connected to the upper, or drive output shaft, by means of a rigid flanged coupling, of either the welded or interference fit hub type. Mating coupling faces shall have a rabbeted male and female pivoted connection for accurate concentricity, and shall not require match marks for alignment. The coupling shall be designed to minimize shaft run-out, and it shall be located near the tank deck level. To protect the gears form normal shock loads, the mixer drive shall incorporate an oversized solid output shaft. Diameter of the output shaft shall be greater than the extension shaft.

J. **Structural Strength and Stability:** Structural members and connections shall be designed to withstand, within normal working stresses and deflections, all loads imposed on them by rotation of the assembly at maximum design speeds submerged and dry, as well as loads which may be superimposed during or subsequent to erection while the basins are empty. The shaft shall be designed for a maximum stress not to exceed 11,000 psi while under maximum operating loads. The shaft shall be of the overhung design and the use of bottom steady bearings shall not be permitted. The shaft impeller design shall be such that the operating speed shall not exceed 70 percent of the first lateral critical speed. Lower shaft straightness, rigid coupling squareness, and output shaft accuracy shall give a maximum runout at the lower end of the shaft of 1/8-inch for every 10 feet of overhang, as measured when turning over by hand.

2.3 MANUFACTURERS:

A. **Chemineer, Inc.;**

B. **Lightnin.**

PART 3 – EXECUTION

3.1 INSTALLATION

A. General installation requirements shall be in accordance with Sections 11000.

B. Placement of the anchor bolts shall be determined by the CONTRACTOR from certified dimension prints supplied by the equipment Manufacturer.

- END OF SECTION -

SECTION 11230 – GRAVITY THICKENER

PART 1 — GENERAL

1.1 DESCRIPTION

A. **Scope:** The work included in this section of the specifications consists of furnishing two (2) new pier supported circular sludge collector (TS-SC-00.01 & 00.02) detailed to fit the two (2) existing Washwater holding tanks as shown on the plans. This equipment shall be constructed such that all rotating elements of the mechanism shall be supported above the water surface. Generally, the units furnished shall include a stationary center pier supporting a turntable drive and access bridge with a rotating drive cage supporting the flight arms. Included with the two plow sludge collectors will be the rotating sludge suction and holding tub and the mechanical sludge pumps with suction and discharge piping. Work within this section shall be completed in accordance with Section 01313 – Sequence of Construction.

B. **Related Work Specified Elsewhere:** Drawings and General Conditions of the Contract, including Supplemental General Conditions and applicable provisions of Divisions 1 Specification sections, apply to WORK of this Section.

The following sections also apply to work in this section:

Section 02050 – Demolition and Salvage
Section 02565 – Ductile Iron Pipe
Section 03310 – Cast-in-place Concrete
Section 05500 – Miscellaneous Metal Work
Section 05521 – Aluminum Railing
Section 09800 – Protective Coatings
Section 15006 – Pipe Supports
Section 15000 – Piping General
Section 15145 – Pipe and Equipment Insulation
Division 16 – Electrical
Division 17 – Instrumentation

C. **General Requirements:** The equipment furnished under this section shall be built by an established process equipment manufacturer with 25 years experience in clarifier/thickener design and experience in the manufacture of such equipment from 304 stainless steel and with at least 10 installations of such equipment. The clarifier equipment specified below shall be the Model SS-2.5 sludge collector as manufactured by *ENVIROQUIP, INC.* of Austin, Texas. All equipment furnished under this section shall be the product of one manufacturer.

D. **Detailed Requirements:** The sizes and capacities of the major items of equipment shall be as follows:

1. Gravity Thickener No. 1 Dimensions:

a.	Diameter:	70'-0"
b.	Side Wall Depth:	7'-6"

c.	Freeboard:	1'-0"
d.	Floor Slope:	4.7%
e.	Diameter of Center Pier:	24"

2. Gravity Thickener No. 2 Dimensions:

a.	Diameter:	70'-0"
b.	Side Wall Depth:	7'-6"
c.	Freeboard:	1'-0"
d.	Floor Slope:	15.6%
e.	Diameter of Center Pier:	24"

E. **Identification:**

1.	Equipment Name	- Gravity thickener rake arm mechanism
2.	Equipment Number	- TS-SC-00.01 & TS-SC-00.02
3.	Quantity	- 2
4.	Location	- Gravity Thickeners

F. **Operating Conditions:** The WORK of this section shall be suitable for long term operation under the following conditions:

1.	Duty	- Continuous
2.	Drive	- Constant
3.	Ambient environment	- Outdoors
4.	Sludge blanket thickness	- 4 feet
5.	Percent solids in blanket	- 0.5% to 10%
6.	Flow into Gravity Thickeners	- 720gpm to 1440gpm
7.	Maximum surface overflow rate	- 634 gpd/ft^2

All equipment included in this section shall be capable of starting from a completely stopped position in a 4 four deep blanket of sludge of a 10% solid composition with out any adverse effects upon the mechanism and without motor overload or operation in the service factor.

1.2 QUALITY ASSURANCE

A. **Standardization:** All mechanisms, support pier, access bridge, spur gear drive and sludge suction well are to be the product of one manufacturing organization.

B. **Coordination:** The contract documents provide details of a complete equipment installation for the purpose specified. It shall be the Contractor's responsibility to coordinate all the details required for a complete operating system such as protective coating and electrical requirements as well as provide all work needed to properly install, adjust, and place in operation a complete working system.

C. **Manufacturer's Quality Control:** All fabrication shall be carefully inspected at the site of fabrication by factory inspectors who shall use whatever means necessary to assure the proper fit of all field connections and compliance with all material and fabrication requirements of the specifications.

1.3 MANUFACTURER'S SERVICES

A. **Technical Representative:** The manufacturer shall furnish the services of trained technical representatives as needed to provide for a satisfactorily operating system. Services to be included are as follows:

1. Prior to equipment delivery, the manufacturer shall furnish jointly to the Engineer and Contractor a minimum of three sets of complete installation, operation and maintenance manuals which shall include erection drawings, as built drawings of electrical equipment, assembly details, parts lists, and detailed written instructions for the installation, operation and maintenance of the equipment furnished.

2. Deviations from the manufacturer's written or verbal instructions shall be subject to approval by the Engineer and discrepancies or unsatisfactory work shall be reported in writing by the equipment manufacturer's representative jointly to the Engineer and Contractor.

3. Not less than two trips of two days on the job for inspection of final leveling, alignment, tensioning and lubrication of the installed equipment and a detailed check of the completed work prior to start- up.

B. **Certification:** Within ten days after the final inspection of the completed installation, the manufacturer's representative shall furnish a detailed report jointly to the Engineer and Contractor which shall list any deficiencies found in the work and which shall recommend corrective action for each deficiency. Upon completion of any corrective action required, the manufacturer shall furnish a letter certifying that the equipment is now properly installed and ready for the operation and beneficial use by the Owner.

1.4 SUBMITTALS

A. **Shop Drawings:** All equipment and materials shall be new and shall be specially designed or selected for the function and service specified. No equipment or materials may be used in the project that has not been approved by the Engineer. Approval for incorporation into the project will be made only after the review of shop drawings, specifications and data as required below:

1. Shop drawings complete with all dimensions, anchor locations, openings required in structures, details of connecting piping and the size and location of any required electrical conduits and conduit openings.

2. Specifications for the main spur gear drive, the torque monitor, all mechanical and electrical components; and complete wiring diagrams for all electrical equipment.

3. Details of the major fabricated components showing the arrangement of devices and labeled with member sizes and materials of construction.

4. AGMA torque and strength calculations for the main spur gear drive.

5. Manufacturer's recommended procedures for jobsite storage of equipment, handling and erection.

6. Installation list as required by Section 1.1-C.

B. **Operation and Maintenance Manuals:** Prior to delivery of equipment and updated as required during installation of the equipment, the manufacturer shall furnish complete and detailed installation, operation and maintenance manuals which shall include the following information as a minimum requirement:

1. Name, address and phone number of nearest competent service organization who can supply parts and service. If this is not the manufacturer's own service department, then furnish letters confirming that the named organization has been factory authorized to represent the manufacturer of the equipment furnished.

2. Complete descriptive literature and drawings of all material furnished. This is to include "as built" wiring diagrams of all electrical equipment, "as built" erection drawings providing up-to-date information on the actual construction of the equipment furnished and any field modifications made during installation, start-up and testing.

3. Installation, operation and maintenance brochures from the original manufacturers of all mechanical components such as gear reducers, drive couplings, etc., incorporated into the completed installation.

4. Recommended spare parts list.

5. Guide to "trouble shooting".

6. All required assembly, installation, alignment, adjustment and checking instructions.

7. All required operating instructions.

8. All required maintenance instructions including schedules of routine maintenance and lubrication checks.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. **Preparation for Shipment:** All pieces shall be delivered in the largest pieces practical for field assembly by the Contractor. Individual pieces shall be permanently tagged with welded erection marks or stainless steel tags cross referenced with information on the Manufacturer's erection and assembly drawings. Gear boxes, mechanical and electrical components shall be protected from the weather and suitably packaged to facilitate handling and storage. Special lubricating and rust preventative oils shall be provided to prevent internal corrosion of gear assemblies. All mechanical equipment shall be kept thoroughly dry at all times and shall be stored indoors.

B. **Storage of Equipment:**

1. All equipment stored on the job shall be protected and maintained in accordance with the manufacturer's recommendations.

2. Electrical equipment must be stored in weatherproof, ventilated enclosures.

3. Structural materials may be stored outdoors on pallets or other wooden supports providing for the proper support and drainage. Equipment shall not be allowed to contact the ground directly.

PART 2 — PRODUCTS

2.1 GENERAL REQUIREMENTS

A. **Structural Design:** Design loading for the structural analysis of the drive cage, flight arms, and center pier shall be taken as all dead loading resulting from the weight of all rotating equipment, plus a live load equal to 2.25 times the continuous output torque rating of the spur gear drive. All rotating equipment shall be able to withstand the stress of the mechanism starting from a complete resting position ramping up to full operational speed in a 10% solids environment. The maximum allowable combined stress in any member at this loading shall not exceed 20,000 psi. Structural design of the mechanism and access bridge including allowable stresses and slenderness ratios where applicable shall be in accordance with the American Institute of Steel Construction Specification for Steel Buildings, latest edition.

A. **Stainless Steel Fabrication:**

1. All submerged components of the collector mechanism including the center pier, drive cage, collector arms, flights, squeegees, and supports shall be 304 stainless steel.

2. The minimum sized structural shape used for constructing any part of the drive cage, flight arms, or center pier shall be of adequate thickness and size to provide the resistance to any permanent damage from torque applied as previously outlined in section 2.1 paragraph A.. Engineering calculations shall be provided by the equipment manufacturer confirming the design. Top and bottom plates for the center pier shall be 3/4" thick with 3/16" gussets. Collector arm flights, squeegees, sludge wells, shall be provided from material thicknesses and shapes adequate to provide resistance to permanent damage or unusual deflections form forces applied from there intended use. Design and construction of clarifier components shall prevent any unusual warpage that is functionally and aesthetically unappealing during the fabrication process.

3. All welding shall conform to the latest AWS Standards and shall be performed by certified welders. All welds shall be a minimum of 3/16" fillets, and shall be the full length of all mating surfaces of structural torque transferring members. All welds shall be cleaned to remove weld slag, splatter, and B-B's with grinding, sanding, or polishing disks specifically designed for use with stainless steel to prevent carbon deposits to the surface of the stainless steel.

4. All field connections shall be bolted connections designed to resist all static, live and erection loads. Field welded assembly will not be allowed. All bolted structural connections shall be gusseted as required to prevent deflection with minimum 3/16" thick steel plate. Main structural connections shall use a minimum of 3/4" diameter bolts. Secondary structural connections shall use a minimum of two 5/8" diameter bolts.

B. **Hot Dip Galvanizing:** All fabricated steel components of the of the sludge collector

mechanism that are not submerged or in a splash area shall be hot dipped galvanized after fabrication in accordance with ASTM A-123.

1. All structural components shall be designed and fabricated per ASTM A-143, A-384, and A-385. No field welding on hot dipped galvanized equipment will be permitted.

2. Minor defects in the hot dipped galvanizing coating caused by shipping, handling or installation shall be repaired after equipment installation. The defects shall be thoroughly cleaned and wire brushed to remove all foreign substances, wiped clean with a suitable solvent, thoroughly dried, and coated with at least 3 mils of a zinc rich compound specifically formulated for touch-up of galvanizing and conforming to USN Specification MIL-P-21035 or USAF Specification MIL-P-26915A.

3. All fabricated members delivered to the project site shall be stored by the Contractor in a position where they are raised off of the ground and well separated to provide ventilation and drainage.

C. **Anchorage and Fasteners:**

1. All structural fasteners 3/8" and larger shall be type AISI 303-304 stainless steel.

2. All structural fasteners smaller than 3/8" shall be of AISI Type 303-304 stainless steel.

3. All cast-in-place equipment anchorage, including nuts and washers shall be of AISI Type 304 stainless steel. The minimum size of any cast-in-place anchor shall be 3/4" diameter.

4. All installed anchors shall be drop-in style (hole size equals bolt size), and shall conform to Federal Specifications GSA FF-S-325, Group II, Type 4, Class 1. Anchor bolts to be Type 303 -304 SS with clips, nuts and washers to be Type 304 stainless steel.

2.2 CONSTRUCTION AND MATERIALS

A. **Drive Mechanism:** The center drive assembly mounted to the center pier shall consist of a cast iron turntable base with ball race, and an internal forged steel spur gear designed such that the gear, bearing balls, and raceways can be removed for service or replaced without removing the access bridge, gear housing, or disconnecting the drive cage and anything attached thereto from the drive assembly. All repairs or replacement of drive components shall be performed without dewatering the collector basin or disrupting the flow through the basin. All work should be performed with the aid of only a portable hoist with no more than a one-ton capacity. This disassembly procedure shall be demonstrated to the Owner and Engineer during the operator training of the clarifier equipment through VHS video. The video will become the property of the owner. Replacement of the clarifier main internally cut spur gear and main bearing, including the labor and crane time, shall be the responsibility of the clarifier manufacturer for the first ten years of operation if the failure is due to poor quality materials, workmanship, or material fatigue under normal design operating and non contaminated conditions.

1. The main gear shall be an internal cut spur gear which shall be of AISI 1045 forged steel, hardened to 280 to 320 BHN, having a 99,000 psi yield strength. The main gear shall have teeth with a diametral pitch and length to produce up

to 43,000 ft.-lbs. continuous operating torque as calculated by AGMA 218.01. The gear shall have a minimum 35.0-inch pitch diameter. The gear teeth shall be stressed to no more than the allowable bending stress at the continuous rated output torque. Life factors should be based on 1 million load cycles. Minimum stalled torque rating will be 86,000 ft.-lbs.

2. The main bearing shall have a 40-inch ball race diameter and 1¼-inch diameter chrome alloy balls with nylon spacers. The bearing balls shall run completely submerged in an oil bath protected by dust seals and a condensate drain. The bearing balls shall be of Type 52100 steel hardened to 60/66 Rc. The bearing balls shall rotate in a full circle four-point contact raceway having a 60-degree contact angle for the transfer of large thrust and overturning moment loading. The raceway shall be induction hardened to 60 Rc for a depth of 3/16-inch and ground to shape. The main bearing shall provide 2-million life cycles or revolutions at design loads.

3. A separate circular cast iron load and torque transfer ring with heavy cast iron mounting pads for the drive cage shall be bolted to the inner rotating race of the gear-bearing. Each of the four mounting pads shall have provision for four fasteners.

4. The main gear housing shall be a heavy casting of high strength Class 40B gray iron. The housing shall be adequately proportioned and stiffened to support the entire rotating weight of the mechanism, the access bridge, and all possible dead and live loads anticipated for the life of the equipment. The housing shall be circular in shape to conform with the general geometry of the spur gear bearing and load plate, and shall provide a containment for the oil bath lubrication of the spur gear and bearing.

5. The main gear housing shall be fitted with oil fill ports and an oil level sight glass. Two drains shall be provided to assure the complete removal of spent oil and condensate from the housing. One drain shall be fitted with clear glass-like condensate reservoir/drain assembly. The center opening of the housing shall be fitted with a removable steel floor plate for access to the oil and condensate drain. The main housing shall also be fitted with a minimum of eight mounting/leveling bolts, 1-inch in diameter.

6. The spur gear shall be driven by an internal pinion. The pinion shall be machined from AISI Type 4140 alloy steel, quenched and tempered to 350 to 400 BHN hardness. The pinion shall be keyed to and driven by a low speed shaft mounted between bearing assemblies to offset the overhung load produced by gear meshing.

7. The intermediate gear reducer housing shall be constructed of SAE Class 30 gray cast iron. Gears shall be manufactured from case hardened steel and hardened to 58-62 Rockwell C. All gear teeth are shaved or ground to ensure accurate tooth profile. Minimum 95% gear efficiency shall be achieved regardless of ratio. The bearings shall be of ABEC-1 tolerance class. The shafting shall be of SAE 1045 steel or equivalent. The shaft seals shall be of Nitrile (Buna-N) rubber with double lip on the output seal. The reducer shall be rated for continuous duty at the mechanical capacity and shall not be thermally limited. The gearbox shall be designed with a high cross section modulus and a center wall for maximum rigidity.

The gear reducers shall be provided with stainless steel nameplates. The reducers shall be AGMA rated to provide a maximum Class 1 output torque required to achieve the required continuous operating torque. The reducer output shaft shall be direct coupled to the drive pinion with machined slip fit tolerances to effectively provide a continuous pinion shaft through the intermediate drive unit. The primary gear motor shall be constructed to the same specifications as the intermediate reducer with the exception of the integrally mounted motor and the hollow output shaft.

8. The motor shall be 3 phase TEFC, with NEMA B characteristics rated for continuous duty in accordance with Section 16460 – Electric Motors.

9. All torque overload protection shall be in accordance with Section 11000 – Equipment General Provisions.

10. The complete spur gear drive assembly shall rotate the rake arm at a tip speed of approximately 7 to 10 ft/min.

11. A size 1 motor starter with motor circuit protector, main disconnect switch, thermal overload protection, alarm and shut-down contacts and wiring, alarm light w/horn, on/off switch w/run light, and alarm reset button all mounted in NEMA 4X enclosure shall be provided. All components of the drive mechanism shall meet the requirements set forth by Section 16485.

B. **Center Pier:** The manufacturer shall provide a circular steel center pier. The top of the center pier shall provide a stable and accurate surface upon which the main gear may be mounted. The center pier shall support the main gear, both access bridges, and the entire weight of the rotating mechanism.

1. The center pier shall be sized as indicated in Section 1.1-D,2. and shall be constructed of stainless steel plate or steel pipe. The pier shall be provided with minimum 3/4" thick stainless steel plate top and bottom flanges. The top flange shall have mounting holes matching the main spur gear drive. The bottom flange shall provide for the center pier anchorage. The required anchorage shall be selected and provided by the equipment manufacturer; however, as a minimum, eight 1" diameter anchor bolts shall be provided.

C. **Drive Cage:** The center rotating drive cage shall be supported and driven from the turntable type main spur gear and shall be of heavy duty construction throughout. The lower portion of the drive cage shall provide attachment for the two flight arms and the upper end shall connect to the drive gear with four drive cage hangers. The drive cage shall be completely supported and stabilized by the main bearing. No below water supports, bearings or bumpers will be allowed.

D. **Flight Arms:** The sludge collector mechanism shall have two collector arms with angled flights and arranged to sweep settled sludge to the center of the basin.

1. The flight arms shall be cantilevered box trusses fabricated from stainless steel angles. The flight arms shall be rigidly connected to the central rotating drive cage and shall not require tie rods or secondary bracing for support. Flights shall be a minimum of 10" deep and shall be fabricated from 10ga thick stainless steel plate. Adjustable squeegees shall be provided of 16-gauge stainless steel and shall be attached with 1/2" diameter stainless steel bolts in slotted holes on a maximum of 18" centers. Steel washers shall be provided for both sides of the

connection. The flight arm truss shall be capable of withstanding the loads described in Section 2.1-A.

E. **Access Walkway:** A fixed access bridge, walkway and service platform shall be furnished to provide access to the center drive assembly. The bridge shall span one-half of the gravity thickener tank and shall be supported at the tank wall and the main spur gear.

1. The bridge shall consist of two structural steel wide flange beams interlaced with steel angles for rigidity. Structurally, the bridge shall be designed such that the maximum deflection shall be limited to 1/800 of the span, with all dead loads plus a live load of 50 lbs/ft^2 on the walkway. The manufacturer shall be responsible for sizing the bridge members to meet these requirements; except, that the members specified are the minimum acceptable.

2. Two slide plates shall be provided at the gravity thickener side wall to allow for thermal expansion. The slide plates shall be a minimum of 1/2" thick steel plate.

3. The bridge shall be provided with a minimum 36" wide walkway designed to allow for an uninterrupted passage along its entire length. The access walkway shall consist of hot dipped galvanized steel grating sections, 1-1/4" x 3/16" x 1" clear openings.

4. Aluminum handrails shall meet requirments of Section 05521 – Aluminum Railings.

5. A service platform shall be provided to allow easy maintenance of the spur gear drive. The platform shall be a minimum 60 square feet with aluminum handrails, galvanized checkered floor plate flooring and a ¼" thick by 4" high aluminum kickplate.

6. The CONTRACTOR shall attach the existing access bridge to the new center steel pier and have the connection verified by the ENGINEER.

F. **Sludge Suction and Holding Well:** A circular double wall sludge holding well with multiple suction tubes shall be provided to consolidate the sludge at the sludge suction point of the bridge mounted sludge pump.

1. The tub shall be circular with an inside and outside wall and bottom with pipe connections for the sludge suction tubes. Both the inside and outside walls will have trim angles to maintain the shape. The walls and bottom on the tub shall be a minimum 10ga. 304 stainless sheet. The tub will be supported by and rotate with the drive cage. The size and number of sludge draw-off tubes shall be capable of conveying sludge of up to 10% solids up to the holding well at a nominal rate of 375 gpm and a maximum rate of 420 gpm. The tub shall be sized by the manufacturer to maintain a proper liquid level to draw the sludge through the draw –off tubes at a nominal rate of 375 gpm and a maximum rate of 420 gpm and maintain an adequate pump suction head to prevent pump cavitation.

G. **Sludge Pump:** Each thickener mechanism shall be equipped with two (2) bridge mounted suction type sludge pumps to pump the sludge from the sludge suction/holding well. These two Crane-Deming vertical solids handling pumps are currently being used and shall be reused in the new operation. The pumps are 15 Hp capable of discharging 350 gpm at 30 feet of TDH, and will continue to do so in the new operation. Interconnecting piping, fittings,

gauges, and valves to control pump discharge and flow rate are to be removed and reused. The CONTRACTOR shall be responsible for the removal, modification, rehabilitation, and mounting of the existing pumps on to the clarifier drive access platform. Each pump shall be driven by and electric motor and each pump/motor unit shall be mounted on a common base provided by the clarifier manufacturer.

H. **Pump Controls:** A factory pre-wired pump control panel shall be furnished in a NEMA 4X enclosure. Pumps shall be controlled in accordance with Division 17 and meet all requirements set forth by Section 16485.

I. **Influent Flocculating Feed Well:** Thickener influent shall pass through an influent feed well sized to diffuse the flow into the thickener. The influent well shall be furnished in 14ga 304 stainless steel segments for field bolting together using minimum 3/8" diameter fasteners. These segments shall be in eight flanged flat sections four foot seven inches tall. There shall be top and bottom trim angles minimum 2-1/2" x 2-1/2" formed from 304 stainless steel plate with the vertical stiffener angle flanges to bolt the segments together forming a 18 foot diameter octagonal shape.

J. **Influent distribution piping**: Influent to the thickener shall be through a 10" feed pipe supported by the existing access bridge. This feed pipe shall turn down and tee into a 10" pipe size 13'-0" center line diameter octagonal shaped distribution header mounted inside the flocculating influent well with 24 - 4" diameter discharge orifices equally spaced. The top of the octagonal distribution header shall be mounted approximately one and one-half (1 ½) feet below the maximum water level. The 24 discharge orifices shall be located on the top of the distribution header distributing flow equally around the annulus between the Influent well and sludge collection tub.

PART 3 — EXECUTION

3.1 INSTALLATION

A. **Manufacturer's Service Representative:** The sludge collectors shall be furnished complete by the manufacturer and shall be assembled, erected and installed by the General Contractor as directed by the manufacturer in his working drawings and written instructions. The installation, alignment, testing and grouting shall be checked and approved by a factory representative before acceptance.

1. The Contractor shall include in his bid the services of a factory trained representative for a period of four days and two trips as described in Section 1.3-A. The manufacturer's representative shall inspect the completed installation, and assist the Contractor in aligning, start-up, and testing. The representative shall also instruct plant personnel in operation and maintenance of the equipment.

2. A written report shall be furnished by the equipment manufacturer and shall describe the representative's observations. This report shall describe in detail any deficiencies noted. All such deficiencies, whether by the manufacturer or Contractor, shall be corrected at no expense to the Owner.

3. Prior to final approval, the manufacturer shall submit a letter certifying that the installation meets all requirements of the manufacturer.

B. **Lubrication:** Lubricants of the type recommended by the equipment manufacturer shall be furnished by the clarifier manufacturer and applied by the Contractor. The Contractor

shall certify that the collector drive system has received the proper amount of recommended lubricant.

C. **Anchorage:** The equipment manufacturer shall furnish all required anchor bolts, leveling nuts, washers, and tie-down nuts and washers. The anchorage shall be placed by the Contractor in exact accordance with the manufacturer's certified dimension prints and as directed by the manufacturer. The Contractor shall furnish all templates needed to accurately set the anchor bolts to the dimensions and projections specified.

D. **Floor Grout:** The collector mechanism shall be detailed to allow clearance for a grout topping to be applied to the rough floor of the settling basins. All grout shall be in accordance with Contract Drawings and Section 03315 – Grout. The purpose of the topping is to provide a smooth uniform floor and a precision fit to the scraper blades. The grout topping shall be nominally 2" thick adjusted as required to fit the mechanism but in no case shall the topping be less than 1" thick. The collector arms and rotating mechanism shall be carefully leveled and adjusted in accordance with the manufacturer's written instructions and as directed in the field by the manufacturer's technical service personnel prior to placement of the floor grout.

- END OF SECTION -

SECTION 11258 - CHEMICAL FEEDING EQUIPMENT, GENERAL

PART 1 – GENERAL.

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide chemical feeding equipment shown and specified, complete with metering and transfer pumps, polymer blending units, feeders, tanks, motors, drives, mixers, meters, control panels, piping, valves, controls, and accessories to transfer, dilute, mix, and feed chemicals and solutions, complete and operable, in accordance with the Contract Documents.

B. All equipment shall be from manufacturers with several years of experience in the manufacture and assembly of similar products, with a record of successful installations. Such manufacturers shall maintain a well established, authorized, local service agency with sufficient spare parts and personnel to respond within 48 hours to any service calls.

C. The requirements of Section 11000 - Equipment General Provisions apply to the WORK of this Section.

1.2 CONTRACTOR SUBMITTALS

A. Submittals shall be furnished in accordance with Section 01300 - Contractor Submittals.

B. **Shop Drawings:** Complete fabrication, assembly, foundation, and installation drawings, together with detailed specifications and data covering materials used, wetted parts power drive assemblies, parts, devices, pumps, blending units, feeders, tanks, mixers, supports, panels, and other accessories forming a part of the equipment being furnished, as well as schematics, diagrams, and panel layouts, shall be submitted for review in accordance with Section 01300 - Submittals.

C. **Certification:** The CONTRACTOR shall obtain written certification from the manufacturer, addressed to the OWNER, stating that the equipment will efficiently and thoroughly perform the required functions in accordance with these Specifications and as indicated on the Drawings, that the materials are best suited for the chemicals handled, and that the manufacturer accepts joint responsibility with the CONTRACTOR for coordination of all equipment, including motors, variable speed drives, controls, and services required for proper installation and operation of the completely assembled and installed unit. The CONTRACTOR shall submit all such certificates to the ENGINEER.

D. **O & M Manuals:** Prior to start-up, the CONTRACTOR shall furnish to the OWNER, complete operations and maintenance manuals in accordance with Section 01300.

E. **Tools:** Special tools necessary for maintenance and repair of the equipment and one pressure grease gun for each type of grease required for the equipment shall be furnished as part of the WORK; such tools shall be suitably stored in metal tool boxes, and identified with the equipment number by means of stainless steel or solid plastic name tags attached to the box.

F. **Spare Parts:** The CONTRACTOR shall obtain from the manufacturer a list of suggested spare parts for each piece of equipment subject to wear, such as seals, packing, gaskets, nuts, bolts, washers, wear rings, etc., as well as a set of spare bearings. The

CONTRACTOR shall furnish all these parts suitably packaged and labeled in a box as described above for tools.

E. **Maintenance:** Printed instructions relating to proper maintenance, including lubrication, and parts lists indicating the various parts by name, number, and diagram where necessary, shall be furnished in duplicate with each unit or set of identical units. A recommended spare parts list shall be included.

F. **Field Procedures:** Instructions for field procedures for erection, adjustments, inspection, and testing shall be furnished prior to installation of the equipment.

G. **Calibration Graphs:** The manufacturer's representative shall prepare a calibration graph from field tests for each chemical feed unit which does not have a rate set device. Graphs shall read in pounds per hour for dry feeders or in gallons per hour for liquid feeders. The graph shall show the rate setter graduation conversion to pounds per hour or gallons per hour throughout the range of the feed unit. Each graph shall be furnished on hard paper and sealed in clear plastic.

1.3 MANUFACTURER'S SERVICE REPRESENTATIVE

A. **Erection and Startup Assistance:** Service and instruction assistance by the manufacturer's engineering representative for each equipment unit shall be provided by the CONTRACTOR as required.

B. **Instruction of OWNER's Personnel:** The CONTRACTOR shall provide for the services of a factory service representative to instruct the OWNER's personnel in the operation and maintenance of the equipment as required.

1.4 GUARANTEES, WARRANTIES

A. After completion, the CONTRACTOR shall furnish to the OWNER the manufacturer's written guarantees that the equipment will operate with the published efficiencies, heads, criteria, and flow ranges and meet these specifications. The CONTRACTOR shall also furnish the manufacturer's warranties as published in its literature and as specified.

PART 2 – PRODUCTS

2.1 GENERAL

A. Wherever it is specified that a single manufacturer shall be responsible for the compatible and successful operation of the various components of any equipment unit, it shall be understood to mean that the CONTRACTOR shall furnish and install only such equipment as the designated manufacturer will certify is suitable for use with its equipment and with the further understanding that this in no way constitutes a waiver of any specified requirements.

B. All manufactured items provided under this Section shall be new, of current manufacture, and shall be the products of reputable manufacturers specializing in the manufacture of such products.

C. Where 2 or more units of the same type or size of equipment are required, such units shall be produced by the same manufacturer.

2.2 MATERIALS

A. **General:** Materials employed in the equipment shall be suitable for the intended application; materials not specifically called for shall be high-grade, standard commercial quality, free from defects and imperfections that might affect the serviceability of the product for the purpose for which it is intended.

B. **Corrosion Resistance:** All materials used in the construction of chemical feeding equipment, shall be resistant to corrosive attacks from the chemicals. The following table lists the chemicals to be used under the Kentucky American Water Company Residuals Contract and some of the suitable materials for the construction of chemical feeding equipment. Unless the manufacturer proposes more suitable materials, the following table shall be adhered to. **THE FINAL RESPONSIBILITY FOR THE SELECTION OF EQUIPMENT WETTED PARTS SHALL BE THE MANUFACTURER OF THE CHEMICAL FEED EQUIPMENT.**

Chemical	Suitable Handling Material
Polymers: (Ionic) (Cationic) (Nonionic)	Type 316 stainless steel PVC FRP (suitable grade) Teflon Polypropylene

2.3 APPURTENANCES

A. **Nameplate:** Each piece of equipment shall be provided with a stainless steel nameplate, indicating equipment characteristics, capacity, motor horsepower, speed, electrical characteristics, manufacturer, model number, and serial number.

B. **Solenoid Valves:** The equipment manufacturer shall provide solenoid valves which are part of the chemical feeding unit. The solenoid valve electrical rating shall be compatible with the equipment voltage and valves shall be complete with the necessary conduit and wiring from the control panel to the solenoids. The valve material shall be suitable for the intended service in accordance with Section 15230 -Miscellaneous Valves.

C. **Pressure Gauges:** Where indicated, chemical transfer and metering pumps and other equipment shall be equipped with pressure gauges with diaphragm seals in accordance with Sections 17100/17220.

D. **Equipment Supports:** Chemical feeding equipment and piping shall be firmly supported on concrete equipment pads and anchored down. Fabricated metal supports exposed to chemical spills shall be of type 316 stainless steel or enameled steel. All anchor bolts, nuts, and washers of such supports shall be of Type 316 stainless steel, with an antiseize compound on the threads.

E. **Motors:** All motors shall be corrosion resistant and shall conform to the requirements of Section 16460. All motors shall be designed for aggressive chemical handling duty and corrosive atmosphere.

F. **Controls:** Controls shall be housed in enclosures with NEMA ratings which comply with the area designations of Section 16050 - Electrical Work, General.

G. **Safety Equipment:** Where required by Code, chemical unloading, storage, and feeding equipment shall be provided with the necessary safety devices and warning signs, clearly visible.

PART 3 – EXECUTION

3.1 INSTALLATION

A. **General:** Chemical feeding equipment shall be installed in accordance with governing safety standards and procedures submitted with the Shop Drawings, and as indicated on the drawings, unless otherwise approved by the engineer.

B. **Alignment:** Equipment shall be field tested to verify proper alignment, operation as specified, and freedom from binding, scraping, vibration, shaft runout, or other defects. Drive shafts shall be measured just prior to assembly to ensure correct alignment without forcing. Equipment shall be secure in position and neat in appearance.

C. **Lubricants:** The WORK shall include furnishing the necessary oil and grease for initial lubrication and testing of all equipment.

- END OF SECTION-

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide chemical transfer pumps and appurtenances, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 11000 - Equipment General Provisions, 111000 - Pumps and 11258 – Chemical Feeding Equipment, General apply to the WORK of this Section.

PART 2 – PRODUCTS

2.1 GENERAL

A. The pumps shall be of corrosion-resistant construction and diaphragm shall be a suitable material for the chemicals indicated at maximum temperature of 125 degrees F. Each pump shall be complete with pump base, drive, diaphragm, and motor. Size and characteristics of the pumps shall be as specified.

B. The pumps shall be suitable for the transfer of liquid polymer from the bulk storage tanks to the intended day tanks.

2.2 CONSTRUCTION

A. **Type and Range:** The pumps shall be centrifugal type with closed impeller and wetted parts suitable for transfer of specified chemical. The pumps shall have a constant speed to deliver the specified rate.

B. **Materials:** Wetted parts of transfer pumps shall be selected by the manufacturer to ensure optimum, corrosion-free, and erosion-free operation for the chemicals involved. Pumps for polymer service shall be suitable for feeding cationic, nonionic, or anionic polymer solutions having a maximum viscosity of 2500 centipoise.

2.3 CONTROL

A. The feed rate of each transfer pump shall be set at 50 gpm to fill the day tank in two minutes.

2.4 SCHEDULE OF TRANSFER PUMPS

I.D. No.	Chemical	Feed Rate (gpm)	Min Head (TDH)	Min Motor (hp)	Discharge Flange (in)	Suction Flange (in)	Type of Drive
GPOL-P-00.01, GPOL-P-00.02	Polymer	50	40	5	1.5	2	Electric
BPOL-P-00.01, BPOL-P-00.02	Polymer	50	40	5	1.5	2	Electric

2.5 PUMP ACCESSORIES

A. **Mounting and Connections:** Unless otherwise indicated, transfer pumps shall be mounted on concrete equipment pads of approximately 6-inches in height. Pipe connections to pumps must be firmly supported as approved by ENGINEER to avoid any stress on the pump or on the piping system.

2.6 SPARE PARTS

A. A complete set of extra diaphragms shall be furnished with each pump. Where applicable, one set of spare bearings shall be furnished with each piece of equipment.

2.7 MANUFACTURER

A. **Manufacturer's Experience:** The pumps shall be the product of a manufacturer who has designed and manufactured similar equipment and has a record of at least 5 years of successful operation of this type of process. The CONTRACTOR may be required to submit evidence to this effect together with a representative list of installations. The pump manufacturer shall maintain a permanent, local service department and a spare parts department.

B. **Manufacturers:**

1. **Sethco**

C. **Unit Responsibility:** The CONTRACTOR shall assign to a single manufacturer full responsibility for the furnishing and functional operation of the transfer pumps and motors.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Pumping equipment shall be installed in accordance with the Shop Drawings and as indicated.

B. General installation requirements shall be in accordance with Section 11100 - Pumps, General.

- END OF SECTION -

SECTION 11260 - POLYMER BLENDING SYSTEMS

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall furnish and install polymer blending systems, together with all drives, motors, valves, supports, controls, accessories, and appurtenances necessary for feeding polymer solutions, complete and operable, in accordance with the requirements of the Contract Documents.

B. The requirements of Section 11000 - Equipment General Provisions and Section 11258 – Chemical Feeding Equipment, General apply to the WORK of this Section.

C. The pump manufacturer shall consider each polymer blending system, including, as a minimum, the sizes and layouts of the suction and discharge piping, for proper selection of the blending systems including calibration chamber, pressure gauges, anti-siphon valves, and all other appurtenances so that a complete and operable system is achieved.

1.2 CONTRACTOR SUBMITTALS

A. The CONTRACTOR shall submit shop drawings in accordance with Section 01300 – Submittals, indicating detailed dimensioned plan and section layouts of polymer storage, small piping, pumps, gages, valves and pump accessories for each polymer blending system. Operation and maintenance instruction manuals shall be submitted in accordance with Section 01300 – Submittals.

PART 2 – PRODUCTS

2.1 GENERAL

A. **Activation Chamber:** Each polymer blending system shall be integrated equipment packages to automatically meter, dilute, mix, activate, and feed liquid/emulsion polymer solution. Concentrated polymer and water shall be blended in a non-mechanical blending chamber capable of diluting and activating liquid emulsion type polymer with viscosities up to 75,000 cps in the piping system indicated. The chamber's mixing energy shall be staged such that it provides for high, non-damaging mixing energy over the full operating range of the system. The blending chamber shall include an integral water control device constructed of stainless steel and brass which shall provide additional mixing energy. The polymer blending system shall be designed for use with potable or non-potable dilution water and the type of water used shall not effect the specified warranty of the equipment in any way. The blending chamber shall include a drain valve with a ½" fitting which shall be plumbed to the nearest sump. The blending chamber shall have a maximum rated pressure of 150 psi with no less than 50 psi over the calculated losses for each polymer blending system. All components for the polymer blending system must be readily accessible for periodic maintenance.

B. **Metering Pumps:** Each polymer blending system shall include an integral rigid stator progressive cavity type metering pump, capable of pumping liquid emulsion polymers in

the piping system indicated. At no time shall the polymer be exposed to a rotating centrifugal pump impeller or other excessive shear. The pump shall be constructed of stainless steel with viton elastomers with a minimum of four stages to minimize slip. Each pump shall meet the maximum output as specified below, with a 20:1 operating range. Each pump shall be mounted on the frame of the intended system by a stainless steel bracket with the pump suction positioned no more than 18" off of the base to maintain good suction conditions. The pump shall be driven by a totally enclosed motor, which shall be connected to a gear reducer. Pump speed shall not exceed 585 rpm and shall be controlled by an SCR motor controller mounted on the NEMA 4X control Panel.

C. **Dilution Water Inlet Manifold:** The dilution water inlet assembly shall include an inlet fitting as indicated in the Polymer Blending System Schedule, NEMA 4X dilution water solenoid valve, rotameter type flow meter with specified range, stainless steel dilution water inlet pressure gauge and stainless steel water control valve. The anticipated dilution water supply pressure and anticipated pressure loss down-stream of the polymer systems, including injection pressure into the process stream, are as specified below:

Service	Minimum Anticipated Supply Pressure (Inlet to polymer blending system)	Anticipated Downstream Backpressure
Wash Water Waste	70 psi	20 psi
Gravity Thickeners	88 psi	38 psi
Belt Presses	87 psi	37 psi

D. **Polymer Check Valve:** The polymer blending system shall include a neat polymer specifically designed to isolate polymer from dilution water. The valve body shall be constructed of Teflon with a stainless steel ball and PVC boot covering the spring. The valve shall be designed with an open path to the valve seat. It shall be readily accessible for cleaning and disassembly.

E. **Solution Discharge Assembly:** The solution discharge assembly shall include a discharge fitting as specified, an adjustible mixing chamber pressure relief valve plumbed to the chamber drain and a stainless steel liquid filled pressure gauge.

2.2 SCHEDULE OF POLYMER BLENDING SYSTEMS

ID No.	Service	Polymer Type	Feed Range (gph)	Dilution Water Range (gph)	Water Inlet (in)	Polymer Suction Size (in)	Solution Outlet Size (in)	Model
WPOL-PBS-00.01 WPOL-PBS-00.02	Wash Water Waste	Liquid Emulsion	0.125-2.5	60-600	1	1	1	Dynablend L4-600-2.5P STRANCO
GPOL-PBS-00.01 GPOL-PBS-00.02	Gravity Thickeners	Liquid Emulsion	0.125-2.5	30-300	1	1	1	Dynablend L4-300-2.5P STRANCO
BPOL-PBS-10.01 BPOL-PBS-20.01	Belt Filter Press (2)	Liquid Emulsion	0.125-2.5	60-600	1.5	1.5	1.5	Dynablend L4-600-2.5P STRANCO

2.3 CONSTRUCTION

A. **Components:** Each polymer blending system shall consist of a blending chamber, a calibration column, a metering pump, and a supporting skid and frame, a rotameter, solenoid valve, piping, controls, and necessary any other necessary accessories to provide a complete system resistant to the intended chemical. All motors and controls shall be interconnected to require a single 120-volt, 60-Hz or 120/240-volt, 60-Hz, single-phase connection to the system. Motors shall comply with Section 16460 - Electric Motors.

B. **Materials:** Each system frame shall be of rugged 304 stainless steel construction. The skid shall be constructed of 304 stainless steel as well as any piping supports and vertical frame members. The skid shall be designed for easy lifting and accessibility of all system components for maintenance. The skid shall have holes for mounting on a concrete equipment pad. Wetted parts of the equipment shall be made of materials suitable for service with polymers having a pH between 4 and 12.

2.4 CONTROLS

A. Each unit shall be equipped with all necessary controls, interwired, to provide the following minimum functions:

1. Water inlet solenoid valve controlled from control panel via on/off switch.
2. On/off switch to control power to blending system and metering pumps.
3. Terminal blocks sized for 14 gauge wire with terminal block numbers and legend.
4. Ten-turn potentiometer for manual pump output control.

5. LCD display and an external 4-20mA signal of pump output speed.

6. Any other controls shown on electrical and instrumentation drawings.

7. Automatic feed control paced from an external 4-20 mA signal.

8. Local/remote switch to allow blending system to be controlled locally via potentiometer or remotely via an external 4-20 mA signal.

9. A metering pump on/off status contact, start command, input contact, and local/remote status contact.

10. A pressure switch sensing dilution water pressure loss and shutting pump down with an alarming light.

11. Drive fault alarm light.

12. External system fault contact for low seal water pressure and drive fault.

13. All controls shall meet the requirements of Section 16485.

2.5 POWER SUPPLY

A. Each system shall have a 120-volt, or 120/240-volt, 60-Hz, single-phase supply with a power input of maximum 10 amps, and thermal overload protection with manual reset.

2.6 SYSTEM ACCESSORIES

A. Unless otherwise indicated or specified, pumps shall be equipped with the following accessories:

1. Solenoid valve for on/off control of dilution water supply.

2. Rotameter flow indicator

3. Rate adjusting valve.

B. **Mounting and Connections:** Each polymer blending system skid shall be mounted on concrete equipment pads of approximately 6 inches in height. Pipe connections must be firmly supported to avoid any stress on the pump or on the piping system.

2.7 SPARE PARTS

A. Each polymer blending system shall be furnished with a complete set of seals, packing, gaskets, O-rings, and any other parts subject to wear. Where applicable, one set of spare bearings shall be furnished with each pump.

2.8 MANUFACTURERS:

A. **Dynablend, Model L4-300-2.5P, L4-600-2.5P**

B. **STRANCO.**

PART 3 – EXECUTION

3.1 INSTALLATION

A. The polymer blending systems shall be installed in accordance with the Shop Drawings and as indicated.

B. General installation requirements shall be in accordance with Section 11000 - Equipment, General.

- END OF SECTION -

SECTION 11500 – COMPRESSORS, GENERAL

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide compressors, and appurtenances, complete and operable, in accordance with the Contract Documents.

B. The provisions of this Section shall apply to all compressors, except where otherwise indicated.

C. The requirements of 11000 - Equipment General Provisions, Section 01300 - Contractor Submittals, and Section 16460 - Electric Motors apply to the WORK of this Section.

D. The CONTRACTOR shall assign to a single manufacturer full responsibility for the furnishing and functional operation of the compressor units, including drives, drive motors, speed control equipment (where variable speed drives are required), and accessories. The designated single Manufacturer, however, need not manufacture more than one part of the unit, but shall coordinate the design, assembly, testing, and erection of the units.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **Commercial Standards:**

ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800
ANSI B16.5	Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and other Special Alloys
ANSI/ASME PTC 9	Performance Test Code - Displacement Compressors, Vacuum Pumps and Blowers
ANSI/ASME PTC 10	Performance Test Code - Compressors and Exhausters
ANSI/ASME B31.1	Power Piping
ANSI/IEEE 112	Test Procedure for Polyphase Induction Motors and Generators
ASTM A 48	Gray Iron Castings.

1.3 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01300 - Contractor Submittals.

B. **Shop Drawings:** Shop Drawings shall contain the following information:

1. Equipment name, identification number and specification number.

2. Equipment detailed description and specification.

3. Electrical data including control and wiring diagrams.

4. Assembly and installation drawings including shaft size, seal, coupling, anchor bolt plan, part nomenclature, material list, outline dimensions and shipping weights.

5. Equipment drive and motor in accordance with Section 16460 - Electric Motors.

C. **Certification:** The CONTRACTOR shall obtain written certification from the designated single manufacturer, addressed to the OWNER, stating that the equipment will efficiently and thoroughly perform the required functions and that the designated single manufacturer accepts the CONTRACTOR'S assignment of full responsibility for coordination of all equipment, including motors, variable speed drives, controls, and services required for proper installation and operation of the completely assembled and installed unit(s). The CONTRACTOR shall submit all such certificates to the ENGINEER.

D. **O & M Manuals:** Prior to start-up, furnish complete operations and maintenance manuals in accordance with Section 01300. Printed instructions relating to proper maintenance, including lubrication, and parts lists indicating the various parts by name, number, and diagram where necessary, shall be furnished in duplicate with each unit or set of identical units in each station. A recommended spare parts list shall be included. Instructions for field procedures for erection, adjustments, inspection, and testing shall be provided prior to installation of each piece of equipment.

1.4 QUALITY ASSURANCE

A. **Equipment Testing:** The CONTRACTOR shall be responsible for the coordination of the following tests of each compressor, drive, and motor:

1. General: Tests shall be performed in accordance with the ANSI/ASME PTC 9 and 10 Performance Test Codes. Tests shall be performed on the actual assembled unit from surge condition to 25 percent above the required design capacity. Prototype model tests will not be acceptable.

2. Field Tests: Units shall be field tested after installation, in accordance with the Contract Documents, to demonstrate satisfactory operation, without causing excessive noise, vibration, and overheating of the bearings. The field testing shall be performed by the CONTRACTOR in the presence of a factory-trained, experienced field representative of the manufacturer, who shall supervise the following tasks and shall certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted, and readied for operation:

   a. Start-up, check, and operate the equipment over required operation range. The vibration shall be within acceptable limits.

   b. Equipment performance shall be documented by obtaining concurrent readings, showing motor voltage, amperage, and discharge head. Each power lead to the motor shall be checked for proper current balance.

   c. A contact-type thermometer shall determine bearing temperatures. A running time of at least 20 minutes shall be maintained for this test.

   d. Electrical and instrumentation testing shall conform to other applicable Sections of the Specifications.