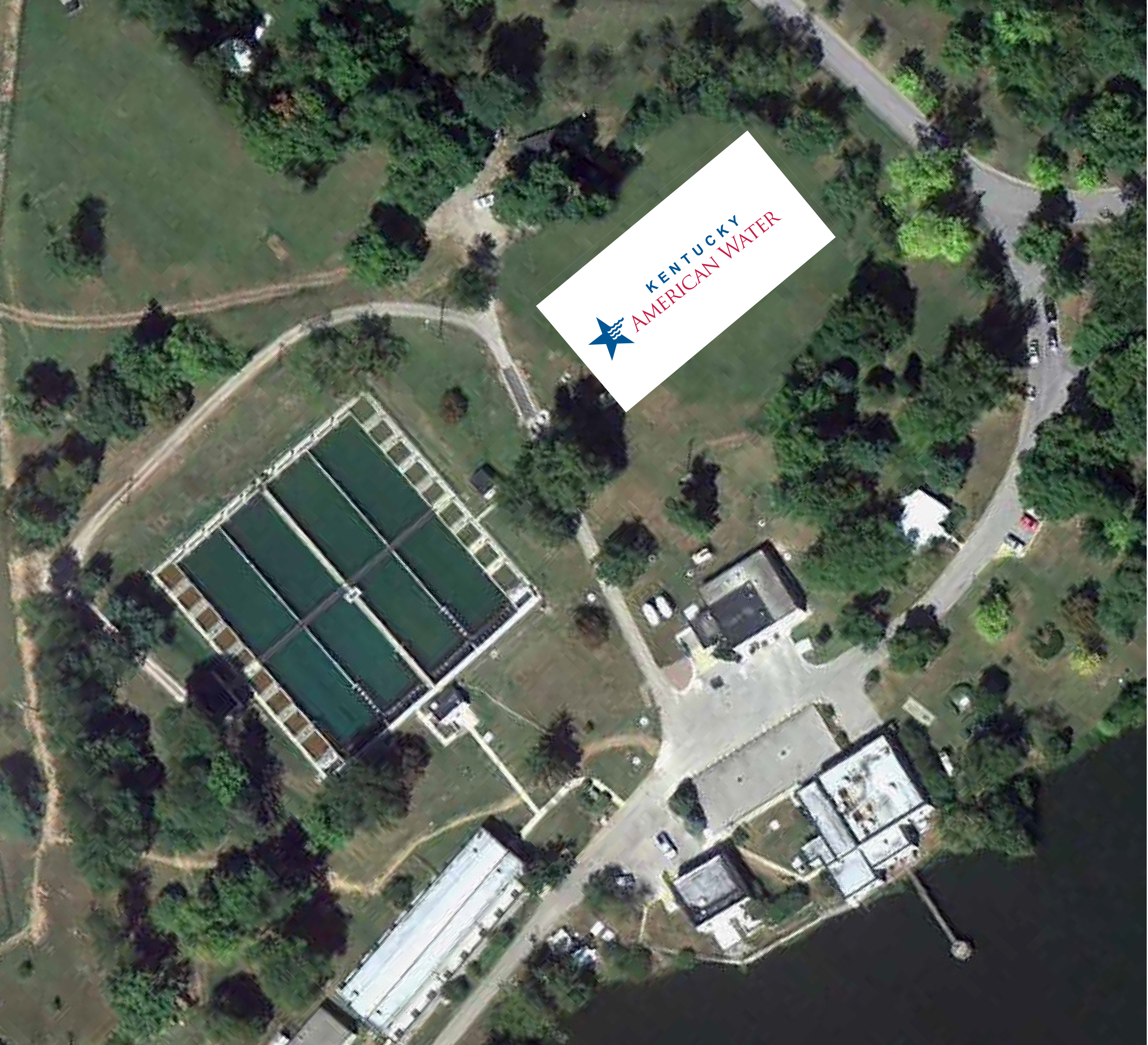

Basis of Design Memo - Final

New Filter Building Design
Richmond Road Station Water Treatment Plant

Kentucky American Water

HAZEN AND SAWYER
Environmental Engineers & Scientists

SECTION 1
PROJECT SCHEDULE

1.1 Project Background

The original four filters and finished water clearwell under the filters was constructed in 1924, with expansions to the filters and clearwell in 1937-38. The filter complex was again expanded in 1953 without further expansion of the clearwell, bringing the total number of filters to 16.

With careful operational controls in both the pre-treatment and filtration processes, the filters produce acceptable water quality satisfying the requirements of the Safe Drinking Water Act and water quality goals established by Kentucky American Water. However, the filter building structure and supporting systems within the filter complex are deteriorated and difficult to maintain due to several factors including:

- Age,
- Configuration of the facility and piping, and space limitations, and
- Operating environment and corrosive atmosphere.

In 2013 Kentucky American Water engaged a consultant, HDR, to perform a condition assessment of the filtration facilities and clearwell beneath to evaluate options for rehabilitation or replacement. The primary areas of considerations for their assessment of the filter facility were: 1) water quality, 2) general maintenance, 3) electrical, and 4) structural. In short, the consultant’s recommendation was replacement of the filter complex as a result of contributing factors in all four of the primary areas of assessment. Due to space limitations in the existing structure and the configuration of the existing facility, the report concludes that rehabilitating process piping, electrical and structural aspects of the facility would be difficult, if not impossible, while the facility remained in service.

As for the assessment of the clearwell beneath the filters, the consultant’s report concludes that the structural elements of the clearwell are serviceable. However, the report raised concerns about the clearwell’s stability once the filter building were removed from on top. Additionally, the assessment indicates that the clearwell must remain full of water at all times as hydrostatic load imbalances from groundwater could disrupt the base slab and other structural elements. Considering these stated concerns, it would again be difficult, if not impossible, to effect meaningful repairs and alterations to this clearwell (such as baffling) to provide additional contact time. In summary, the consultant’s report recommended a new filtration complex, citing that the existing facilities are no longer serviceable. Additionally, while the report indicates that the existing clearwell under the filter complex would be serviceable, it was not practical to proceed with modifications given the structural limitations.

1.2 Project Schedule

The design of the Richmond Road Station Water Treatment Plant (RRS WTP) started with the notice of award in January 2014 and extends to July 2014.

There are several key milestones that must be accomplished to meet the completion date of this important project. Hazen and Sawyer prepared a preliminary Basis of Design Memorandum for review by Kentucky American Water (KAW). A meeting was held March 27, 2014 to review the memo and confirm design criteria.

H&S incorporated the design review comments into the drawings and preliminary drawings and submitted a 30% drawing set on April 18, 2014. The 30% design meeting was held on April 22, 2014, which discussed the process design and site/civil coordination. After the 30% meeting, drawings and specifications were updated and submitted to Kentucky Department of Water (KDOW) on May 9, 2014.

A 60% Design Review Package will be submitted to KAW on June 2, 2014. During this time KAW solicited bids to award the contract for Construction Manager at Risk. Hazen and Sawyer will work closely with the Contractor for the remainder of the project design. At the 60% design level, documents will be submitted to Lexington-Fayette Urban County Government for permitting. After KDOW permit approval is received, KAW will submit 60% design documents and the target cost to the Public Service Commission (PSC) in late June or early July of 2014.

The 90% design documents will be prepared and provided to KAW for review the end of July 2014. The Final Design Documents will be provided to KAW the end of August 2014.

As specified in the RFP, the Notice of Award to the contractor is anticipated in January 2015. Based on our initial estimates, the construction period should be approximately 340 days. Construction is scheduled to be complete by April 2016.

2.1 Kentucky Division of Water (KDOW)

2.1.1 Water Supply Construction Permit

Under Title 401, Chapter 8 of the Kentucky Administrative Code, the Kentucky Department for Environmental Protection, Division of Water (KDOW) will issue a "construction" permit for the construction of the new facilities. The permit application, Form DW-2, has multiple sections for the following:

- I – Project Information
- II – Utility Information
- III – Design Considerations, and
- IV – Fees.

This application, along with plans, specifications and other supporting documents and design calculations, will be submitted. Under 401 KAR 8:101, the Department shall have up to 45 days from receipt of a complete submittal package to issue a preliminary or final approval. It is anticipated that the application for construction permit will include, but not be limited to, the following components:

- New filter complex,
- New CT contact basin,
- New backwash tank, and
- Relocation of chemical application points

The 30% Design Documents and the Basis of Design Memorandum were submitted to KDOW in May to begin the review process prior to the PSC submittal.

2.1.2 Floodplain Management Permit

It is not anticipated that new construction will take place in the 100-year flood plain. Therefore, a permit for work in the floodplain will not be required.

2.1.3 Sanitary Sewer Construction Permit

An extension of sanitary sewer service is not included in the project; no permit required.

2.2 Lexington-Fayette Urban County Government Permitting

2.2.1 Site Plan Approval

Based on meetings with LFUCG's Division of Planning and Development, no pre-site plan approval is required.

2.2.2 Building Permit

Required by the LFUCG Division of Building Inspections. 90% architectural, structural, electrical, HVAC plans will be submitted to the Technical Committee. LFUCG currently applies the following codes for these reviews:

- International Mechanical Code 2012
- Kentucky Plumbing Code 2013
- Kentucky Building Code 2013 (2012 IBC with 2013 Kentucky Amendments)
- NEC 2011 Code (AKA NFPA 70)
- National Fuel Gas Code 2009 (AKA NFPA 54)
- International Energy Conservation Code 2009

Two sets of plans shall also be submitted to the Office of the Fire Marshall for fire alarm and sprinkler systems, as applicable to the project. Building Permit issued as part of the development plan approval, in the same 60-day timeframe.

2.2.3 Final Development Plan Approval

A Final Development Plan is required when more than one principal structure is proposed on a lot or a parcel of land. Based on discussions with LFUCG Planning staff, an approved Final Development Plan will be required for this project.

2.2.3 Land Disturbance Permit

A land disturbance permit will be required by LFUCG's Division of Engineering prior to the start of grading. The requirements for this permit include a Grading & Drainage Plan, Erosion Control Plan, and Storm Water Pollution Prevention Plan (SWPPP). This permit will be acquired by the Contractor prior to construction, using the Notice of Intent (NOI; KDOW) and plans prepared by the design team.

2.2.4 Demolition/Wrecking Permit

Before any building is demolished either in part or in whole, the applicant is required by law to obtain a wrecking permit from the Division of Building Inspection. A wrecking permit is non-transferable and can only be issued to a wrecking contractor or the property owner upon proof of proper liability insurance. Should the property be deemed to have historic significance, the Division of Historic Preservation may impose a delay of up to 30 days so the documentation of the property can be completed before wrecking is commenced. In addition to the demolition permit, an accompanying grading permit of the demolished area must also be obtained.

2.5 Permit Schedule

Table 2.1 is a tentative schedule for the application and issuance of permits. This table will be further refined as the project moves forward.

TABLE 2.1 PERMIT SCHEDULE		
Permit	**Apply**	**Receive**
KDOW		
Water Supply Construction	May 2014	June 2014
LFUCG		
Building Permits	August 2014	September 2014
Final Development Plan Approval	December 2014	January 2014
Land Disturbance Permit	December 2014	January 2015
Demolition Permit	December 2014	January 2015

3.1 Overview

The Richmond Road Station Water Treatment Plant (RRS WTP) is rated at 25 million gallons per day (MGD) with conventional treatment processes. RRS WTP has the ability to draw from two existing raw water sources, Jacobson Reservoir and the Kentucky River. The raw water source is selected based on supply, water quality and power consumption consideration. Raw water enters the WTP and goes through coagulation, flocculation and sedimentation in the four sedimentation basins west of the existing filter building. The basins handle 100% of the flow through the WTP. The settled water flows by gravity to the existing filter building, housing 16 filters. Each filter has a rated capacity of 1.56 mgd and consist of a gravel layer, 6-inches of sand with a 24-inch granular activated carbon (GAC) cap. Fluoride and chlorine are dosed in the filter effluent line before entering a 600,000 gallon clearwell underneath the building. Water flows by gravity to a second hydraulically connected clearwell (454,000 gallons), which provides additional storage for distribution system management and to achieve CT. Six (6) finished water, horizontal split case pumps, deliver the finished water into the distribution system. These pumps are installed in the Operations building adjacent to Clearwell No.1. One 50,000 gallon ground storage tank, located on high ground on the plant site, is used for filter backwash. A vertical turbine pump located in the pipe gallery of the filter building is used to fill the backwash tank. There is also an emergency backwash connection on the discharge side of high service pumps.

The south end of the plant property contains solids management facilities consisting of sludge holding tanks, washwater holding tanks, filter press building and solids pump station. The spent filter backwash water and filter-to-waste are discharged by gravity to the washwater holding tanks. Solids collected from the tanks are sent to the sludge holding tanks and eventually to the filter press building, while supernatant is discharged to reservoir number 4. Sedimentation basin solids are discharged to the sludge holding tank and sent through the filter press.

RRS WTP has two chemical storage and feed facilities. The plant feeds sodium permanganate at the raw water intake for oxidation. Gaseous chlorine is added pre and post filtration as the primary disinfectant, and gaseous ammonia post filtration to facilitate chloramination as the secondary disinfectant and to assist with compliance with the disinfection by-product rule. Other post filter chemicals include caustic soda, corrosion inhibitor and fluoride.

The proposed facilities consist of a Filter Building (FTB), CT Basin (CT basin), Backwash Tank, and Chemical Feed Vault, located adjacent to existing facilities within the current plant land space. The proposed filters are designed at a filtration rate of 5.0 gpm/ft^2, with a backwash rate of 20 gpm/ft^2. Air scour will be provided at a rate of 2.5 scfm/ ft^2. A new blower is proposed for duty operation, and the existing blower will be relocated to the FTB and equipped with a larger motor. Backwash waste and filter-to-waste piping is provided for each filter and will be connected to the existing solids handling facility.

The new CT basin, or chlorine contact tank, is recommended to achieve contact time with free chlorine as required by the Surface Water Treatment Rule. The new CT basin will provide slightly more than 22 minutes of post-filtration theoretical contact time and a T10 contact time of approximately 15.5 minutes under the design conditions identified in **Section 5**. Chlorine will be fed upstream of the CT basin at the filtered water effluent control structure. A chlorine boost, ammonia, phosphate, caustic soda and fluoride will be relocated to the new chemical feed vault located upstream of Clearwell No.1. Chlorinators and ammoniators will be replaced as required. Details of these improvements are provided in **Section 5** of the Basis of Design Memo. A process flow diagram is shown in **Drawings G05** of the 60% Completion Documents.

3.2 Water Quality

A summary of raw and finished water quality data from the Richmond Road Station for the years 2013 through 2014 is given in **Table 3.1** below.

TABLE 3.1
RICHMOND ROAD STATION WATER QUALITY DATA – JAN 2013 THROUGH FEB 2014

Parameter	Sample Location	Average	Minimum	Maximum
Residual Chlorine, mg/L (Total Chlorine Residual)	Plant Effluent	3.2	2.1	7.5
Fluoride, mg/L	Raw	0.2	0.03	0.9
	Effluent	1.2	0.8	1.7
Alkalinity, mg/L	Raw	96	34	150
	Effluent	80	22	119
Hardness, mg/L	Effluent	156	70	356
Orthophosphate, mg/L	Effluent	1.1	0.8	1.5
pH	Raw	7.9	7.3	8.9
	Settled	7.6	7.0	8.0
	Effluent	7.3	6.8	7.8
Temperature, °F		57	37	81
Turbidity, NTU	Raw	20	4	406
	Settled	0.5	0.2	1.5
	Effluent	0.1	0.03	0.3

3.3 Hydraulics

The hydraulic calculations for constructing the new filter building and CT basin have been based on existing hydraulic conditions at Clearwell No. 1 and the Sedimentation Basin. There is 26.5 feet of available hydraulic head between the sedimentation basin weirs and normal clearwell operating level.

The hydraulics for the Richmond Road WTP have been evaluated for the current average flowrate of 10 MGD and peak daily flow of 25 MGD. The new filter box design provides eight feet of driving head above the filter media. **Table 3.2** summarizes the hydraulic grade line. A hydraulic gradeline profile is shown in **Drawing G05** of the 60% Completion Documents.

TABLE 3.2
RICHMOND ROAD STATION WTP - HYDRAULIC PROFILE WATER SURFACE ELEVATIONS

	at 10 MGD	at 18 MGD	at 25 MGD
Clearwell No.1, Normal WSE	978.7	978.7	978.7
CT Basin	990.81	991.33	991.84
High Water Elevation in Proposed Filter	1002.12	1002.12	1002.12
Rate of Flow Valve Position, % Open (clean media)	20%	30%	40%
Sedimentation Basin Effluent Trough	1002.53	1003.26	1004.26
Sedimentation Basin Weirs	1004.7	1004.7	1004.7

4.1 Site Access

The Richmond Road Station Filter Building site is currently accessed from Richmond Road (US 25/421) through the administration building's main entrance. Development of the proposed Filter Building project will not require any additional, permanent site accesses.

The existing perimeter of the RRS site, including the adjacent reservoir, is surrounded by security fencing. The proposed Filter Building (FTB), CT Basin (CTB), and Backwash Tank are to be located adjacent to existing facilities within this secured area, as shown on **Drawing C02** of the 60% Completion Documents. All construction will be inside of the perimeter of the property and no disturbance of the surrounded security fencing is expected. No additional entrances will be required for this project, although vehicular and pedestrian access to each of the three facilities will be provided through new pavement construction and/or improvements to the existing roadways.

Construction traffic will use the main plant entrance on Richmond Road and the access drive between the proposed facility construction site and the existing Administration Building.

4.2 Site Work, Grading, and Drainage

The proposed FTB and CTB facilities will be constructed behind the existing Chemical Building on a gentle hillside with an approximate slope of 10:1 horizontal to vertical, as shown in **Drawing C03**. The proposed grading plan is based on a preference to bench the new facilities into the existing slope (finished grade outside of each end of the facilities at approximately equal elevations) rather than "terraced" into the slope (finished grade on the west side higher than that on the east side). Finished grades outside the proposed facilities will be closely coordinated with the facility design, especially as they relate to access points and windows.

The existing one-lane access road on the south side of the proposed construction area, and a "roll curb" should be constructed in place of the existing "box curb" on the widened side of the road to allow vehicles to drive over that side without damaging vehicles or the curb.

Paved access to each of the facilities will be provided, including vehicular access for maintenance and operations, and pedestrian access as appropriate.

Stormwater best management practices should be incorporated into the project to mitigate impacts to surface water quality, in accordance with local requirements. Based on discussions with LFUCG staff, mitigation of increased volumes of surface runoff will not be necessary due to the negligible downstream impact of the proposed improvements. Stormwater practices will be required to address water quality impacts, and KAW plans to employ green infrastructure practices for this purpose, and possibly to reduce increases in the site's stormwater user fee billings. Rain gardens will be implemented near the CTB and across the road at the reservoir, as shown on **Drawing L01**.

Surface drainage will be accommodated with minimal storm sewer piping, consistent with the existing adjacent facilities. Roof drains shall be connected via downspout boots to the storm sewer. Runoff will be directed to the two proposed rain gardens described above.

The Contractor's staging area, parking area, and temporary excavated material stockpile area will be on the hillside west of the proposed facilities. Trees in this area will be protected by construction fencing. All excess excavated material will be wasted on-site.

4.3 Landscaping and Signage

The site setting is a wooded area with a light density of trees. Most if not all of the existing trees within the project limits appear to be near the end of their useful life. The landscape plan will include plantings around the perimeter of the structures consistent with adjacent planted areas, as well as low-maintenance vegetation for steeper graded slopes. In general, the landscaping requirements will specify preserving existing trees wherever possible.

A stone wall will be constructed on the north and east sides of the CT Basin, and landscape plantings will be installed on the south side of the basin.

Signage on site will likely be minimal, and would include directional signs for deliveries and any warning or information signage as may be necessary for plant operations. All signage will be consistent with existing plant signage, especially building identifiers.

4.4 Utilities and Exterior Lighting

Sanitary sewer service is not required for the proposed facilities. Potable water connections for operations and maintenance will likely be required at or near the proposed facilities (to be confirmed during design).

The proposed facilities locations are within open space in the interior of the existing plant site, and numerous existing utilities, primarily underground, cross the site. Utility conflicts appear to involve the following existing plant utilities:

- Process and finished water piping
- Overhead and underground electric
- Chemical feed lines

Maintenance of Plant Operations (MOPO) will be an important design consideration. The existing underground electric lines serve the nearby office building, overhead site lighting, and plant facilities. KAW staff is currently confirming the location of existing water mains in the project area, but existing mapping indicates that lines up to 24-inches in diameter may be impacted. If possible, proposed facilities will be relocated to eliminate major utility conflicts.

Exterior lighting will be installed by Kentucky Utilities at locations determined for safe access and as required for proper site security. All site lighting shall be in conformance with the local requirements and consistent with adjacent plant areas wherever feasible.

4.5 Site Security

Security around the existing treatment plant facility consists of chain-link fencing around the site perimeter to provide deterrence from intruders. It is not anticipated there will be any revisions to the existing perimeter fence as part of the proposed plant upgrade work. The existing plant site includes a video surveillance system. KAW and the Project Team will work with KAW's internal security personnel as well as their security consultant, ADT, on details for additional active security measures.

Passive security measures used will include ensuring unrestricted sight lines to all portions of the structure and provisions for security lighting at important locations on site and at the site entrance.

4.6 Erosion Control

Erosion control measures will be employed on the site throughout construction activities to prevent pollution of waterways and the discharge of sediment into the reservoir. In general, erosion control will be achieved through the use of erosion control measures on the site and the preparation and implementation of a Stormwater Pollution Prevention Plan (SWPPP). The SWPPP shall be completed as indicated by local requirements and the Lexington Fayette Urban County Government's NPDES permit. Associated erosion control plans shall clearly indicate temporary and permanent erosion control measures. The erosion control plan sheet shall be combined with the grading plan to show temporary and permanent erosion control measures.

All erosion control measures shall be installed and implemented prior to the beginning of construction. All measures shall be inspected weekly, and after any significant rain event, and any noted deficiencies shall be repaired immediately. Care shall be taken to not disturb the soil on any project site to a larger degree than is necessary. Tracking mud and soil debris off the site shall be avoided and when debris is tracked onto adjacent roadways, it shall be cleaned up at the end of the workday.

The temporary stabilization of disturbed areas is very important in minimizing erosion and sediment transport. All stripped areas not anticipated to have construction take place within 28 days shall be seeded immediately, weather and soil conditions permitting. Finally, immediately after the completion of construction, permanent seeding shall be planted. Once all disturbed areas have been permanently stabilized, temporary erosion and sedimentation control measure may be removed, the area returned to original grade, and any disturbance caused by removal repaired.

5.1 Overview

Kentucky American Water Company (KAW) is undertaking a project to replace the existing filter building with a new filter building at their 25 mgd Richmond Road Station Water Treatment Plant (RRS WTP) located in Lexington, KY. The project also includes a new chlorine contact basin (CT basin) and filter backwash tank, pumps and chemical feed vault. Detailed information on each of these is provided below. KAW has elected to use the construction manager at risk (CMR) delivery method for the project. The CMR will be brought in after completion of the 60% design to aid in the completion of the design and target cost.

5.2 Filtration

The existing filter building was originally constructed in 1924. Several additions were made to the filter building, the last of which was done in 1953. A 600,000 gallon clearwell (constructed in the 1920's and 30's) is located under the filter building. An inspection and study of the existing filter building and clearwell performed in 2013 (by others) recommended replacement of the filter building with a new filter building. In addition, due to concern about the long-term condition of the clearwell below the filter building, KAW has also decided to demolish the existing clearwell as part of this project.

Proposed filtration will be provided by eight cast-in-place concrete gravity filter boxes. Each filter box will provide a media surface area of 496 square feet with a flow rate of 3.6 mgd and a filter media loading rate of 5 gpm/ft^2. Seven filters will provide a firm capacity of 25 mgd of treatment with one filter out of service for washing or maintenance. The filters are proposed dual media of granular activated carbon (GAC) over sand. Air scour will be provided to enhance backwashing. Individual filter turbidity monitors will be provided, in addition to a combined filter effluent turbidity monitor. Filter-to-waste piping will also be provided and be properly designed with an adequate air gap. A filtered water control weir (and vault) is proposed on the combined filter effluent to provide hydraulic control and separation from the CT basin. The filter building is shown in **Drawings M100 through M104** of the 60% Completion Documents. **Table 5.1** provides design criteria for the filter boxes. A pre-filter chlorine application point will be provided in the settled water influent channels in the filter building.

TABLE 5.1	
Design Criteria for Pressure Filters	
Item	**Design Criteria**
Number of Filters	8
Capacity of Each Filter (mgd)	3.6
Type of Filter	Cast-in-place concrete Gravity filter
Filter Loading Rate (gpm/sf)	5
Total Area per Filter (sf)	496
Depth of Filter Media	
Sand (inches)	12
Granular Activated Carbon (inches)	24
Media Support (inches Gravel)	12
Individual Turbidity Monitoring	Provided
Filter-to-Waste	Provided

5.3 Filter Backwash Systems

The existing filters are backwashed using a 50,000 gallon ground storage tank on higher ground and a parallel 1000-gpm backwash pump. The plant also has an emergency backwash supply connection to the existing high service pump discharge. KAW would like to eliminate the existing backwash tank. In addition, the proposed filters are larger than the existing filters and therefore, new backwash pumps are recommended to properly fluidize and expand the filter media bed. Two pumps will be provided, each sized to fluidize the media during the warmest water conditions. A backwash rate of 20 gpm/sf is proposed for 20% expansion. **Table 5.2** provides design criteria for filter backwash pumps.

TABLE 5.2	
Design Criteria for Backwash Pumps	
Item	**Design Criteria**
Maximum Backwash Rate (gpm/sf)	20
Number of Backwash Pumps	2
Backwash Pump Capacity (gpm)	10,000
Total Dynamic Head (feet)	25
Wash Rate Control Method	Variable Frequency Drives

The backwash pumps will be controlled by VFD, allowing for high and low wash rate fluctuation along with seasonal adjustment over the varying head conditions. The design will include air scour for agitation of the media bed prior to backwash water flow. **Table 5.3** provides design criteria for the filter air scour blowers. KAW has an existing blower which will be relocated and used as a stand-by unit. The existing system will require a larger motor (60 hp) to accommodate the new operating conditions.

TABLE 5.3	
Design Criteria for Air Scour Blowers	
Item	**Design Criteria**
Number of Blowers	2
Capacity of Each Blower (scfm/sf)	2.5
Design Capacity (scfm)	1,240
Design Pressure (psi)	5.8

A new backwash water supply tank will be constructed of cast-in-place concrete with a roof deck made of a combination of precast concrete panels and cast-in-place concrete. The backwash water supply tank will be located on the south end of the CT Contactor; the north wall of the backwash water supply tank being common with the south wall of the CT Contactor. The volume of the backwash water supply tank will be 150,000 gallons with a maximum side water depth of 8.5 feet. The basin will be fitted with an arrangement of piping, and manual and motor operated open/close valves to facilitate filling from either Cell 1 or 2 from the CT Basin. An additional manual fill connection will be made between a high service pump discharge yard piping and the backwash tank to facilitate the initial fill upon construction and for future emergency or anomaly use. The backwash water supply tank is shown in **Drawings M200, M201, M202** of the 60% Completion Documents.

Each of the two proposed backwash pumps, one duty and one stand-by, will take suction from a sump located in the west end of the backwash water supply tank. The backwash cycle will be programmable based upon desired low and high wash rates and durations. The back wash water supply tank refill and shutoff will be activated based upon pump operation and a level sensor in the tank. Upon pump activation, the MOV for the fill will open and remain open until the level sensor reads the tank is full. The flow rate through the fill valve is self-regulating based upon the differential in water levels between the CT basin and the backwash water supply tank. The fill time will be dependent upon the total volume of wash water used in the filter wash cycle. As an example, a low wash rate of 5 gpm/sf for 3 minutes at both the beginning and end, and a high wash rate of 20 gpm/sf for 7 minutes would use approximately 85,000 gallons. It is anticipated that with the tank fill beginning upon activation of the backwash pump, at the end of the filter wash cycle when the pump shuts off, the tank will be depleted by approximately 50,000 to 55,000 gallons, or three feet below full. The refill for this volume at this elevation differential will take approximately 35 to 45 minutes. Should plant operations choose to do a second, successive filter wash cycle immediately following the first, sufficient volume would remain in the tank to do so. The volume depleted from the tank will be slightly diminished and the refill rate for this volume will increase due to a higher differential between water surface elevations resulting in a higher refill flow rate.

5.4 CT Contactor

Under the Surface Water Treatment Rule, the Richmond Road WTP is required to achieve a minimum of 4-log inactivation of viruses and 3-log inactivation of *Giardia* cysts through the physical particle removal treatment processes and disinfection. For plants with complete treatment (coagulation, flocculation, settling and filtration) and meeting filter effluent turbidity standards, removal credits for complete treatment processes are generally assumed to be up to 2.0 log for viruses and 2.5 log for *Giardia*, resulting in a minimum of 2-log inactivation of viruses and 0.5-log inactivation of *Giardia* through disinfection. Inactivation by disinfection will be through exposure to a disinfectant concentration over a sufficient contact period, otherwise known as C*T (concentration times contact time), and expressed in units of mg-min/L. Sizing of the CT contactor will be based on achieving 0.5-log inactivation of Giardia since this value is significantly larger than the C*T required to achieve 2-log inactivation of viruses.

One new CT basin will be constructed of cast-in-place concrete with a precast concrete roof deck. The CT contactor is proposed as a two celled rectangular tank with baffling, and a weir at the effluent to keep the contactor full. The two cells are piped to flow in series or in parallel. During normal operation, the positioning of the manual valves in the tank and yard will provide for series operation of the two cells. However, repositioning of these valves will also allow for one cell of the basin to be removed from service, while the other cell remains in service. The CT basin is shown in **Drawings M200, M201, M202** of the 60% Completion Documents. **Table 5.4** provides design criteria for the CT contactor.

TABLE 5.4	
Design Criteria for CT Contactor	
Item	**Design Criteria**
Design pH	7.6
Free Chlorine Residual (mg/L at effluent)	2
Design Temperature (°C)	7
Design Flow Rate at 7°C (mgd)	18
C*T Required (mg-min/L)	31
C*T Achieved (mg-min/L)	31
T10/Td	0.7
Td Provided (minutes)	22.2
T10 Provided (minutes)	15.5
Shape of Contactor	Rectangular
Volume of Contactor (mg)	0.28
Number of Cells	2
Volume of Each Cell (mg)	0.14
Side Water Depth (feet)	7.3
Length and Width (feet)	88 X 65
Baffling	Horizontal Serpentine
Length-to-Width Ratio (series flow)	50:1
Length-to-Width Ratio (parallel flow)	25:1

Filtered water will flow by gravity from the Filtered Water Control Vault (FWCV) at the FTB. Chlorine, for free chlorine disinfection, will be applied upstream of the weir at the FWCV. Sample points for residual confirmation will be provided at the FWCV and at the end of Pass 4 or 8 in the CT basin. Additional chemical feeds for water quality, are noted in **Section 5.5**.

A secondary pH and chlorine residual of 7.8 and 1.5 mg/L, respectively, were evaluated through the proposed CT footprint. The maximum flow that could be treated through the basin under these conditions is 13.5 mgd at 7 ^{o}C.

5.5 Chemical Feed Vault

A new chemical feed vault will be added to the site to feed chlorine, ammonia, fluoride, caustic soda, and zinc orthophosphate. The additional chlorine boost at this location is included to provide an opportunity to increase the chloramine residual in the distribution system if desired. Chemical feeds will be flow paced using the flow meter installed upstream of the chemical application points. It is anticipated that the existing feed equipment can be reused due to the proximity of the vault to the chemical feed building. The post-filter chlorine feed represents the furthest relocation effort and may potentially require upgrades to the existing equipment. The chemical vault is shown in **Drawings M050** of the 60% Completion Documents.

6.1 Piping

A schedule of the proposed exterior and interior process piping for the Richmond Road Station Water Treatment Plant is presented in **Table 6.1 and 6.2** respectively. The piping system designations are shown in **Table 6.3.** All major proposed piping at the plant is included in this schedule.

TABLE 6.1
EXTERIOR PIPING SCHEDULE

PIPE	MATERIAL	TYPE OF JOINT	CLASS/DESIGN	RESTRAINT SYSTEM DESIGN PRESSURE	Test Pressure
ASC	CARBON STEEL (BURIED)	WELDED/FLANGED	CLASS B (EXPOSED)	25 PSI	25 PSI
	STAINLESS STEEL (EXPOSED)				
AMS	CPVC (EXPOSED)	SOCKET	SCH 80	150 PSI	150 PSI
	BRAIDED PVC HOSE IN CASING PIPE (BURIED)	BARB WITH 316 SS CLAMPS	125 PSI	N/A	
BWW	DIP	RESTRAINED	CLASS 350	150 PSI	150 PSI
CAS	BRAIDED PVC HOSE IN CASING PIPE (BURIED)	BARB WITH 316 SS CLAMPS	125 PSI	N/A	125 PSI
CLG	CARBON STEEL	THREADED	SCH 80	125 PSI	100 PSI
D	< 4" PVC	SOCKET	SCH 80	N/A	50 PSI
	> = 4" DIP	PUSH-ON	CLASS 150		
F, P	BRAIDED PVC HOSE IN CASING PIPE (BURIED)	BARB WITH 316 SS CLAMPS	125 PSI	N/A	125 PSI
	CPVC (EXPOSED)	SOCKET	SCH 80	150 PSI	150 PSI
FLW, FTW, FW	DIP	RESTRAINED	CLASS 350	150 PSI	150 PSI
NPW	< 4" PVC	SOCKET	SCH 80	150 PSI	100 PSI
	> = 4" DIP	RESTRAINED	CLASS 350		
OF	DIP	RESTRAINED	CLASS 350	20 PSI	10 PSI
PW	< 4" PVC (BURIED)	SOCKET	SCH 80	150 PSI	100 PSI
	< 4" COPPER	SOLDERED	TYPE K (BURIED)		
	> = 4" DIP	RESTRAINED	CLASS 350		

S	PVC	SOCKET	SCH 80	50 PSI	50 PSI
SPD	< 4" PVC	SOCKET	SCH 80	50 PSI	100 PSI
	> = 4" DIP	PUSH-ON	CLASS 350		
SW	DIP	RESTRAINED	CLASS 350	150 PSI	150 PSI
CASING PIPE FOR AMS, F, C, P	PVC	SOCKET	SCH 40	N/A	N/A

TABLE 6.2 INTERIOR PIPING SCHEDULE					
PIPE	MATERIAL	TYPE OF JOINT	CLASS/DESIGN	RESTRAINT SYSTEM DESIGN PRESSURE *	TEST PRESSURE
ASC	STAINLESS STEEL	FLANGED	CLASS D	25 PSI	25 PSI
AMS	PVC	SOCKET/FLANGED	SCH 80	150 PSI	150 PSI
BWS	DIP	FLANGED	CLASS 350	150 PSI	150 PSI
CLG	PVC	SOLVENT WELDED/FLANGED	SCH 80	125 PSI	100 PSI
D	< 4" PVC	SOCKET	SCH 80	N/A	50 PSI
	> = 4" DIP	FLANGED	CLASS 350		
F	PVC	SOLVENT WELDED/FLANGED	SCH 80	150 PSI	125 PSI
FLW, FTW	DIP	FLANGED	CLASS 350	150 PSI	150 PSI
NPW	< 4" PVC	SOCKET	SCH 80	150 PSI	100 PSI
	>=4" DIP	FLANGED	CLASS 350		
PW	< 4" PVC	SOCKET	SCH 80	150 PSI	100 PSI
	< 4" COPPER	SOLDERED	TYPE L		
	>=4" DIP	FLANGED	CLASS 350		
S	PVC	SOCKET	SCH 80	150 PSI	150 PSI
SPD	< 4" PVC	SOCKET	SCH 80	50 PSI	100 PSI
	> = 4" DIP	PUSH-ON	CLASS 350		

TABLE 6.3 PIPING SYSTEM SCHEDULE DESIGNATIONS					
ASC	AIR SCOUR	D	DRAIN	P	PHOSPHATE
AMS	AMMONIA SOLUTION	F	FLUORIDE	OF	OVERFLOW
BW	BACKWASH	FLW	FILTERED WATER	PW	POTABLE WATER
BWS	BACKWASH SUPPLY	FTW	FILTER TO WASTE	S	SAMPLE
BWW	BACKWASH WASTE	FW	FINISHED WATER	SPD	SUMP PUMP DRAIN
CAS	CAUSTIC SOLUTION	NG	NATURAL GAS	SW	SETTLED WATER
CLG	CHLORINE GAS	NPW	NON-POTABLE WATER		

6.2 Gates

No gates are anticipated in the current improvements.

6.3 Valves

Table 6.4 describes the process application and operator for each type of valve.

TABLE 6.4 VALVES		
Valve Type	**Service**	**Operator Type**
Butterfly Valves	Isolation, Flow Control – Water Service Air Header – Blower Piping	Manual or Electric
Swing Check Valves	Pump Protection	
Ball Valves	Isolation - Chemical Service	Manual

7.1 Overview

Structural design of the Filter Building and Chlorine Contact Basin at the Richmond Road Station Water Treatment Plant in Fayette County, Kentucky shall be performed in accordance with the requirements of the 2013 Kentucky Building Code (2012 IBC with 2013 Kentucky Amendments). Since the structural components of the design qualify as process concrete structures used for treatment of water, the design shall be performed in accordance with the requirements of AC1 350 - Code Requirements for Environmental Engineering Concrete Structures to ensure structures are watertight and impermeable with stresses remaining in the elastic stress range to limit the potential for cracking. Loading conditions shall be based on the worst case operating scenario with design water surface elevations being based on the maximum water level possible, not just the hydraulic profile.

A geotechnical investigation has been completed by Thelen Associates providing necessary parameters for the design of foundations and structures. Based on findings within the report, the Filter Building will bear primarily on bedrock with an allowable bearing capacity of 30,000 psf. Since the bedrock is sloping downward in a southeasterly direction across the site and the Filter Building bears at multiple elevations, clay soils will likely be encountered in some areas below the foundation. At these locations, the soils will be removed and replaced with lean concrete backfill to provide a consistent bearing material. The Chlorine Contact Basin is anticipated to bear in stiff to very stiff residual clay soils with an allowable bearing capacity of 3,000 psf. The allowable bearing capacity for each structure well exceeds the anticipated maximum structure loads. Concrete mudmats will be used to prevent degradation of exposed rock and soils underneath foundations. The geotechnical report also indicates groundwater may be present and recommends providing drainage measures. These will be incorporated into the design.

7.2 Codes, Standards, References

7.2.1 Governing Code

The strength, serviceability, and quality standards shall not be less than stipulations required by the governing code. The governing code used for the proposed design is the 2012 IBC with 2013 Kentucky Amendments.

7.2.2 Supplemental Design Codes

Selected provisions from the following codes may also be used for the project.

- Standard Specifications for Highway Bridges, American Association of the State Highway and Transportation Officials, Latest Edition

- American Society of Civil Engineers – ASCE 7, Latest Edition
- American Institute of Steel Construction (AISC) – Manual of Steel Design, 14th Edition

7.2.3 Codes and Standards for Specific Materials

Design of specific materials will be performed in accordance with the standards, codes, and specifications adopted by the governing code as listed below.

7.2.3.1 All Materials

- The American Society for Testing and Materials (ASTM) standards, as referenced by the governing code or the other codes, standards, or specifications listed herein.

7.2.3.2 Concrete

- Building Code Requirements for Structural Concrete, Publication No. 318, Latest Edition, American Concrete Institute.
- Specifications for Structural Concrete, Publication No. 301, Latest Edition, American Concrete Institute.
- Code Requirements for Environmental Engineering Structures, Publication No. 350 and Commentary, Publication No. 350R, Latest Editions, American Concrete Institute.

7.2.3.3 Masonry

- Building Code Requirements for Masonry Structures, Publication No. ACI 530, Latest Edition, American Concrete Institute.
- Specifications for Masonry Structures, Publication No. ACI 530.1, Latest Edition, American Concrete Institute.

7.2.3.4 Steel

- Specification for Structural Steel Buildings, American Institute of Steel Construction, Latest Edition.
- Code of Standard Practice for Steel Buildings and Bridges, American Institute of Steel Construction, Latest Edition.
- Structural Welding Code, Publication No. D1.1, Latest Edition, American Welding Society.
- Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders, Steel Joist Institute, Latest Edition.
- Specifications for the Design of Cold-Formed Steel Structural Members, American Iron and Steel Institute, Latest Edition.

7.2.3.5 Stainless Steel

- Specifications for the Design of Cold-Formed Stainless Steel Structural Members, American Society of Civil Engineers, Latest Edition.

7.2.3.6 Aluminum

- Specifications for Aluminum Structures, Aluminum Association, Latest Version.
- Engineering Data for Aluminum Structures, Aluminum Association, Latest Version.
- Structural Welding Code, Publication No. D1.2, American Welding Society, Latest Version.

7.2.3.7 Fiberglass Reinforced Plastic (FRP)

There are no nationally recognized codes, standards, or specifications for the design of FRP. Proprietary design manuals that have been referenced are listed in the section below, Section 7.2.4, References.

7.2.4 References

Engineering manuals, handbooks, textbooks, articles, and technical publications that may be used in design on this project are as follows:

- Reinforced Concrete Design Handbook, Working Stress Method, Publication SP-3, American Concrete Institute.
- Design Handbook in accordance with the Strength Design Method, Publications SP-17 and SP-17A, American Concrete Institute.
- Detailing Manual, Publication SP-66, American Concrete Institute.
- Moments and Reactions for Rectangular Plates, Engineering Monograph No. 27, U.S. Department of the Interior, Bureau of Reclamation, W.T. Moody.
- MSP-1 Manual of Standard Practice, Concrete Reinforcing Steel Institute.
- PCI Design Handbook, Precast/Prestressed Concrete Institute, Latest Version.
- Masonry Designers' Guide, American Concrete Institute/Masonry Society, Latest Version.
- Reinforced Masonry Engineering Handbook, James E Amrheim, Masonry Institute of America, Latest Version.
- Manual of Steel Construction, American Institute of Steel Construction, Latest Version.
- Structural Steel Detailing Manual, American Institute of Steel Construction, Latest Version.
- Design Manual for Composite Decks, Form Decks, Roof Decks and Cellular Floor Deck with Electrical Distribution, Publication No. 28, Steel Deck Institute, Latest Version.

- Diaphragm Design Manual, Second Edition, Larry D. Luttrell, Publication NO. DDM02, Steel Deck Institute, Latest Version.
- Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders, Steel Joist Institute, Latest Version.
- Design Manual for Structural Stainless Steel, Nickel Development Institute, Latest Version.
- Specifications and Guidelines for Aluminum Structures, Aluminum Design Manual, Aluminum Association, Latest Version.
- Extren Fiberglass Structural Shapes- Design Manual, Strongwell, Inc., Latest Version.

7.3 Design Loads

7.3.1 Dead Loads

Dead loads are those resulting from the weight of all permanent non-removable stationary construction, such as walls, floors, roofs, permanent partitions, framing, ceilings, cladding, and equipment bases. Loads from process liquids within the structure and from soil and groundwater outside the structure will not be considered as dead loads. Dead loads will be in accordance with the governing code and as follows:

Dead Loads	
Concrete	150 pcf
Steel and Stainless Steel	490 pcf
Aluminum	169 pcf
Fiberglass reinforced plastic (FRP)	120 pcf
Masonry, CMU, 8” Lightweight	77 psf (grouted solid) 50 psf (grouted at 32” oc) 38 psf (hollow)
Masonry, CMU, 12” Lightweight	118 psf (grouted solid) 73 psf (grouted @32” oc) 55 psf (hollow)
Wood	30 to 40 pcf
Select Fill	130 pcf
Aggregate Base	135 pcf
Pipe Loads	– Design for actual dead loads for pipes > 16” diameter – Where beams may support pipes =<16” diameter, add 1,000 pounds at midspan

7.3.2 Live Loads

Live loads technically include all nonpermanent loadings that can occur, in addition to the dead loads. Live loads are those resulting from occupancy, furnishings, and equipment. Live loads will be used in accordance with the governing code, unless a larger value is listed below:

Area	Live Load
Working roofs	100 psf
Non-working roof loads	As per code, including wind
Office floors	80 psf
Corridors and stairways (process areas)	150 psf
Pipe supports	25 to 100 psf
Electrical control rooms	250 psf
Light storage	150 psf
Heavy storage	300 psf
Grated access platforms and walkways	100 psf
Catwalks	100 psf
Pipe Loads	– Design for actual live loads for pipes > 16" diameter – Where beams may support pipes=<16" diameter, add 1,000 pounds at midspan
Truck accessible areas	HS-20 loading per AASHTO
Liquid Chemicals	Per specified specific gravity
Liquid Loads (all unless specified otherwise)	63 pcf
Lifting Points	– Vertical load = 2 * (heaviest piece of equipment lifted) – Horizontal load = 0.20 * (vertical load)

7.3.3 Equipment Loads

Process area operating floors are designed for the load case resulting in the maximum stresses from the following live load conditions:

- 300 psf on the entire floor area, with no additional load from equipment included
- 150 psf on the areas not directly under equipment, plus actual equipment loads

Equipment loads obtained from manufacturers will be used when available, and other equipment loads will be assumed for the preliminary design. These loads will be confirmed prior to completion of design. In addition to the equipment's operating weight (including any fluids contained), other loads due to moving parts, malfunction, and maintenance will be designed for. Examples of these other loads include but are not limited to the following:

- Loads from rotating equipment will include moment, torque, and lateral thrust.
- Loads from all equipment will include those for required maintenance, such as the removal of large components that may be temporarily placed on the adjacent floor.

The load option, which creates the highest stress conditions, shall be used. The weight of equipment components, which could be placed on or transported across the floor, shall be located to create maximum stress conditions.

7.3.4 Piping Loads

For preliminary design, the live loads listed above will be considered to include the loads from process piping that are supported by the floor below the piping. On floors and roofs that will support process piping suspended below, an additional live load allowance will be included for the preliminary design. This allowance ranges from 25 psf to 100 psf, depending on the size and quantity of piping, anticipated to be suspended below the floor or roof.

Upon completion of piping layout, these allowances will be reviewed for accuracy with the actual pipe configurations for pipes less than 18 inches in diameter, and the actual concentrated loads from pipes 18 inches and larger will be considered.

7.3.5 HVAC, Ducts, Plumbing, and Electrical Raceway Loads

Loads from HVAC ducts, plumbing, and electrical raceways that are suspended from floors and roofs above are typically relatively light and included within the live loads listed above. However, if they do get significant at selected locations, they will be considered prior to completion of design.

7.3.6 Wind Loads

Wind loads on any above grade structures will be in accordance with the governing code and ASCE 7.

7.3.7 Snow Loads

Snow loads will be in accordance with the governing code.

7.3.8 Seismic Loads

Seismic loads resulting from seismic acceleration of the structure dead and live loads, including equipment and piping, will be determined in accordance with the governing code and ASCE 7 as applicable codes for seismic design.

7.4 General Basis for Design

7.4.1 Loading Combinations

The following factored load combinations shall be used in the design of structures. Additional load combinations, which may produce a maximum stress condition, are also to be considered, as appropriate. Note that combinations, which clearly do not govern, will not need to be fully analyzed.

Load Combinations
1.4(D + F)
1.2(D + F) + 1.6(L + H) + 0.5(Lr or S)
1.2D + 1.6(Lr or S) + (L or 0.8W)
1.2D + 1.6W + L + 0.5(Lr or S)
1.2D + 1.0E + L + 0.2S
0.9D + 1.6W + 1.6H
0.9D + 1.0E + 1.6H
D = dead load, F = fluid load, H = soil load, L = live load, S = snow load, Lr = live roof load, W = wind load, E = earthquake load

7.4.2 Safety Factors

Structures are designed on the basis of determining the service loads and obtaining a suitable ratio of material or soil strength to these loads termed a safety factor. Either the service loads are multiplied by a suitable set of load factors and compared with the ultimate strength or the structural material or yield strength is divided by a suitable safety factor.

Safety Factors	
Overturning	2.0
Sliding	1.5
Buoyancy for Groundwater, Design Elevation	1.25
Buoyancy for Groundwater, 100-yr Flood Elev.	1.10

Forces resisting buoyancy shall be a combination of structure dead load, weight of soil directly over footings (considering buoyant soil weight), and the tensile resistance of piles and/or tension anchors (based on allowable load values provided by the geotechnical report), if applicable. Where there are superstructures above grade, the drawings shall clearly indicate at what level of completion dewatering operations can be terminated.

7.5 Serviceability Considerations

7.5.1 Introduction

Serviceability of a structure is defined as its ability to behave under load in a manner that does not adversely affect the intended use of the structure or provide discomfort to its occupants. Harsh chemical environments may require a special coating to protect the concrete. Some processes may also require more concrete cover over the reinforcement than typically provided for the structure as a whole to limit possible structural deterioration. Deflections and vibrations are behaviors of a structure that do not necessarily cause damage to the structure itself, but if excessive can cause minor damage or wear to equipment or discomfort and annoyance to occupants. Structures will be designed to limit deflections and vibrations as stated below such that the intended use and performance of the structures are not adversely affected.

7.5.2 Deflection

Maximum allowable deflections used for design are shown in Table 15-3. An asterisk (*) indicates the deflection limit applies to live loads only.

Maximum Allowable Deflection	
Structures	**Deflections**
Floors, concrete	Per ACI 318
Floors, structural metal framed *	L/360
Grated access platforms *	L/240
Roofs *	L/240
Beams, lintels, or slabs supporting masonry	L/720

7.5.3 Vibration

The design should provide appropriate protection against structural or mechanical deterioration and occupant discomfort from the effects of vibrations. The guidelines stated below will be used to mitigate the effects of vibration.

- The operating frequencies, unbalanced loads, and specific design recommendations from equipment manufacturers will be considered in the design
- To minimize resonant vibrations, the structure supporting the equipment shall be designed such that the ratio of its natural frequency to the operating frequency of the equipment is less than 0.50 or more than 1.50.
- Equipment shall be mounted on concrete foundations rather than metal support systems whenever possible and appropriate.
- Concrete pads or foundations shall be provided with a mass equal to ten times the rotating mass of the equipment or three times the gross mass of the equipment, whichever is greater.
- Vibration isolators or dampeners shall be used on equipment foundations where appropriate.

7.6 Seismic Design

The basis for determining acceleration values and corresponding factors for design are given in the section presenting load criteria. Structures shall be designed according to the governing code and ASCE 7 requirements using the values given in the appropriate code formulas.

Seismic forces due to vertical acceleration result from all dead loads, including the total mass of water above slabs (especially suspended slabs). The direction of force (up or down) shall be selected to create maximum stresses when combined with horizontal seismic forces. The design of foundations resisting overturning must assume that balancing dead loads are reduced by vertical accelerations.

Transitory live loads are not to be used to produce seismic loading nor combined with seismic with the following exceptions. In storage areas, the loading which is anticipated to be in place the majority of the time shall be used but not less than 25 percent of the total live load. Equipment, partition walls, and other fixed items shall be considered as dead loads for determining seismic forces. Seismic loads shall be combined with 75% of the snow load when applicable.

7.7 Concrete Design

All portions of the structure that are in contact with soil or that contain process liquids (including slabs over process liquids) will be designed using Ultimate Strength Design, per ACI 318 with revised load factors and durability coefficients recommended in ACI 350R

Portions of the structure not included above may be designed per ACI 318 without including the ACI 350R recommendations.

Materials for use in concrete design will be specified to have the following minimum properties:

Concrete Class A1 – Structural: (all applications unless otherwise noted)	
28 day compressive strength (f'c)	4,500 psi
Cementitious Materials	ASTM C150 Type I plus mandatory addition of pozzolan such as Class F fly ash or ground granulated blast furnace slag
Maximum water/cementitious materials ratio	0.42
Air content	4.5% to 7.5%
Concrete Class B: (thrust blocks, encasements, concrete fill)	
28-day compressive strength (f'c)	3,000 psi
Cementitious Materials	ASTM C150 Type I plus mandatory addition of pozzolan such as Class F fly ash or ground granulated blast furnace slag
Maximum water/cementitious materials ratio	0.50
Deformed reinforcing bars (unless otherwise noted)	ASTM A615 Grade 60
Welded wire fabric	ASTM A185

Minimum required amounts of reinforcing would be determined per ACI 318 recommendations depending on the spacing of movement joints provided. Amounts of reinforcing used will be as required for structural strength, but not less than these minimum amounts. Maximum spacing of reinforcing bars will be 18 inches on-center.

Finishes on concrete surfaces will be provided in accordance with ACI 301, and as is appropriate for their use and exposure. Interior exposed walls, columns, ceilings, and beams in habitable spaces will receive a smooth rubbed finish. Interior walls above the water surface of open tanks and any exterior exposed walls above grade will receive a grout-cleaned finish. Floors of tanks and floors in areas likely to be intermittently wet due to washdown or maintenance of equipment will receive a floated finish. Floors in habitable areas intended to be dry at all times will receive a steel troweled finish.

Waterproof coatings will be provided on all walls and slabs in that are in contact with liquid on one side and in a dry habitable space on the other. Concrete sealers will be provided on all floors that are exposed, not intended to be immersed, and have no other type of coating.

7.8 Masonry Design

Masonry will be designed in accordance with ACI 530 and ACI 530.1. Materials for use in masonry design will be specified to have the following minimum properties:

Minimum Properties for Masonry Design	
Compressive strength of masonry (f'c)	1,500 psi
Concrete masonry units	ASTM C90 Grade N Type
Compressive strength of masonry units	1,900 psi
Mortar	ASTM C270 Type S
Grout	ASTM C476
Compressive strength of grout	2,000 psi
Deformed reinforcing bars	ASTM A615, Grade 60
Horizontal joint reinforcing	ASTM A82

Minimum required amounts of reinforcing for seismic loads would be provided in accordance with ACI 530 and ACI 530.1. Amounts of reinforcing used will be as required for structural strength, but not less than these minimum amounts. All cells containing reinforcing will be grouted. Maximum spacing of horizontal joint reinforcing will be 16 inches on-center vertically.

7.9 Structural Metals Design

Structural steel will be designed in accordance with AISC Specification for Structural Steel Buildings – Allowable Stress Design or Load Resistance Factor Design, with modifications as stated in the governing code.

Steel joists will be designed in accordance with the SJI Standard Specifications, Load Tables, and Weight Tables for Steel Joists and Joist Girders with the modifications as stated in the governing code.

Steel decking will be designed in accordance with the SDI Design Manual for Composite Decks, Form Decks, Roof Decks, and Cellular Deck Floor Systems with Electrical Distribution. Diaphragm action of steel decks will be designed in accordance with the SDI Diaphragm Design Manual.

Cold-formed steel structural members will be designed in accordance with the AISI Specification for the Design of Cold-Formed Steel Structural Members, with modifications as stated in the governing code.

Cold-formed stainless steel structural members will be designed in accordance with ASCE 8 Specification for the Design of Cold-Formed Stainless Steel Structural Members.

Aluminum members will be designed in accordance with the Aluminum Association's Specifications for Aluminum Structures.

Materials for use as structural metals will be specified to have the following minimum properties:

Minimum Properties for Structural Metals	
Structural steel shapes	ASTM A992, A572, Grade 50
Steel plates, angles and bars	ASTM A36
Structural steel tubing	ASTM A500, Grade B
Structural steel pipe	ASTM A53, Type E or S, Grade B
High strength steel bolts	ASTM A325 or ASTM A490
Steel anchor bolts and threaded rods	ASTM F1554
Stainless steel shapes	ASTM A276, Type 316
Stainless steel plates and sheet	ASTM A167, Type 304 or 316
Stainless steel bolts	ASTM F593, Type 304 or 316
Aluminum structural shapes	ASTM B308, 6061-T6
Aluminum extruded rods, shapes, and tubes	ASTM B221, 6063-T6
Aluminum plates	ASTM B209, 6061-T6
Aluminum sheet	ASTM B221, 3003

7.10 General Description of Structural Systems

7.10.1 Filter Building

The Filter Building will consist of a reinforced concrete substructure and a concrete-framed superstructure. The filters and pipe gallery will be contained within the substructure while the filter gallery will be located in the superstructure above. The filters and pipe gallery will consist of reinforced concrete tank walls supported by a reinforced concrete mat foundation. The interior tank walls of the building will divide the filters into eight separate tanks and support a reinforced concrete slab serving as the main floor of the building superstructure. A reinforced concrete moment frame with a precast prestressed hollowcore plank roof system will serve as the primary structural system for the superstructure. The architectural roof, consisting of trusses, decking, insulation and standing seam metal, will be added over the precast planks to provide sloped drainage and ensure water-tightness of the system.

7.10.2 Chlorine Contact Basin and Backwash Supply Tank

The Chlorine Contact Basin will consist of reinforced concrete tank walls supported by a reinforced concrete mat foundation. Concrete divider walls will separate the basin into Cell Nos. 1 and 2 and a Backwash Tank. Each CT basin cell will be divided by three partial baffle walls which will separate the areas into four parallel channels with a continuous flow path. Precast prestressed concrete hollow core roof planks will span between exterior and interior tank walls to provide cover for the basin. Concrete beams will be added extending over the open ends of the partial baffle walls to support the precast roof members. The roof over the Backwash tank will be a combination of cast-in-place, over the pumps and hollow planks. Rigid insulation and a membrane roof will be placed over the precast members to provide sloped drainage and ensure water-tightness of the cover system.

8.1 General

The following section outlines approaches to the architectural design for the expansion of the Richmond Road Water Treatment Plant Improvement Project, including code compliance issues related to occupancy, type of construction, fire resistance of materials and separation requirements, interior finishes, fire prevention and separation, fire protective systems, means of egress, accessibility, interior environment, exterior wall construction, roof construction, and exterior appearance.

8.2 Architectural Code Requirements

Codes, standards, and references will provide the minimum standard for fire resistance, serviceability and quality of materials used for construction. The 2013 Kentucky Building Code, which references and modifies the 2012 International Building Code (IBC) as adopted and amended by the State of Kentucky will act as the governing building code. Accessibility issues will be governed by Chapter 11 of the Kentucky Building Code. Provisions of Kentucky Plumbing Code, the International Mechanical Code, 2009 International Energy Conservation Code and NFPA 70 - National Electrical Code will be applied. Additional federal, state and local codes, standards and references will be coordinated and applied in accordance with the 2009 IBC. A partial list of these codes and standards follow.

- 29 CFR 1910 – Occupational Safety and Health Standards
- ACI 530/ASCE 5/TMS 402 – Building Code Requirements for Masonry
- ACI 530.1/ASCE 6/TMS 602 – Specification for Masonry Structures
- American with Disabilities Act
- NFPA 10 – Portable Fire Extinguishers
- NFPA 13 – Installation of Sprinkler Systems
- NFPA 80 – Fire Doors and Fire Windows
- NFPA 704 – Identification of Fire Hazards of Materials
- UL Fire Resistance Directory

In addition to the State and Federal codes, local regulations additionally impact the design of the buildings and include the local Zoning Regulations. The impact of these regulations includes developed area, parking, landscaping, signage and noise.

8.3 New Filter Building

The primary occupancy and use of the new administration and chemical building will be Low Hazard Factory Industrial (F-2). The building will be two stories with a pipe gallery on the lower level with filter gallery and filters on the upper floor. The building will be occupied by employees and escorted visitors. The Accessibility Code requires access to buildings by people with physical limitations. Water treatment facilities have several areas that are not considered accessible spaces due to the hazards present.

The building will be designed to provide adequate egress from the building and each room. Exits will open directly to the exterior, exit passageway or stairwell. Exits will be located as remote from each other as possible. One stair connecting the floor will be housed within a fire rated enclosure and exit directly to the exterior. A second stair will be provided for egress and will be enclosed within a rated enclosure. Illuminated exit signage and emergency lighting shall be placed throughout the buildings. Fire extinguishers will be located throughout the building and will be compatible with the contents of the room.

The travel distance within a space or floor having one exit shall not exceed 75 feet. Travel distance to the nearest exit from any point in the building shall not exceed 300 feet. Travel distance shall take into account travel around fixed pieces of equipment. Equipment and rooms shall not create common path of travel in excess of 75 feet. Paths of travel shall not proceed from a room of low hazard to a room of higher hazard.

Interior finishes will include painted concrete masonry units and concrete. Floors will be sealed concrete. Ceilings will remain open to the structure above and be painted. Finishes at the main entrance may vary and include epoxy floor and base, painted concrete masonry, , and possible upgraded lights.

Exterior walls will be non-loadbearing masonry and utilize an insulated cavity wall design. The cavity wall design will consist of an interior wythe of concrete masonry, and an outer wythe of brick. A continuous insulation and drainage cavity will be formed between the wythes to enhance energy performance. The cavity will include an air barrier applied to the exterior face of the concrete masonry, 1 ½ to 2 inches of rigid insulation, and a 1" airspace. The cavity will drain through a series of weep vents above the through-wall flashing. A mortar net will be used at the base of the wall to ensure open drainage. The walls will be reinforced to resist loads as required by the 2012 IBC.

Roof shall have a minimal slope of 1" per 12" and drain to gutters along the outside edges of the roof. The slope will be obtained with sloping structural truss members. Rigid roof insulation shall be placed above the structural substrate and a self-adhered underlayment placed above the insulation. The roof covering shall consist of a standing seam metal roof system with a Kynar based coating system. The roof will be detailed in accordance with the manufacturer's recommendations for a 25 year total system weathertightness warranty..

The exterior appearance will utilize a brick façade and harmonize with the existing structures. As the existing facilities have several different architectural treatments the administration building will draw elements from the different buildings and to help develop a unifying aesthetic. Multiple colors of masonry may be used as well as windows and openings that complement the proportions of the building and the existing buildings.

8.4 Chlorine Contact Basin and Backwash Supply Tank Roof

Roof shall have a minimal slope of 1/8” per foot and drain to edges of the structure. Slope will be obtained with sloping structural members. The roof covering shall consist of a fully adhered single ply membrane. The roof membrane will have a high Solar Reflectance Index. The roof will be detailed in accordance with the manufacturer’s recommendations for a 15 year total system warranty. Ballast stone will be added on the roof covering to reduce the prominence of the structure. A stone wall will also be added on the north and east sides of the tank to reduce visibility from Richmond Road. Walkways will be provided to roof mounted equipment from the roof access points.

9.1 General

The following section outlines approaches to the HVAC design for the renovation and expansion of the Richmond Road WTP Improvement Project, including dehumidification of the filter pipe gallery and operating floor and cooling of the electrical room. American Water HVAC Standards as well as other applicable codes and standards will be observed.

9.2 New Filter Building

In the filter pipe gallery space relative humidity will be controlled by multiple portable mechanical refrigeration type dehumidifiers. These units do not require additional ductwork, but will require providing a local drain to accommodate removal of condensate. Insulation on gallery piping will also be provided to minimize pipe surface condensation. Electric unit heaters (corrosion resistant construction for moist environments) will be used in the filter pipe gallery to maintain the space during heating season above 50 degrees.

In the filter gallery, an air handling unit (gas-fired) will be used to provide an average continuous rate (3 air changes per hour) of ventilation with heating to maintain the space during heating season above 60 degrees.

The electrical room in the Filter Building will be kept below the maximum rated temperature of the electrical gear and control panels through a filtered outside air intake, to draw air in, and exhaust ventilation to remove air.

10.1 Electrical Requirements and Modifications

The new filter building will include a dedicated electrical room for housing electrical and control equipment in a ventilated, clean, dry, non-corrosive space. The electrical room is proposed to be served by a single 480-volt, 3-phase power feed terminating at power distribution equipment to serve the required filter building, chlorine contact basin, and backwash pump station loads. The treatment plant has multiple utility service drops installed at the plant site for various expansions or modifications. Originally, it was proposed that the utility source for the new filter building originate at some existing service entrance equipment if feasible to avoid the necessity of another metered service. However, the only source with enough potential capacity was at the high service pump station. Upon consideration of duct bank routing and possible future high service loading scenarios, the existing high service pump electrical service is an unattractive option and, therefore, a new service drop and transformer from Kentucky Utilities will be pursued. The electrical room will include a main circuit breaker for single point disconnection of utility power.

In addition to multiple utility services, multiple standby emergency generators have also been installed at the plant. After evaluation and discussion with plant personnel, it is proposed to replace the existing 250KW generator just west of Chemical Building No. 2. The generator is over 20 years old. It is proposed that it be replaced with a generator of sufficient capacity to serve its present load (Chemical Bldg. No. 1, Chemical Building No. 2, and the Electrical Control Building) plus the new filter building and chlorine contact basin loads. To minimize site impact, the new generator is proposed to be installed at the location of the existing generator, resulting in a transitional period in which standby power will be absent. The construction contract will call for the contractor to provide temporary standby power during the transitional period. Also, the possibility of utilizing natural gas on the plant site in lieu of diesel fuel will be investigated as a fuel source. Inside Chemical Building No. 2, the emergency power main disconnect switch and distribution panel will be replaced due to corrosion. The new disconnect switch and distribution panel will be installed in the same location as the existing and will distribute emergency power to the existing loads via re-used feeders as well as the new filter building loads. Emergency power from Chemical Building No. 2 will terminate at a single disconnect switch in the new filter building electric room. This disconnect and the main utility circuit breaker will provide a single disconnecting means to isolate all new loads from an electrical power source if necessary. Both utility and generator power will feed an automatic transfer switch.

The load side of the automatic transfer switch will feed a fused disconnect power panel fused with current-limiting fuses that in turn will feed multiple panelboards and motor controlling equipment. In discussion with plant staff, it was agreed to use this design approach in an attempt to minimize arc-flash categories to all field equipment that operations and maintenance personnel would most frequently engage. Additionally, the series rating of downstream circuit breaker panels will allow for smaller, less expensive panelboards to be used as the current-limiting fuses should reduce the severity and duration of fault currents at downstream equipment.

A 208/120V dry-type step down transformer and panelboard will be provided for lighting, receptacles, instrumentation, and other miscellaneous power needs in the filter building. An outdoor, 240/120V packaged power supply will be provided for the few single-phase loads at the chlorine contact basin.

Variable frequency drives (VFDs) will be provided for modulating backwash flow rate. Instead of a motor control center, VFDs will be housed in wall-mounted or floor-mounted stand-alone enclosures to provide optimum flexibility in maintenance or replacement. VFDs will include input reactors to reduce harmonic effects on the power system and minimize susceptibility to utility grid transients. Shielded VFD cable will be provided between VFDs and pump motors to withstand insulation stresses under VFD use. For VFD-driven motors, shaft grounding rings are proposed for pump motors to prevent bearing damage due to VFD control. The motors will be specified for inverter duty.

Air scour blowers will be constant speed and controlled by reduced-voltage, solid-state (RVSS) motor starters with input isolation contactors. As with the backwash pump VFDs, the starters will be housed in individual enclosures to facilitate isolation for maintenance replacement if necessary.

Outdoor, exposed conduit will be specified as PVC-coated rigid steel conduit. Schedule 80 PVC conduit will be utilized in all indoor areas. Underground conduit will be concrete-encased PVC schedule 40. Wiring troughs may be considered for the small but numerous power, control, and instrumentation conductors anticipated in the filter gallery. All underground power conductors are proposed to be XHHW-2. THHN/THWN building wire is proposed for lighting, receptacle, control, and other miscellaneous power wiring within buildings. All analog signaling will utilize twisted, shielded pairs or triads as required by the application. No wire nut-type splices will be allowed for conductors with the exception of lighting and receptacle circuits. Splicing in all other wiring applications shall be at terminal blocks, power blocks, or for motor housing leads, crimp-type connectors.

Lighting will be provided as needed at levels recommended by IES for the filter building. Moist areas will dictate corrosion-resistant material be specified for fixtures. All indoor fixtures will be placed at serviceable heights and locations whenever possible. Wall pack type lighting will be utilized on filter building exterior doors, the lighting element to be shielded from direct view. Outdoor site lighting will be contracted through Kentucky Utilities. All lighting specified for installation by the contractor will be based on LED technology.

Ground grids will be provided around the perimeter of the filter building and chlorine contact basin. Ground rods with inspection wells will be provided at evenly-spaced intervals and exothermically welded to a bare #4/0 buried copper conductor. The need for lightning protection for the structures will be discussed with KAW personnel during design and, if implemented, will be connected to the ground grid.

KAW will contract with ADT security company directly for security cameras and building access. Scope of ADT to be determined. Hazen and Sawyer will coordinate with ADT once scope is established to facilitate installation of security equipment.

American Water Company Electrical Standards as well as other applicable codes and standards will be observed during design of the project.

11.1 Plant Control System

The Bristol Babcock ControlWave programmable controller (PLC) is proposed for automatic control of the new filters and backwash pumps, filter flow rates, backwash sequencing, chlorine contact basin, and other appurtenant equipment and instrumentation. Four of 8 recently-installed ControlWave-based PLC enclosures will be removed from the existing filter building and reused in the new filter building to control the 8 new filters, one enclosure per pair of filters. Also, manual controls will be provided via four new operator displays,one display per filter pair, located adjacent to the re-used PLC enclosures and will provide for local manual control of the filters. Hard-wired electrical consoles with mechanical switches and pilot lights similar to the existing filters will not be duplicated as originally proposed. Each of the four displays will contain the manual controls of all 8 filters thereby enabling manual control of any filter from the filter gallery in the event of a display failure.. A master PLC panel with a new ControlWave will be located in the filter building electric room to control the backwash process, monitor the CTB finished water flow, normal and emergency power status, and other miscellaneous status and alarm data associated with the facility. The new ControlWave was selected in collaboration with KAW staff to maintain commonality of hardware, software, and communication protocol with the filter PLCs and the host HMI in the main control room. The PLC-based control panels will house the PLC and other control equipment such as power supplies, relays, terminal blocks, etc. necessary for each process. Each control panel will be powered via aDC uninterruptible power supply (UPS) to isolate the PLC control system from power transients and momentary outages ensuring high availability, smooth operation, and limiting the necessity of processor rebooting.

The existing MODBUS TCP/IP protocol via Category-6 and fiber optic cable will be used for communications among the PLCs via industrially-hardened Phoenix Contact managed Ethernet switches matching other Ethernet switches in the plant network. A laptop power and network interface port will be available on the outside of the master PLC in the electric room allowing safe programming access to the PLCs via laptop without opening the enclosure doors.

The fiber optic SCADA network will be extended to the filter building from Chemical Building No. 2. The network will be intercepted in an existing fiber termination box inside the building to insert the new filter building in the existing communication loop.

Modifications of the existing Iconics Genesis plant-wide SCADA human machine interface (HMI) will require programming effort to update graphics, trending, alarming, server data bases, historical data archiving, report generation, etc. to allow monitoring and control of the new processes added under this project as well as remove existing filter processes that will be eliminated. Emerson Process Management will be sole-sourced as the project system integrator per KAW.

Typical analytical field instruments will be included for design. Turbidity, chlorine residual, pH, temperature, flow, differential pressure and level will be monitored at various locations and as directed by KAW. Combined filtered water (including CT basin effluent) will include redundant instrumentation. Chlorine residual will be performed using amperometric technology to reduce overall instrumentation maintenance.

12.1 General

This section provides a functional description of the operation and control features of the proposed facilities at the Richmond Road Water Treatment Plant (WTP). The detailed functional control is located in **Section 17950** of the Contract Specifications. The process covered in this functional description include, filtration, chlorine contact basin, backwash pumping and chemical feed vault.

12.2 Filtration

Eight new conventional dual media filters with sand and granular activated carbon are utilized for filtration. Each filter unit is equipped with a water level sensor, differential pressure transmitter, filter effluent turbidity meter, and a flow meter and control valve in the effluent piping, as well as other filter valves. All filter valves will include electric actuators. New backwash pumps will also be provided for filter backwash.

The filtration system will include the following:

- New Open/Close valves provided for each filter for filter influent, filtered water, filter-to-waste, backwash isolation, backwash drain, and air scour service as shown on the Drawings. Each valve will be provided with an actuator that includes the following:
  - Remote-Off-Local selector switch
  - Open-Stop-Close pushbuttons
  - Digital position status indicator (full open/full closed) to PLC
  - Selector switch in Remote status to PLC
  - Actuators to accept Open and Close commands from PLC
- A new modulating filter effluent control valve will be provided for each filter as shown on the Drawings. Each valve will be provided with the following:
  - Remote-Off-Local control capability
  - Open-Stop-Close control capability
  - Analog position status feedback to PLC
  - Selector switch in remote status to PLC
  - Actuators to accept analog positioning command from PLC
- Filter process instrumentation will include:

- Filter level
- Filter loss of head
- Filter flow
- Filter turbidity
- Redundant combined filter effluent turbidity
- Combined filter effluent chlorine residual
- Backwash flow

- Two filter backwash pumps with flow monitoring. Backwash pumps installed at the backwash tank attached to the CT basin. Flow meter installed in pipe gallery in Filter Building.

Monitoring and control for the filters will be as follows:

- When filter valves are in the Local control mode at the actuator, the valve will be opened and closed with the Open-Stop-Close pushbuttons also located on the actuator. When valves are the in Remote mode at the actuator, automatic valve control will be through the PLC control system. An operator display will be provided for each pair of adjacent filters (1-3, 2-4, 5-7, and 6-8). An Auto-Manual button on the operator display will toggle between automatic and remote manual operation. When in Auto, PLC program logic will control filter operation based on various operator-entered time, turbidity, and loss-of-head setpoints. When toggled to Manual at the operator display, PLC automatic control will be blocked and PLC control outputs will be manually manipulated by Open-Stop-Close buttons on the operator display for the various valves. Valve position (% open) for all modulating valves, and full open/full closed status for open/close valves, will be indicated at the display.

- Under automatic PLC control, flow through each filter shall be controlled via a proportional-derivative-integral (PID) control loop in the PLC comparing filter flow with an operator entered setpoint at the HMI and positioning the Effluent Control Valve to eliminate the difference between the two. Provisions for manual manipulation the valve position will also be provided via the operator display.

- Filter backwash will be initiated based on conditions monitored through sensors and analytical instrumentation. Parameters operating outside set tolerances initiate a filter backwash, which will include:

  - Filter effluent turbidity
  - Filter headloss
  - Filter run time

  Filter backwash sequence may also be initiated manually via a button on an operator display.

- The control system will allow only one filter to be backwashed at a time. When a backwash is initiated, the control system will check the volume available in the backwash tank to determine if the level is high enough for a backwash. If required volume is less than available volume, filter backwash will proceed. If required volume is more than available volume, an alarm will be displayed at the HMI. The operator will interact with the control strategy by entering the following parameters:

    - Air scour duration
    - Low wash rate/duration (up)
    - High wash rate/duration
    - Low wash rate/duration (down)

- Filter backwash water will be provided from one of two redundant backwash supply pumps at the backwash tank. The operator will select the backwash pump. The the filtered water valve will close after filter is drained down to a pre-set elevation, the backwash isolation valve will open, , and the backwash supply pump will start a low wash cycle and air scour. After the adjustable preset duration, the air scour valve will close and the low wash cycle will continue. After an adjustable preset duration for low water wash, the backwash pump will provide high wash rate for an adjustable duration. After the high water wash, the backwash pump will deliver the low wash rate for an adjustable duration. At the end of the second low wash cycle, the backwash supply isolation valve at the filter will close, the backwash supply pump will stop, and the backwash drain valve will close. Prior to bringing the filter back into service the filter influent valve and filter-to-waste valve will open, and filter to waste will continue until an adjustable preset turbidity level is reached. The filter-to-waste valve will close and the filter effluent will open to return to constant flowrate control. Once the filter effluent valve opens, the filter run clock will reset and begin recording filter run time. The control system will calculate and record the volume of washwater used.

- The following conditions will initiate a “Backwash Fail” alarm condition:

    - Neither backwash pump starts
    - Any valve fails to open or close, or fails to reach its position in the allotted time
    - Power fails during backwash

12.3 Chlorine Contact Basin (CT basin)

One CT basin will be provided as described in Section 5. The layout will allow the CT basin to operate in series or with half out of service (for inspection or maintenance) by the opening and closing of manual valves.

The CT basin will include the following:

- The basin will be provided with vents, overflows, and adequate access hatches.
- Redundant temperature, chlorine residual and pH monitors.

Either half will be able to be taken out of service with the other half remaining in service. Monitoring and control of the CT basin will be as follows:

- Clearwell temperature, chlorine residual, and pH will be indicated at the operator displays and the HMI.
- The control system will determine both the required and achieved C*T based on flow rate through the basin, basin volume, disinfectant concentration, water temperature, and pH.

12.4 Backwash Tank

One new backwash tank will be constructed adjacent to the CT basin. Two vertical turbine backwash pumps will be installed to pump filtered water to the filter backwash system. A check valve will be provided on the discharge of each pump. Pumps will be controlled by variable frequency drives (VFDs), as discussed in Section 5.

- Each pump will be provided with the following monitoring and control features:
  - Hand-Off-Auto and Local-Remote selector switch at the VFD. In Auto, control of pump run status is determined by PLC via momentary start and stop outputs. In Hand, the Local-Remote switch passes control to Start and Stop pushbuttons either at the VFD (Remote) or at the pump (Local). Either normal Stop pushbutton will stop the pump regardless of what mode of control the pump is in. The same will be true for either of two Emergency Stop pushbuttons, one located at the VFD, the other at the pump.
  - In Hand, manual speed control via speed potentiometer at the VFD.
  - In Auto, automatic speed control via PLC.
  - Analog speed feedback from VFD to PLC.
  - VFD fault alarm to PLC.
  - Motor temperature fault to PLC.
  - High discharge pressure to PLC.
  - Low level interlock to PLC.
  - Hand-Off-Auto switch in Auto to PLC.
  - Emergency Stop switch to PLC.

- Two backwash tank fill valves will be provided.
  - Normal supply will be via a motorized valve taking filtered water from the CT basin. The valve will include a Local-Off-Remote switch. In Local, valve position will be manipulated via Open and Close pushbuttons on the valve actuator. In Remote, automatic PLC control of the valve will open to fill the backwash tank at an operator-selected low-level setpoint and close at an operator-selected high-level setpoint.

- Alternate supply of finished water will be supplied via a motorized valve taking water from the plant's existing high service discharge and will be controlled similar to the normal supply valve as described above.
- Each valve will be provided with an actuator will includes the following:

    - Local-Off-Remote selector switch
    - Open-Stop-Close pushbuttons

- A flow meter located in the FTB pipe gallery will be provided on the backwash supply header as mentioned in the Filtration section above.

Monitoring of the Backwash Pump Station will be as follows:

- Backwash supply water flow will be metered at the common discharge header.
- Backwash tank continuous level, high-high level, and low-low level alarms.
- The following will be monitored for each backwash pump:
    - Run and auto status of each pump
    - Pump motor run time
    - Pump discharge high pressure alarm
    - Pump motor over temperature alarm
    - Pump low level interlock
    - Pump emergency stop button alarm
- The following will be monitored for each backwash tank fill valve:
    - Digital position status indicator (full open/full closed) to PLC
    - Selector switch in Remote status to PLC

12.5 Chemical Feed Vault

A new chemical feed vault will be added to the site to feed chlorine, ammonia, fluoride, caustic soda, and zinc ortho-phosphate. Chemical feeds will be flow paced using the flow meter installed upstream of the chemical application points.

13.1 General

The intent of this section is to outline the minimum requirements necessary to provide continuous pumping and treatment throughout the construction period.

Existing plant operation will be continuously maintained by Kentucky American Water during the entire construction period. Construction work will be scheduled so as not to impede any treatment process, reduce the quality of the finished water, or cause other nuisances.

H&S will work closely with the Construction Manager (CM) to coordinate the design and general construction as well as the mechanical, electrical and instrumentation construction schedules. The Contractor will provide permanent or temporary power for all existing, proposed, and temporary facilities that are required to be on-line at any given time. The Contractor will also provide additional temporary facilities, if needed, to eliminate a constraint and maintain continuous and dependable plant operation at the flow rate required to satisfy system demands.

All treatment processes will be maintained in continuous operation during the construction period except during approved process interruptions. All system or partial system shutdowns and diversions will be approved, coordinated, and scheduled at times suitable to Kentucky American Water. Contingency planning is required for all shutdowns, and standby equipment may be necessary, depending on the situation. Shutdowns will be fully coordinated with Kentucky American Water at least 7 days, and in some cases 14 days, before the scheduled shutdown. Shutdowns will typically be scheduled during the workday, which represent low flow periods. Night shut downs will not be permitted. The duration of shutdowns will be at the discretion of Kentucky American Water. Further, Kentucky American Water will have the authority to order work stopped or prohibited that would, in their opinion, unreasonably result in interrupting the necessary functions of the plant operations.

Shutdowns will not begin until all required materials are on hand and ready for installation. The Contractor shall proceed with the work continuously, start to finish, until the work is completed and normal plant operation is restored. Appropriate diversion facilities will be furnished when the plant cannot be shut down for a sufficient period of time to accomplish the work. If the Contractor completes all required work before the specified shutdown period has ended, Kentucky American Water may immediately place the existing system back into service. In the event that plant operation is impaired, the Contractor will immediately make all repairs or replacements and do all work necessary to restore the plant to operation to the satisfaction of Kentucky American Water. Such work shall progress continuously to completion on a 24-hours-per-day, seven-work-days-per-week basis.

13.2 Specific Operational Constraints

Specific construction constraints and shutdowns are outlined in **Section 01520** of the Contract Specifications. In general, the new facilities will be constructed prior to taking any of the existing facilities out of service, which will significantly reduce the impacts to the operation of the RRS WTP during construction. The main plant shutdowns that may be required during construction would be related to relocation of buried utilities. Additional shutdowns will be required to make connections into existing piping.

14.1 Equipment Manufacturers

The following is a list of manufacturers proposed for the major equipment required for the Richmond Road Station Treatment Plant Addition. The list is based on the Preliminary List of Manufacturers discussed at the kick-off meeting, but also reflects recommendations from Hazen and Sawyer based on past AWC projects. The manufacturers listed in red are KAW's acceptable manufacturers, with preferred manufacturers noted in bold. Those listed in blue are manufacturers that Hazen and Sawyer considers comparable and recommends including to promote competition.

TABLE 14.1
GENERAL EQUIPMENT

Equipment Description	Manufacturers
Ductile Iron Pipe	American Ductile Iron Pipe Griffin Pipe Products United States Pipe and Foundry
Butterfly Valves w/Electric Operators	DeZurik Valve Company Henry Pratt Company
Butterfly Valves w/Manual Operators	DeZurik Valve Company Henry Pratt Company Clow Valve Company Val-Matic
Resilient Seat Gate Valves	Mueller Company Clow Valve Company United States Pipe and Foundry American Flow Control
Check and Air Valves	Golden Anderson Cla-Val APCO Val-Matic
Electric Valve Operators	**Auma Actuators, Inc.** **EIM**
Rate of Flow Control Valve Operators	**Beck** **REXA Electraulic Actuation**
Bronze Ball Valves	Conbraco Industries Nibco Watts Regulator Company
Backflow Preventers	Ames Company, Inc. Watts Regulator Company
Paint	Carboline Paint Company M.A. Bruder and Sons (MAB) Sherwin Williams Company Tnemac Company, Inc.

TABLE 14.2 WATER TREATMENT PROCESSES	
Equipment Description	**Manufacturers**
Filtering Equipment	**Roberts** **Leopold**
Blowers	**Kaeser Compressors**
Vertical Turbine Pumps	**Flowserve** **Floway** Goulds Peerless Fairbanks Morse

TABLE 14.3 PROCESS INSTRUMENTATION	
Equipment Description	**Manufacturers**
Venturi Meters	Primary Flow Signal Leeds and Northrup Henry Pratt Company
Magnetic Flow Meters	Sparling Instruments, Inc. ABB Rosemont Endress Hauser
Displacement and Turbine Meters	Sensus Technologies, Inc. Schlumberger Industries
Ultrasonic Level Probes	Endress Hauser Inventron Miltronics Drexelbrook
Turbidimeters	**Swan Analytical** Rosemount Analytical Hach Company Sigma **Great Lakes Instrument**
Temperature Transmitters	**Hach Company** **ProMinent** Rosemount Endress Hauser
pH Analyzers	**ProMinent** Rosemount Analytical Endress Hauser Leeds & Northrup Great Lakes Instruments Hach Company
Chlorine Residual Analyzers	**ProMinent** Hach Company ProMinent
Pressure Gauges	Trerice Ashcroft

Table 14.4 Electrical Equipment	
Equipment Description	**Manufacturers**
Motor Control Centers	General Electric Allen Bradley Eaton Cutler Hammer Square D
Panel Boards	General Electric Eaton Cutler Hammer Square D
Outdoor Transformers	General Electric Eaton Cutler Hammer Square D
Dry Type Transformers	General Electric Eaton Cutler Hammer Square D
Variable Frequency Drives	**Allen Bradley PowerFlex** **Eaton Cutler Hammer SVX** **Toshiba** **Danfoss**
Reduced Voltage Solid State (Soft) Starters	**Allen Bradley SMC Flex** **Eaton Cutler Hammer S811** **Square D Altistart**
Power Generation Equipment	Caterpillar, Inc. Engine Division Onan Corporation Penn Detroit Diesel
Automatic Transfer Switch	Automatic Switch Company Onan Corporation Russelectric
Push Button Selector Switches/Pilot Light	General Electric Allen Bradley Eaton Cutler Hammer **Square D**
Relays	General Electric Eaton Cutler Hammer Potter Brumfield **Square D**
Control Relays, Timing Relays	IDEC Diversified Electronics Agastat General Electric
Power Panels	General Electric Square D Eaton Cutler Hammer
Lighting	Holophane Day-Brite Benjamin

TABLE 14.5 SCADA EQUIPMENT	
Equipment Description	**Manufacturers**
Fiber Optic Modems	Phoenix Microwave
Uninterruptable Power Supply	Best Falcon **Sola Hevi-Duty**
PLCs	Allen Bradley ControLogix or CompactLogix
Operator Interface Terminals	**Allen Bradley Panelview Plus**
Laptop Access Port	**Graceport**
PLC Cabinets	**Hoffman** Rittal **Hammond**
Ethernet Switches	**N-Tron** **Hirschmann** **Phoenix Contact**
Power Supplies	**Phoenix Contact** **Allen Bradley** **Sola Hevi-Duty**
Systems Integrators	**TBD**

TABLE 14.6 HVAC EQUIPMENT	
Equipment Description	**Manufacturers**
Electric Unit Heaters	Indeeco Chromalox Qmark
Exhaust Fans	**Big Ass Fans** Greenheck Loren Cook Twin City Aerovent
Dehumidifiers	**HI-E Dry** Desert Aire Dectron, Inc.
Louvers and Dampers	Construction Specialties (C/S), Inc. Ruskin Airolite Company