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RECEIVED

DEC 22 2005

PUBLIC SERVICE
COMMISSION

December 22, 2005

***Via Hand Delivery***

Beth O'Donnell, Esq.
Executive Director
Public Service Commission
211 Sower Boulevard
Frankfort, Kentucky 40601

RE: Kentucky-American Water Company Case No. 2005-00546

Dear Ms. O'Donnell:

Enclosed you will find for filing the original and eight (8) copies of the Application of Kentucky-American Water Company for a Determination by the Public Service Commission of the Adequacy of Its Water Storage Capacity Analysis Dated December 21, 2005 and for a Deviation from 807 KAR 5:066, Section 4 (4), Until December 31, 2020, Pursuant to 807 KAR 5:066, Section 18.

Very truly yours,

STOLL, KEENON & PARK, LLP

By Lindsey Ingram Jr.
Lindsey Ingram, Jr.

/sl
Encs.
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DEC 2 2 2005
PUBLIC SERVICE COMMISSION

**COMMONWEALTH OF KENTUCKY**

**BEFORE THE PUBLIC SERVICE COMMISSION**

**IN THE MATTER OF:**

| | | |
|---|---|---|
| **APPLICATION OF KENTUCKY-AMERICAN WATER COMPANY FOR A DETERMINATION BY THE PUBLIC SERVICE COMMISSION OF THE ADEQUACY OF ITS WATER STORAGE CAPACITY ANALYSIS DATED DECEMBER 21, 2005 AND FOR A DEVIATION FROM 807 KAR 5:066, SECTION 4 (4), UNTIL DECEMBER 31, 2020, PURSUANT TO 807 KAR 5:066, SECTION 18** | ) | **CASE NO.** 2005-00546 |

* * * * * * * * * * * *

Comes Kentucky-American Water Company (Kentucky American Water), by counsel, and for its Application states as follows:

1. Kentucky American Water is a corporation organized and existing under the laws of the Commonwealth of Kentucky with its principal office and place of business in Lexington, Fayette County, Kentucky. It is engaged in the distribution of sale of water in its Central Division, consisting of Bourbon, Clark, Fayette, Harrison, Jessamine, Scott and Woodford Counties, and its Northern Division consisting of Gallatin, Grant and Owen Counties. The post office address of Kentucky American Water is 2300 Richmond Road, Lexington, Kentucky 40502.

2. Copies of the Articles of Incorporation of Kentucky American Water, together with all amendments thereto, have heretofore been filed with this Commission in Case No. 95-554, Notice of the Adjustment of the Rates of Kentucky-American Water Company Effective On and After February 29, 1996, and are incorporated herein by reference as authorized by 807 KAR 5:001, Section 8 (3).

3. Kentucky American Water prepared a Storage Capacity Analysis dated September, 1993, and by Order entered in Case No. 93-432 on December 20, 1993, Kentucky American Water was granted a deviation from the requirements of 807 KAR 5:066, Section 4 (4), and was given until December 31, 2005, to comply with the construction of storage facilities as set forth in its Application in Case No. 93-432. Kentucky American Water has complied with the provisions of its Application in Case No. 93-432.

4. 807 KAR 5:066, Section 4 (4), provides that "the minimum storage capacity for systems shall be equal to the average daily consumption." Kentucky American Water believes that its existing potable water storage, raw water storage, emergency pumping and production capability and planned construction are sufficient to meet the intent of the regulation. Kentucky American Water has prepared a Storage Capacity Analysis dated December 21, 2005, and a copy thereof is attached hereto and marked Exhibit 1.

5. The Storage Capacity Analysis attached hereto evidences the belief of Kentucky American Water that it has adequate facilities to provide reasonable service to customers during various emergency situations.

6. As a part of its continuing effort to address its source of supply and treatment plant deficits, Kentucky American Water proposes to construct an additional potable water storage tank which will provide additional storage to meet pressure equalization and fire protection needs. Kentucky American Water estimates that the 3,000,000 gallon pumped potable water storage facility will be completed by 2010. The current estimated cost of the construction of the storage facility ranges from $2,000,000 to $3,500,000 depending upon its location.

WHEREFORE, Kentucky American Water requests that the Public Service Commission determine the adequacy of its water Storage Capacity Analysis attached hereto and that it be authorized to deviate from the requirements of 807 KAR 5:066, Section 4 (4), until December 31, 2020, by construction of an additional 3,000,000 gallon pumped storage tank, all pursuant to the authority contained in 807 KAR 5:066, Section 18.

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BY: Lindsey Ingram Jr.
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ATTORNEYS FOR KENTUCKY AMERICAN WATER

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**KENTUCKY-AMERICAN WATER COMPANY**
**STORAGE CAPACITY ANALYSIS**
December 21, 2005

**KENTUCKY-AMERICAN WATER COMPANY**
**STORAGE CAPACITY ANALYSIS**
December 21, 2005

## A. INTRODUCTION

Kentucky-American Water Company (KAWC) provides water service and fire protection to Fayette County and portions of Bourbon, Harrison, Scott, Woodford, Jessamine, Clark, Owen, Grant and Gallatin Counties in central Kentucky. A total of 112,026 customers were served as of September 30, 2005 that represents an estimated total population of 325,000 people. This includes approximately 2,160 customers of the former Tri-Village Water District and Elk Lake Water System in Owen, Grant and Gallatin Counties that were acquired in 2001 and 2002 respectively and does not include the Owenton Municipal System acquired September 15, 2005. The storage related to these three Owen County systems has not been included in this analysis since these systems currently have storage in excess of the average daily demand. The Clark County service area was acquired by KAWC in 1999 and integrated into KAWC's Lexington system in 2001. A small portion of Clark county service area (300 customers) is fed from Winchester Municipal Utilities.

The KAWC service area utilizes two primary sources of supply: the Kentucky River and Jacobson Reservoir. In an emergency, a third source of supply, Lake Ellerslie, can also be utilized; however, it has a very low safe yield. The system also includes two treatment plants: the Kentucky River Station (KRS), which is rated for 40 MGD, and the Richmond Road Station (RRS), which is rated for 25 MGD. As of November 28, 2000 the KRS was granted a temporary re-rated capacity of 45 mgd during summer months by the Division of Water (DOW). Further, KAWC has demonstrated the capability of producing up to 50 mgd from KRS and 30 mgd from RRS while maintaining good finished water quality. The DOW has recognized temporary instances on any given day where a system must exceed the reliable plant capacity to meet system demands provided that health standards are met and proper disinfection is maintained. Water treated at KRS is derived only from the Kentucky River whereas RRS is piped to treat water from the Kentucky River, Jacobson Reservoir, or Lake Ellerslie.

The KAWC distribution system consists of approximately 1,603 miles of mains and 6,966 fire hydrants. The mains range in size from 2" to 36" with mains larger than 6" comprising 65% of the total footage. The system is divided into three pressure gradients known as Main Service, High Service, and Sadieville and includes a total of 15 storage tanks (both elevated and pumped storage) and 13 booster stations. A summary of the existing KAWC storage and pumping facilities is provided in Exhibit No. 1 on the following page.

## B. REGULATIONS/HISTORY

The Kentucky Public Service Commission Title 807, Chapter 5 - Utilities, Section 4 - Continuity of Service, paragraph (4) states "the minimum storage capacity for systems shall be equal to the average daily consumption." Section 4 is entitled "Continuity of Service" and generally deals with provisions to provide continuous supply to customers during various emergency situations. The "emergency" storage is generally required so that an adequate supply of water is available in the event of a scenario where water cannot be distributed from the system's source and treatment facilities. Reasons for not being able to supply water to the system could include an emergency in the source of supply (such as a spill), a power failure, or an upset or other treatment problem.

**EXHIBIT NO. 1**
**Kentucky-American Water Company**
Existing Storage and Pumping Facilities

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *Raw Water Pumps* | | | | | | | | |
| **Intake** | | | | | **No. of Pumps** | **Total Pumping Capacity (MGD)** | *** Reliable Pump Capacity (MGD)** | **** Standby Pump Capacity (MGD)** |
| Kentucky River | | | | | 6 | 74.4 | 62.0 | 0.0 |
| Jacobson Reservoir | | | | | 3 | 22.8 | 9.4 | 13.4 |
| Lake Ellerslie | | | | | 2 | 10.0 | 4.0 | 6.0 |
| **Total** | | | | | **11** | **107.2** | **75.4** | **19.4** |
| *Finished Water Storage at Treatment Plants* | | | | | | | | |
| **Plant** | | | | **Clearwell Volume (MG)** | **No. of Pumps** | **Total Pumping Capacity (MGD)** | *** Reliable Pump Capacity (MGD)** | **** Standby Pump Capacity (MGD)** |
| KRS | | | | 2.97 | 6 | 51.6 | 41.7 | 9.9 |
| RRS | | | | 1.05 | 6 | 37.0 | 27.0 | 16.5 |
| **Total** | | | | **4.02** | **12** | **88.6** | **68.7** | **26.4** |
| *Main Service Gradient Storage Facilities* | | | | | | | | |
| **Tank** | **Year Built** | **Volume (MG)** | **Elevated** | **Overflow Elevation** | **No. of Pumps** | **Total Pumping Capacity (MGD)** | *** Reliable Pump Capacity (MGD)** | **** Standby Pump Capacity (MGD)** |
| Clays Mill | 1995 | 3.00 | No | 1022.50 | 2 | 18.00 | 9.00 | 9.00 |
| Clays Mill 2 | 2004 | 3.00 | No | 1022.50 | 0 | N/A | N/A | N/A |
| Tates Creek | 1954 | 0.50 | Yes | 1185.25 | 0 | N/A | N/A | N/A |
| Parkers Mill | 1968 | 3.00 | No | 1025.00 | 1 | 9.00 | 0.00 | 9.00 |
| Eastland Elevated | 2005 | 2.00 | Yes | 1170.00 | 0 | N/A | N/A | N/A |
| York Street | 1949 | 1.00 | No | 1000.25 | 1 | 2.50 | 0.00 | 0.00 |
| Cox Street Ground | 1948 | 1.00 | No | 1001.75 | 1 | 2.50 | 0.00 | 0.00 |
| Cox Street Elevated | 1955 | 1.00 | Yes | 1117.00 | 1 | 3.00 | 0.00 | 0.00 |
| Mercer Road | 1965 | 2.00 | Yes | 1107.00 | 1 | 5.00 | 0.00 | 0.00 |
| Hume Road | 1988 | 3.00 | No | 979.50 | 3 | 9.00 | 6.00 | 6.00 |
| **Total** | | **19.50** | | | **10** | **49.00** | **15.00** | **24.00** |
| *High Service Gradient Pumping Facilities* | | | | | | | | |
| **Booster** | | | | | **No. of Pumps** | **Total Pumping Capacity (MGD)** | *** Reliable Pump Capacity (MGD)** | **** Standby Pump Capacity (MGD)** |
| Briar Hill | | | | | 2 | 4.00 | 2.00 | 0.00 |
| Mt. Horeb | | | | | 2 | 1.15 | 0.57 | 0.00 |
| Newtown | | | | | 3 | 7.70 | 4.70 | 7.70 |
| Delaplain Road | | | | | 1 | 0.85 | 0.00 | 0.00 |
| **Total** | | | | | **8** | **13.70** | **7.27** | **7.70** |
| *High Service Gradient Storage Facilities* | | | | | | | | |

| Tank | Year Built | Volume (MG) | Elevated | Overflow Elevation | No. of Pumps | Total Pumping Capacity (MGD) | * Reliable Pump Capacity (MGD) | ** Standby Pump Capacity (MGD) |
|---|---|---|---|---|---|---|---|---|
| Briar Hill | 1998 | 0.75 | Yes | 1150.00 | 0 | N/A | N/A | N/A |
| Russell Cave Road | 2005 | 1.0 | No | 1020.83 | 3 | 3.00 | 3.00 | 3.00 |
| Muddy Ford | 1989 | 0.75 | Yes | 1130.00 | 0 | N/A | N/A | N/A |
| Hall | 1962 | 0.21 | No | 1115.00 | 2 | 0.58 | 0.29 | 0.00 |
| **Total** | | **2.71** | | | **5** | **3.58** | **3.29** | **3.00** |
| *Sadieville Gradient Storage Facilities* | | | | | | | | |
| **Tank** | **Year Built** | **Volume (MG)** | **Elevated** | **Overflow Elevation** | **No. of Pumps** | **Total Pumping Capacity (MGD)** | *** Reliable Pump Capacity (MGD)** | **** Standby Pump Capacity (MGD)** |
| Sadieville | 1975 | 0.38 | Yes | 992.00 | 0 | N/A | N/A | N/A |
| **Total** | | **0.38** | | | **0** | **N/A** | **N/A** | **N/A** |

**MG = Million Gallons**
**MGD = Million Gallons per Day**
*** Reliable Pumping Capacity = Station capacity with the largest pump out of service**
**** Standby Pumping Capacity = Station capacity during a power outage using an alternate power source (i.e. diesel fuel or natural gas)**

In 1993 the Public Service Commission granted KAWC a variance from this regulation and reduced the storage requirement in the Main Service gradient to 50% of an average day demand by giving credit for standby distributive pumping facilities at the treatment plants. This variance was granted based on the an engineering analysis developed by KAWC in September, 1993 entitled "Storage Capacity Analysis" which reflected KAWC's 1992 Least Cost/Comprehensive Planning Study. The variance was granted in an order dated December 20, 1993. The 1993 report was updated in a report dated November 15, 2002. This report updates the findings of the September, 1993 and the 2002 report.

## C. PURPOSE OF FINISHED WATER STORAGE

Treated water storage in a water distribution system is provided for various purposes as quoted from the following sources:

1. Introduction to Water Distribution (Volume 3 of AWWA's Principles and Practices of Water Supply Operations)

   Chapter 8, Section 8-1, under the chapter heading "Purpose of Water Storage" states that "water storage in the distribution system is required for the following reasons:

   - Equalizing supply and demand
   - Increasing operating convenience
   - Leveling out pumping requirements
   - Providing water during source or pump failure
   - Providing water to meet fire demands
   - Providing surge relief
   - Increasing detention times
   - Blending water sources"

   Under the chapter heading "Capacity Requirements", it also states:

   "The capacity of distribution storage is based on the maximum water demands in different parts of the system. Capacity varies for different systems and can only be determined by qualified engineers after a careful analysis and study of a particular system. Storage capacity needed for fire protection should be based on the recommendation of fire underwriter's organizations. Because there are so many variables involved, operators should contact the Insurance Services Organization Office or the Fire Insurance Rating Office in their state to obtain any available information.

Additional storage capacity may be necessary to meet emergencies such as pump failure, source failure, or transmission-line break. The need for emergency storage should be based on the reliability of the supply and pumping equipment and the availability of backup equipment and standby power resources."

2. <u>Recommended Standards for Water Works</u> (Ten States Standards)

Chapter 7, Finished Water Storage, states the following in chapter 7.0.1 "Sizing":

"Storage facilities should have sufficient capacity, as determined from engineering studies, to meet domestic demand, and where fire protection is provided, fire flow demands.

a. Fire flow requirements established by the appropriate state Insurance Services Office should be satisfied where fire protection is provided.
b. The minimum storage capacity (or equivalent capacity) for systems not providing fire protection shall be equal to the average daily consumption. This requirement may be reduced when the source and treatment facilities have sufficient capacity with standby power to supplement peak demands of the system."

In summary, the quantity of treated water storage in the distribution system should be the sum of equalization requirements, fire flow storage, and to meet emergency conditions depending on the reliability of the source and treatment facilities, system configuration, and the availability of standby power. The minimum storage capacity equal to the average daily consumption is appropriate where there is no reliability of supply and pumping equipment, and no standby power resources. Section G below describes the analysis of the KAWC system under these criteria.

## D. SUMMARY OF PREVIOUS ANALYSIS

In 1993, KAWC submitted a storage capacity analysis to the PSC that recommended the appropriate water storage needs for its system through the year 2005. That analysis evaluated the need for storage based on equalization and fire flow requirements, as well as the need for storage based on the Public Service Commission's requirement of maintaining a supply equal to an average day demand (emergency storage). The results of that analysis, which was segregated for each of the three KAWC pressure gradients known as Main Service, High Service, and Sadieville, are summarized in Exhibit No. 2 on the following page.

If KAWC was to provide one day's emergency storage requirement in the year 2005, storage volume shortfalls of 26.55 MG and 1.44 MG are projected for the Main Service and High Service gradients respectively based on the current storage capacity. However, KAWC at that time requested a deviation from the one-day emergency storage requirement for the Main Service gradient. This was requested on the basis that adequate standby power existed at the company's two treatment plants. The Commission approved this request in their order dated December 20, 1993, and reduced the emergency storage requirement to 50% of the average day demand, or 18.61 MG for the KAWC Main Service gradient. This methodology reduced the storage deficit in the Main Service gradient from 26.55 MG to 7.95 MG.

The 1993 analysis recommended the construction of five storage tanks between 1994 and 2005 in order to eliminate the storage deficit. These included:

1. A 3 mg pumped storage tank to be located in the southwest area of the distribution system.

2. A second 3 mg pumped storage tank at the site of either the existing Hume Road 3 mg pumped storage tank or the Parkers Mill Road 3 mg pumped storage tank.

3. A second 3 mg pumped storage tank at the location of the pumped storage tank to be located in the southwest area of the distribution system

4. A 0.75 mg elevated tank northeast of the Avon Depot and booster station to serve the High service zone.

5. A 1.0 mg pumped storage facility on Russell Cave Road.

**EXHIBIT NO. 2**
**Kentucky-American Water Company**
1993 Storage Capacity Analysis

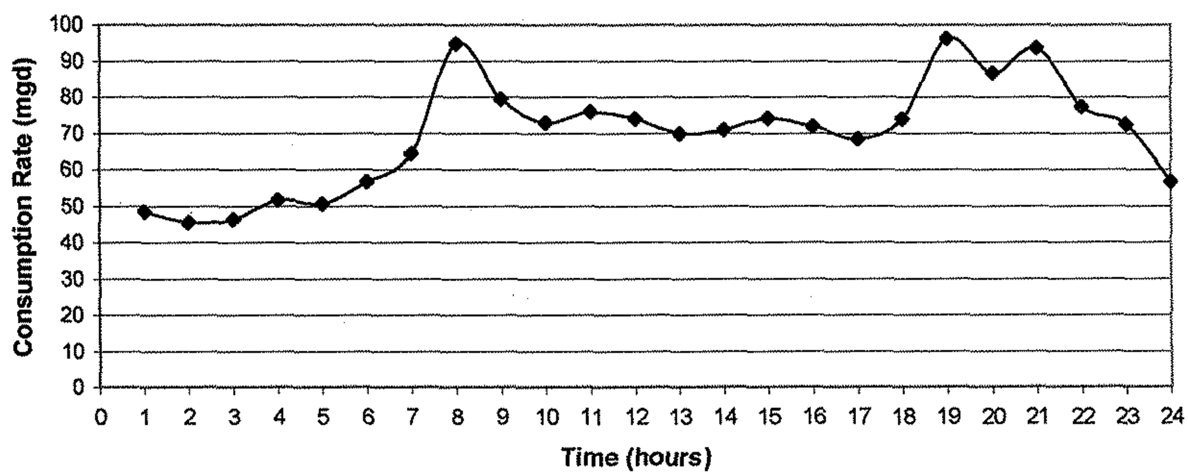
| Year | Avg Day (MGD) | Max Day (MGD) | Existing Effective Storage (MG) | Equalization Storage Need (MG) | Equalization + Fire Flow Need (MG) | Equalization + Fire Flow Surplus/Deficit (MG) | Emergency Storage (100%) Requirement (MG) | Emergency Storage Surplus/Deficit (MG) |
|---|---|---|---|---|---|---|---|---|
| *Main Service Gradient (15% equalization factor)* | | | | | | | | |
| 1992 | 37.54 | 63.79 | 10.66 | 9.57 | 11.49 | -0.83 | 37.54 | -26.88 |
| 1996 | 37.67 | 64.90 | 10.66 | 9.74 | 11.66 | -1.00 | 37.67 | -27.01 |
| 2000 | 37.47 | 65.05 | 10.66 | 9.76 | 11.63 | -0.97 | 37.47 | - 26.81 |
| 2005 | 37.21 | 65.23 | 10.66 | 9.78 | 11.70 | -1.04 | 37.21 | -26.55 |
| *High Service Gradient (25% equalization factor)* | | | | | | | | |
| 1992 | 1.44 | 1.82 | 0.95 | 0.46 | 1.09 | -0.14 | 1.44 | -0.49 |
| 1996 | 2.38 | 3.01 | 0.95 | 0.75 | 1.38 | -0.43 | 2.38 | -1.43 |
| 2000 | 2.39 | 3.02 | 0.95 | 0.76 | 1.39 | -0.44 | 2.39 | -1.44 |
| 2005 | 2.39 | 3.02 | 0.95 | 0.76 | 1.39 | -0.44 | 2.39 | -1.44 |
| *Sadieville Gradient (25% equalization factor)* | | | | | | | | |
| 1992 | 0.07 | 0.12 | 0.25 | 0.03 | 0.21 | 0.04 | 0.07 | 0.18 |
| 1996 | 0.07 | 0.12 | 0.25 | 0.03 | 0.21 | 0.04 | 0.07 | 0.18 |
| 2000 | 0.08 | 0.12 | 0.25 | 0.03 | 0.21 | 0.04 | 0.08 | 0.17 |
| 2005 | 0.08 | 0.13 | 0.25 | 0.03 | 0.21 | 0.04 | 0.08 | 0.17 |

**MG = Million Gallons**
***MGD = Million Gallons per Day***

## E. 2002 STORAGE CAPACITY ANALYSIS

American Water Works Service Co. (AWWSC) updated the 1993 storage capacity analysis to include the new storage facilities, incorporate updated system demand projections and water usage patterns, and extend the analysis through a planning horizon to the year 2020. The updated study included a determination of the equalization storage needs based on an hour-by-hour analysis of the plant production rates, incremental storage changes, and customer usage on a maximum demand day. A maximum day demand of system delivery, 71.82 mgd occurred on August 5, 2002. However, there were some unusual tank operations that day, and therefore August 9, 2002 was deemed to be a more representative day and more appropriate for analysis in this report. Total system demand on this day was 70.23 mgd. From this information, an hourly demand curve was developed which identifies the amount of equalization volume utilized on that day. The hourly demand curve for August 9, 2002 can be found in Exhibit No. 3 below.

EXHIBIT NO. 3
Kentucky-American Water Company
AUGUST 9, 2002 MAX DAY ANALYSIS
Hourly Consumption




The analysis of hourly demands showed that consumption reached a peak rate of 96.23 mgd during the period from 6 pm to 7 pm on August 9, 2002. The minimum consumption rate that day was 45.51 mgd during the 1 am to 2 am period. The amount of storage needed to equalize system production to a constant rate on that day was calculated to be 5.83 MG, or 8.3% of the maximum day demand. To be sure that the equalization analysis adequately identified the amount of storage that might be needed under a range of demand patterns, higher equalization percentages were used in the calculations. Equalization factors selected for the Main Service and

High Service gradients are 12% and 15%, respectively. The factors were reasonable in comparison with values for similar sized systems and have been maintained in the current analysis. The equalization factor of 20% used in the Sadieville gradient was estimated due to lack of metering facilities; however, it was also reasonable based on results of other analyses performed for similar sized systems. Equalization factors generally decrease as the size of the system becomes larger.

The needed fire flow volumes (which did not change from the 1993 analysis) were then added to the equalization storage needs to determine the appropriate amount of storage for proper operation of the system. The quantity of treated water storage needed for fire protection purposes is determined from the insurance rating surveys performed periodically by the Insurance Services Office (ISO). For the Main Service gradient, the fire flow need determined by the ISO is 8,000 gpm over a four (4) hour duration, which equals 1.92 MG. For the High Service gradient, a fire flow need of 3,500 gpm over a three (3) hour duration, which equals 0.63 MG, was estimated in the absence of current ISO information. This fire flow estimate conservatively reflected a significant fire demand for a large commercial or industrial customer. For the Sadieville gradient, a fire flow need of 1,500 gpm over a two (2) hour duration, which equals 0.18 MG, was estimated in the absence of current ISO information. This generally reflected the fire flow needs for the customer makeup in this gradient.

The summation of equalization and fire flow needs was then compared to the existing usable storage in the system to determine if a surplus or deficit exists. The results of this analysis are summarized in Exhibit No. 4. The emergency storage requirement set by the Commission of one average day demand was also reviewed to identify if a surplus or deficit exists from that perspective. The results of this analysis are summarized in Exhibit No. 5.

**EXHIBIT NO. 4**
**Kentucky-American Water Company**
Storage Capacity Analysis
**Equalization and Fire Flow Storage Need**

| Year | Avg Day (MGD) | Max Day (MGD) | * Existing Storage (MG) | Equalization Storage Need (MG) | Equalization + Fire Flow Need (MG) | Equalization + Fire Flow Surplus/(Deficit) (MG) |
|---|---|---|---|---|---|---|
| *Main Service Gradient (12% equalization factor)* | | | | | | |
| 2005 | 40.55 | 69.31 | 14.50 | 8.32 | 10.24 | 4.26 |
| 2010 | 42.57 | 72.52 | 14.50 | 8.70 | 10.62 | 3.88 |
| 2015 | 44.59 | 75.79 | 14.50 | 9.09 | 11.01 | 3.49 |
| 2020 | 46.88 | 79.25 | 14.50 | 9.51 | 11.43 | 3.07 |
| *High Service Gradient (15% equalization factor)* | | | | | | |
| 2005 | 4.22 | 7.21 | 1.71 | 1.08 | 1.71 | 0.00 |
| 2010 | 4.43 | 7.54 | 1.71 | 1.13 | 1.76 | (0.05) |
| 2015 | 4.64 | 7.88 | 1.71 | 1.18 | 1.81 | (0.90) |
| 2020 | 4.87 | 8.24 | 1.71 | 1.24 | 1.87 | (0.16) |
| *Sadieville Gradient (20% equalization factor)* | | | | | | |
| 2005 | 0.090 | 0.153 | 0.380 | 0.031 | 0.211 | 0.169 |
| 2010 | 0.094 | 0.160 | 0.380 | 0.032 | 0.212 | 0.168 |
| 2015 | 0.099 | 0.168 | 0.380 | 0.034 | 0.214 | 0.166 |
| 2020 | 0.104 | 0.175 | 0.380 | 0.035 | 0.215 | 0.165 |

**MG = Million Gallons**
**MGD = Million Gallons per Day**
***For Equalization Purposes, Clearwell Storage at the Treatment Plants is not Included**

Based solely on equalization and fire flow needs, the analysis indicated that there were no storage deficiencies in the Main Service and Sadieville gradients, and only a very minor storage deficit in the High Service gradient, through the year 2020. This is primarily a result of the storage additions KAWC made in the Main Service and High Service gradients following the Commission's order after their review of the 1993 analysis. The minor deficiency in the High Service gradient is offset by the ability to reliably pump additional water from the Main Service gradient where adequate storage for solely equalization and fire flow existed.

**EXHIBIT NO. 5**
**Kentucky-American Water Company**
Storage Capacity Analysis
**Emergency Storage Volume Calculation**

| Year | Avg Day (MGD) | Max Day (MGD) | * Existing Storage (MG) | Emergency Storage Requirement @ 50% for Main, 100% for HS & Sadieville (MG) | Emergency Storage Surplus/(Deficit) @ 50% for Main, 100% for HS & Sadieville (MG) | Emergency Storage Requirement @ 100% for all Gradients (MG) | Emergency Storage Surplus/(Deficit) @ 100% for all Gradients (MG) |
|---|---|---|---|---|---|---|---|
| *Main Service Gradient* | | | | | | | |
| 2005 | 40.55 | 69.31 | 18.52 | 20.28 | (1.76) | 40.55 | (22.03) |
| 2010 | 42.57 | 72.52 | 18.52 | 21.28 | (2.76) | 42.57 | (24.05) |
| 2015 | 44.59 | 75.79 | 18.52 | 22.30 | (3.78) | 44.59 | (26.07) |
| 2020 | 46.88 | 79.25 | 18.52 | 23.44 | (4.92) | 46.88 | (28.36) |
| *High Service Gradient* | | | | | | | |
| 2005 | 4.22 | 7.21 | 1.71 | 4.22 | (2.52) | 4.22 | (2.52) |
| 2010 | 4.43 | 7.54 | 1.71 | 4.43 | (2.73) | 4.43 | (2.73) |
| 2015 | 4.64 | 7.88 | 1.71 | 4.64 | (2.94) | 4.64 | (2.94) |
| 2020 | 4.87 | 8.24 | 1.71 | 4.87 | (3.17) | 4.87 | (3.17) |
| *Sadieville Gradient* | | | | | | | |
| 2005 | 0.090 | 0.153 | 0.380 | 0.090 | 0.290 | 0.090 | 0.290 |
| 2010 | 0.094 | 0.160 | 0.380 | 0.094 | 0.286 | 0.094 | 0.286 |
| 2015 | 0.099 | 0.168 | 0.380 | 0.099 | 0.281 | 0.099 | 0.281 |
| 2020 | 0.104 | 0.175 | 0.380 | 0.104 | 0.276 | 0.104 | 0.276 |

**MG = Million Gallons**
**MGD = Million Gallons per Day**
***For Calculation of Emergency Volume Purposes, Clearwell Storage at the Treatment Plants is Included**

The above analysis indicated that additional storage is needed in the Main Service and High Service gradients to meet the emergency storage requirements. However, the Emergency Storage Requirement shown is based solely on a percentage of projected average daily demand. This approach, while reasonable, is arbitrary when applied to a specific water system. For instance, as shown in Exhibit 5, when 50% of average day demand is considered to be the appropriate volume of emergency storage, KAWC has a 2020 deficit of 4.92 MG. However, when 100% of average day demand is considered to be the appropriate volume, the 2020 deficit increases substantially to 28.36 MG. In order to conduct a full and thorough analysis of the appropriate amount of storage, peak hour equalization needs, fire protection storage, water quality concerns, and an assessment of system vulnerability under a range of emergency scenarios was reviewed.

The 2002 analysis recommended the construction of four storage tanks between 2002 and 2010 in order to eliminate the storage deficit. These included:

1. A second 3 mg pumped storage tank to be located at the Clays Mill Road Three MG Tank site.

2. A One (1) MG ground storage tank on Russell Cave Road with a booster station.

3. A Two (2) MG Elevated Tank in the Main Service Gradient

4. A second Three (3) MG tank at Parkers Mill or Hume Road existing tank sites

The 2002 analysis also recommended five Electrical, valving and pumping Improvements to increase reliability:

1. Improvements to ball valves at pumped storage tank sites to allow quick, remote opening of the valves during an emergency

2. Modifications to the control logic within KAWC's Supervisory Control and Data Acquisition (SCADA) system to automatically turn on pumps at storage tanks in response to a drop in system pressure

3. Modifications to the Tates Creek Elevated Tank to allow water to flow from this tank into the system by gravity in response to a drop in system pressure

4. Installation of a second transformer at KRS and appropriate electrical improvement including a breaker at the transmission line to improve reliability of electrical service at that plant

5. Installation of a sectionalizing breaker on the transmission lines by Kentucky Utilities to remotely switch the electrical feed to KRS to the second feed line serving the facility

## F. STORAGE IMPROVEMENTS

Since 1993, KAWC has constructed and placed into service five storage facilities to address the emergency storage deficits identified in the 1993 analysis. The Clays Mill storage tank and booster station was completed in 1996 at a total cost of $3,120,000, and includes 3.0 MG of pumped storage in the Main Service gradient. The Briar Hill elevated storage tank was completed in 1999, and provides 0.75 MG of elevated storage in the High Service gradient. A 4.0 MGD pumping facility was also constructed concurrently with the Briar Hill tank, to boost water into the tank from the Main Service gradient. The total cost of the Briar Hill facilities was $1,640,000.

In 2004, the second Clays Mill 3.0 MG ground storage tank was completed at a total cost of $1,601,000. The Eastland Elevated storage tank will be completed in December 2005 at an estimated total cost of $3,032,900, providing 2.0 MG of elevated storage in the main service gradient. Also in 2005, the Russell Cave Road 1.0 MG pumped storage tank was completed in the High Service Gradient for a cost of $1,503,400.

Additionally, improvements to the ball valves at pumped storage tank sites, modifications to the SCADA system, and the installation of a sectionalizing breaker on the transmission lines by Kentucky Utilities to remotely switch the electrical feed to KRS to the second line serving the facility were all completed. Work on the Tates Creek tank was halted after design of the Eastland tank demonstrated only marginal additional benefits from the Tates Creek tank. The second transformer at KRS has been deferred after discussions with Kentucky Utilities regarding cost and space requirements. These improvements were completed at a cost of $920,400.

In addition to the above improvements, KAWC's telephone telemetry system was upgraded to a radio based system and completed in February, 2000 at a total cost of $530,000. During thunderstorms, the conventional telephone telemetry system would experience routine outages that prevented KAWC from being able to remotely monitor and control the distribution storage and pumping facilities. The installation of the radio-based system greatly reduced this problem, although loss of the radio system is still a small possibility.

The above storage improvements reduced the projected deficits in all service gradients from the 2002 analysis based on Equalization and Fire Flow, or 50% Emergency storage.

## G. CURRENT STORAGE CAPACITY ANALYSIS

Kentucky American Water has not experienced a new peak day demand since 2002. An update of the 2002 storage tables with the new tank volumes and revised demand projections are shown below. Note that the 2002 population projections have reduced the projected demands, in addition to reduced demands in 2003 and 2004 due to extremely wet summer weather.

**EXHIBIT NO. 6**
**Kentucky-American Water Company**
Storage Capacity Analysis
**Equalization and Fire Flow Storage Need**

| Year | Avg Day (MGD) | Max Day (MGD) | * Existing Storage (MG) | Equalization Storage Need (MG) | Equalization + Fire Flow Need (MG) | Equalization + Fire Flow Surplus/(Deficit) (MG) |
|---|---|---|---|---|---|---|
| *Main Service Gradient (12% equalization factor)* | | | | | | |
| 2005 | 37.21 | 67.82 | 19.50 | 8.14 | 10.06 | 9.44 |
| 2010 | 38.95 | 70.77 | 19.50 | 8.49 | 10.41 | 9.09 |
| 2015 | 40.87 | 74.07 | 19.50 | 8.89 | 10.81 | 8.69 |
| 2020 | 42.84 | 77.39 | 19.50 | 9.29 | 11.21 | 8.29 |
| *High Service Gradient (15% equalization factor)* | | | | | | |
| 2005 | 3.87 | 7.05 | 2.71 | 1.06 | 1.69 | 1.02 |
| 2010 | 4.05 | 7.36 | 2.71 | 1.10 | 1.73 | 0.98 |
| 2015 | 4.25 | 7.71 | 2.71 | 1.16 | 1.79 | 0.92 |
| 2020 | 4.45 | 8.05 | 2.71 | 1.21 | 1.84 | 0.87 |
| *Sadieville Gradient (20% equalization factor)* | | | | | | |
| 2005 | 0.082 | 0.150 | 0.380 | 0.030 | 0.210 | 0.170 |
| 2010 | 0.086 | 0.157 | 0.380 | 0.031 | 0.211 | 0.169 |
| 2015 | 0.090 | 0.164 | 0.380 | 0.033 | 0.213 | 0.167 |
| 2020 | 0.095 | 0.171 | 0.380 | 0.034 | 0.214 | 0.166 |

**MG = Million Gallons**
**MGD = Million Gallons per Day**
***For Equalization Purposes, Clearwell Storage at the Treatment Plants is not Included**

Based solely on equalization and fire flow needs, the analysis indicates there are no storage deficiencies through the year 2020.

| EXHIBIT NO. 7<br>Kentucky-American Water Company<br>Storage Capacity Analysis<br>Emergency Storage Volume Calculation | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | Emergency Storage Requirement | Emergency Storage Surplus/(Deficit) | Emergency Storage Requirement | Emergency Storage Surplus/(Deficit) |
| Year | Avg Day (MGD) | Max Day (MGD) | * Existing Storage (MG) | @ 50% for Main, 100% for HS & Sadieville (MG) | @ 50% for Main, 100% for HS & Sadieville (MG) | @ 100% for all Gradients (MG) | @ 100% for all Gradients (MG) |
| *Main Service Gradient* | | | | | | | |
| 2005 | 37.21 | 67.82 | 23.52 | 18.61 | 4.91 | 37.21 | (13.70) |
| 2010 | 38.95 | 70.77 | 23.52 | 19.48 | 4.04 | 38.95 | (15.44) |
| 2015 | 40.87 | 74.07 | 23.52 | 20.44 | 3.08 | 40.87 | (17.36) |
| 2020 | 42.84 | 77.39 | 23.52 | 21.42 | 2.10 | 42.84 | (19.32) |
| *High Service Gradient* | | | | | | | |
| 2005 | 3.87 | 7.05 | 2.71 | 3.87 | (1.16) | 3.87 | (1.16) |
| 2010 | 4.05 | 7.36 | 2.71 | 4.05 | (1.34) | 4.05 | (1.34) |
| 2015 | 4.25 | 7.71 | 2.71 | 4.25 | (1.54) | 4.25 | (1.54) |
| 2020 | 4.45 | 8.05 | 2.71 | 4.45 | (1.74) | 4.45 | (1.74) |
| *Sadieville Gradient* | | | | | | | |
| 2005 | 0.082 | 0.150 | 0.380 | 0.082 | 0.298 | 0.082 | 0.298 |
| 2010 | 0.086 | 0.157 | 0.380 | 0.086 | 0.294 | 0.086 | 0.294 |
| 2015 | 0.090 | 0.164 | 0.380 | 0.090 | 0.290 | 0.090 | 0.290 |
| 2020 | 0.095 | 0.171 | 0.380 | 0.095 | 0.285 | 0.095 | 0.285 |

**MG = Million Gallons**
**MGD = Million Gallons per Day**
***For Calculation of Emergency Volume Purposes, Clearwell Storage at the Treatment Plants is Included**

The above analysis continues to indicate that additional storage is needed in the Main Service and High Service gradients to meet the emergency storage requirements based on 100% of average day demand. When 50% average day demand is considered, the 2020 storage deficit in the Main Service gradient has now been eliminated. A storage deficit of 1.74 MG is shown to be in the High Service gradient, however, it is anticipated that this storage could be supplied from the Main Service gradient. Again a review of peak hour equalization needs, fire protection storage, water quality concerns and an assessment of system vulnerability under a range of emergency scenarios was conducted to complete a full and thorough analysis of the appropriate amount of storage.

## H. WATER QUALITY CONCERNS

From a system reliability point of view, for many components, it can be considered that "more is better". However, finished water storage can be an exception. Recommended Standards for Water Works (Ten State Standards) states that "excessive storage capacity should be avoided where water quality deterioration may occur." The specific water quality deterioration issues that can become a direct concern with additional storage in the KAWC system include maintenance of a disinfectant residual, increased disinfection by-product formation, and nitrification. Additionally, indirect water quality concerns may also arise due to the potential need to modify distributive pumping operations at the treatment plants.

KAWC currently employs the practice of chloramination (chlorine + ammonia to form chloramines) for final disinfection at its treatment plants prior to delivery to the distribution system. Although chloramines are not as strong a disinfectant as free chlorine, they provide the benefit of being able to persist longer, which reduces the potential need for rechlorination in the distribution system. Additionally, continued formation of disinfection by-products (trihalomethanes or THMs) in the distribution system, which is a function of time, is significantly decelerated. Although the use of chloramines in lieu of free chlorine lessens the potential for loss of a disinfectant residual or increased disinfection by-product formation, increased detention time due to additional storage increases the concern. The maximum contaminant level (MCL) for THMs is 80 ug/L per the Stage I Disinfectants/Disinfection By-Product (D/DBP) Rule. Haloacetic acids (HAAs) are also regulated with an MCL of 60 ug/L. The Stage II D/DBP Rule will require that the MCLs for THMs and HAAs be met at all times at points of maximum detention time in the system. Excess finished water storage could impact the ability to meet this future regulation.

The more immediate water quality concern with the use of chloramines and longer detention times is nitrification. Nitrification in a water system results when nitrifying bacteria (which are nonpathogenic) use ammonia-nitrogen as a food source and convert it to nitrite and ultimately nitrate. Nitrite can exert a significant and almost instantaneous chlorine demand and may accelerate the natural breakdown of a chloramine residual. Additionally, growth of nitrifying bacteria can stimulate the growth of other bacteria including coliforms that use growth by-products of the nitrifying bacteria. The growth of nitrifying bacteria is slow but is accelerated by a neutral to alkaline pH, excess nitrogen in the water, warm temperatures, and long detention times. When KAWC first began practicing chloramination, they experienced nitrification in warm temperatures but have been able to control it by closely monitoring the chlorine-ammonia ratio. In order to ensure that monochloramines are formed and not dichloramines or trichloramines (which are unstable), it is necessary to have excess ammonia in the water; however, too much free ammonia will promote nitrification. Even though KAWC has historically been able to adequately control nitrification, minimizing the detention time in the distribution system is a critical factor in continuing to prevent nitrification.

The Interim Enhanced Surface Water Treatment Rule (IESWTR) lowered the finished water turbidity MCL from 0.5 NTU to 0.3 NTU in at least 95% of the measurements taken each month while at no time exceeding 1.0 NTU in any single sample. The ability to operate the treatment plants with minimal flow variations to avoid treatment upsets is critical in meeting this more stringent regulation. When finished water storage volume in excess of that needed for equalization is provided in the distribution system, variations in raw water flow can occur. These variations in the raw water flow can cause treatment upsets which may compromise the ability of the plants to meet the turbidity requirements of the IESWTR. Thus, maintaining storage in the distribution system that does not significantly exceed the equalization needs is preferred. The current analysis has shown that the existing storage capacity in all three pressure gradients meets this requirement.

## I. RELIABILITY SCENARIO ANALYSIS

It is appropriate to conduct a reliability scenario analysis based on both accepted engineering standards, and also actual occurrences. The 2002 updated storage analysis considered both. In particular, on July 31, 2002, a service disruption to a portion of the KAWC system occurred due to a power failure at the Kentucky River Station during a time of peak summer demand. This was a failure circumstance with details that varied from the assumptions in the 1993 analysis, but its ramifications will be considered in detail in this updated analysis.

### July 31, 2002 Power Outage

A localized power interruption to the Kentucky River Station during a time of high system demand resulted in temporary disruption of service to some customers. The loss of pressure resulted in the precautionary issuance of a Boil Water Advisory to KAWC customers. Full service was restored to customers within approximately 30 minutes. KAWC undertook a full review of that event and implemented improvements to reduce the chances for a recurrence.

The KAWC system had adequate capacity of emergency power, pumps, and storage to meet customer demands. However, the event revealed that improvements were needed to provide the capability to automate or otherwise streamline getting these facilities into emergency service within the first moments after the outage begins. The loss of pressure that some customers experienced happened within minutes of the beginning of the outage, before emergency power facilities could be turned on.

### Failure Scenarios

In addition to consideration of the July 31, 2002 power outage, the adequacy of the KAWC system has been analyzed under a series of theoretical, but plausible, emergency scenarios. These scenarios represent accepted utility planning criteria. Obviously, it is recognized that more severe emergency scenarios can be considered possible, although highly unlikely. Designing the water system based on more extreme scenarios would be very costly, and would create operational difficulties, increased operation and maintenance costs, and water quality problems, with little likelihood of ever delivering benefit from the additional facilities. The following analysis evaluates the ability of the KAWC system to supply water in the event of a total failure of any single major component (source, treatment plant, or booster station).

The KAWC system utilizes two separate sources (the Kentucky River and Jacobson Reservoir), and includes two separate treatment plants known as the Kentucky River Station (KRS) and the Richmond Road Station (RRS). Thus, the level of reliability is significantly greater than that of a single source/treatment system. It is assumed that only a single operational failure would occur at any one time since the two sources are not on the same water supply, and the treatment plants and booster stations are all serviced by separate electrical substations. This analysis is based on the need to provide 0.095 mgd into Sadieville, 4.45 mgd into High Service and 42.84 mgd into Main Service, which represents an average day's supply in each of those gradients in the year 2020. An additional analysis is also included which evaluates the reliability othe system in the event of a total power outage across the entire service area when system demands would be lower than average.

1. Sadieville Gradient Reliability - The Sadieville tank is filled from the High Service gradient by opening an electrically operated valve. Communication with the valve is via radio telemetry, which provides an added degree of reliability in a thunderstorm. The valve can be opened manually in an extreme emergency. Therefore, the Sadieville gradient is capable of providing an adequate supply of water in the event of an emergency. Additionally, the tank is elevated with a volume greater than an average day demand. Thus, the gradient could function adequately in an emergency even without the need to provide water from the High Service gradient.

2. High Service Gradient Reliability - The three tanks in the High Service gradient are filled by four separate booster stations with a total of eight separate pumping units. The four stations are known as Briar Hill, Mt. Horeb, Newtown, and Delaplain Road. These booster stations have a total pumping capacity of 13.7 mgd which includes 7.7 mgd of standby pumping power at the Newtown Booster as shown in Exhibit No. 1. Also, each booster station is serviced by a separate electrical substation.

   If there were a complete loss of the largest station (Newtown), it would still be possible to pump 6.0 mgd into the High Service gradient, which alone would satisfy the High Service demand of 4.45 mgd. Considering the number of booster stations, the number of pumping units, standby power, and individual electrical substations, the High Service gradient is fully capable of providing an adequate supply of water in the event of an emergency.

   Since 2.71 MG of the demand could be taken from existing storage, 1.74 mgd would need to be taken from the Main Service gradient. Thus, the Main Service analysis will address the ability to provide an additional 1.74 MG into the High Service gradient in addition to its own emergency supply.

2. Main Service Gradient Reliability - The Main Service Gradient is supplied directly from KAWC's two treatment plants, which can produce water at capacities of 50 mgd (KRS) and 30 mgd (RRS) if needed during an emergency. These facilities derive their source of supply from two independent sources: the Kentucky River and Jacobson Reservoir. An analysis of a complete loss of any one of these five major system components is provided below.

   a. *Loss of Jacobson Reservoir* - The intake on the Kentucky River has a reliable capacity (largest unit out of service) of 62.0 mgd of which 22.0 mgd can be directed to RRS. Thus, if raw water could not be derived from Jacobson Reservoir, 62.0 mgd could still be produced and distributed which is significantly above the average day demand in the Main Service gradient. Thus, the short-term loss of Jacobson Reservoir would not have a significant negative impact on the ability to provide an emergency supply of water to the Main Service gradient.

b. *<u>Loss of the Kentucky River</u>* - If the Kentucky River were lost due to some emergency, all source water would need to be derived from Jacobson Reservoir, and could be supplemented from Lake Ellerslie if necessary. The piping and pumping configuration at Jacobson Reservoir allows it to supply raw water to only RRS at a maximum rate of 22.8 mgd. There is an additional 1.05 MG of clearwell capacity at RRS. Up to 10.0 mgd of raw water could also be supplied to RRS from Lake Ellerslie. Additionally, even though the Kentucky River would be lost, KRS could continue to distribute finished water from its clearwells, which have an effective capacity of 2.97 MG.

The availability of 22.8 mgd of pumpage from Jacobson Reservoir, 1.05 MG of RRS clearwell storage, and 10.0 mgd of pumpage from Lake Ellerslie is limited to the 30 mgd treatment capacity of RRS. Adding this to the 2.97 MG of clearwell storage at KRS, 19.50 MG of storage in the Main Service Gradient, and deducting 1.74 mgd allocated for the High Service gradient equals 50.73 MG. This meets the total emergency storage need of 42.84 mgd through the year 2020.Of this 50.73 MG, 30 mgd is a <u>continuous</u> supply from RRS as opposed to a finite supply from storage tanks. This is a significantly more desirable scenario for being able to provide an adequate supply of water. This small calculated future deficiency in total emergency storage will be remedied by the tanks proposed in Section J.

c. *<u>Loss of the Richmond Road Station</u>* - If RRS were lost, KRS could continue to deliver water at 50 mgd capacity. This continuous supply coupled with the 17.76 MG of storage (19.50 MG – 1.74 MG allocated for the High Service gradient) more than satisfies the calculated emergency storage requirement. Thus, loss of RRS would not compromise the ability to provide an emergency supply of water to the Main Service gradient.

d. *<u>Loss of the Kentucky River Station</u>* - If KRS were lost, RRS could deliver water at its 30 mgd capacity, since adequate source would still be available from both the Kentucky River, Jacobson Reservoir, and Lake Ellerslie. Similar to the analysis in "b" above, the sum of 30 mgd of pumpage from the RRS, 1.05 MG of RRS clearwell storage, 19.50 MG of storage in the Main Service Gradient, and deducting 1.74 mgd allocated for the High Service gradient equals 48.81 MG. This again is well above the total emergency storage need of 42.84 MG in the year 2020. Similar to the conclusion in "b" above, this is a significantly more desirable scenario for being able to provide an adequate supply of water.

e. *<u>Loss of Storage Tanks</u>* – Since the tanks are spread throughout the distribution system and are on separate power substations, a loss of all of the tanks would be the likely result of a systemwide power outage, which will be addressed in the next section. If the radio system were to fail, the tanks can still be operated manually until the system can be repaired. Although it would take time for personnel to access each tank, the combination of the treatment plants could handle even peak day demands until the tanks could be manually operated.

3. Power Outage Scenario - In the event of a total power outage across the entire service area, actual experience in existing large water systems has shown that usage is reduced to less than 50 percent of the normal average daily use since various water usages are curtailed (e.g. washing machines, dishwashers, many commercial activities, etc.). Thus, the system demands in the year 2020 that would need to be satisfied in this type of emergency are approximately 0.05 mgd in the Sadieville gradient, 2.23 mgd in the High Service gradient, and 21.42 mgd in the Main Service gradient. This analysis evaluates the ability of each system component to continuously supply water for a 24-hour period in a total power outage scenario.

   a. *Sadieville Gradient* – The single 0.38 MG tank in this gradient is an elevated tank which is not dependent on power to meet the system demand. Since the demand is only 0.05 mgd, the system is adequate over a 24-hour period.

   b. *High Service Gradient* - This gradient includes 0.21 MG of pumped storage with no standby power, 1.0 MG of pumped storage with standby power, and 1.5 MG of elevated storage. Since the demand is 2.24 mgd, a surplus of 0.26 mgd is available in the gradient storage under this scenario. The system is adequate over a 24-hour period.

   c. *Main Service Gradient* - The Main Service gradient includes 2.5 MG of elevated storage plus 17.0 MG of pumped storage. 3.0 MG of the pumped storage is stored in elevated tanks that can bypass the pumps in a system wide power outage. Standby pumpage, with a capacity at least equal to its respective tank volume over a 24-hour period, is available at four of the ground storage tanks. These three tanks have a total volume of 12.0 MG bringing the total amount of available storage to 17.5 MG in a power failure scenario. The total system demand is 22.16 mgd (21.42 mgd Main Service + 0.74 mgd High Service). Thus, an additional 4.66 mgd would need to be provided from standby pumpage at the treatment plants. The two treatment plants that supply this gradient include 26.4 mgd of standby pumping capacity. Adequate capability (4.66 MG needed) is available at the treatment plants during a power outage (verified below). Therefore, the system is adequate over a 24-hour period.

   d. *Treatment Plants* - The two treatment plants have clearwell capacity of 4.02 MG. This volume alone would not be adequate to meet the 4.66 MG need identified above; however, adequate standby pumping capacity exists at the raw water facilities to continuously supply water to the treatment plants. Further, backup power is available to process the raw water to meet the needed deficit as evaluated below.

   e. *Raw Water Facilities* - The total standby raw water pumping capacity from the sources of supply is 19.4 mgd. This standby capacity is located at Jacobson Reservoir and Lake Ellerslie, which can supply only RRS. A total of 16.5 mgd of standby pumping capacity is located at RRS. This source and treatment raw water pumping capacity is more than the needed 4.66 MG in the Main Service gradient.

Thus, the existing storage and standby pumping facilities in the system could adequately satisfy the demand in the event of a power outage across the entire service area.

## J. CONSIDERATION OF FUTURE ADDITIONAL SOURCE OF SUPPLY

KAWC is in need of additional water supply to meet current and future demands during a drought. Also, KAWC is in need of additional treatment capacity to meet future maximum day demands. These needs have been fully elaborated on in other documents and proceedings, and will not be elaborated on in detail here. However, regardless of which alternative is ultimately chosen and constructed in order to provide the additional supply and treatment capacity, the end result will be that the new facilities will provide further reliability to the KAWC system. If the new facilities consist of new Kentucky River intake and treatment plant facilities, this will provide additional intake capacity, raw water and finished water pumping capacity, emergency powered pumping capacity, and finished water storage (i.e., plant clearwells). If the new facilities consist of a finished water pipeline to deliver water from some other source, this will provide the reliability of a third, independent source of supply, which is delivered through independent intake, pumping, treatment, emergency power, and clearwell storage facilities. ***In either case, the future additional source of supply and treatment facilities will significantly increase the reliability of the KAWC system, beyond the calculations shown in this report.***

Having more storage than is needed for equalization, fire protection, and reasonable emergency scenarios is not likely to provide any benefit to KAWC customers (and in fact will be a detriment due to increased O & M and energy costs, and water quality degradation), and those facilities would become even less likely to ever be beneficial once the needed additional supply and treatment facilities are in place.

The additional supply and treatment capacity development project will come at a significant rate impact to KAWC customers. It is appropriate and prudent to consider the full benefits that project will bring, and take advantage of costs that can be avoided because of it. Avoiding the construction of extra storage volume beyond that with a documented need can result in an avoided cost benefit to KAWC's customers. These ancillary benefits of the new supply and treatment capacity project point out the value of moving forward with that project expeditiously, for reasons even beyond the documented supply and treatment capacity needs.

## K. RECOMMENDED IMPROVEMENT PROJECTS

### Proposed Additional Storage Facilities

It is proposed that KAWC will construct one additional storage tank. This tank is tentatively proposed as a 3.0 MG pumped storage tank which is currently scheduled in the 2006-2009 time frame. However, this tank would be in conjunction with a solution to the water supply problem, and would be strategically located to act in operation with water from a connection to a regional water supply. Because the plans for the source of supply are still being finalized, the design and construction of this tank is recommended to be delayed until a strategic location is known. This may then push construction beyond 2010. The tank, including land acquisition and pumping facilities is estimated to cost $3.5 million. If the tank can be located at an existing tank site, the cost may be reduced by as much as $1.5 million.

## L. SUMMARY

This report has provided an updated analysis of the adequacy of Kentucky-American Water Company's finished water storage volume, and also an assessment of the reliability of the KAWC distribution system to meet potential emergency scenarios.

Section B of this report assesses the Kentucky regulation on storage volume (807 KAR 5:066 Section 4(4)), which is included under the topic of "Continuity of service" and deals with provisions to provide continuous service to customers during various emergency situations. In 1993, the Public Service Commission granted KAWC a variance from this regulation and reduced the storage requirement in the Main Service gradient to 50% of average day demand. KAWC currently provides 26.61 MG of finished water storage throughout its distribution system (including plant clearwell storage).

Section C describes the purpose of finished water storage, which is primarily to equalize treatment plant flows, provide water to meet fire events, and provide the capability to continue to meet customer demands during an emergency. A summary of KAWC's 1993 storage analysis is summarized in Section D. A review of the updated 2002 analysis was provided in Section E. KAWC has completed five tanks and other reliability improvements since 1993. These improvements have been constructed at a cost of $12,347,700 (Section F).

An updated analysis of equalization and fire protection needs within each of KAWC's three pressure gradients was conducted (Section G). System performance on the maximum demand day on August 9, 2002 was analyzed in detail. KAWC delivered 70.23 mgd on that day. The analysis concludes that existing storage facilities are adequate to meet equalization and fire protection needs in all three gradients. With regard to emergency storage volume, current storage capacity is 65% of 2005 average day demand.

Having more storage than is needed for proper system operation can lead to water quality problems, as described in Section H. Formation of disinfection by-products, nitrification, and treatment plant upsets are among the potential problems.

A detailed assessment of the KAWC system was conducted in Section I. Both the July 31, 2002 power outage as well as a series of theoretical emergency scenarios were analyzed. Although KAWC facilities were adequate to meet customer demands during the July 31, 2002 outage, rapid de-pressurization of the distribution system before pumps could be turned on resulted in the short-term disruption of service to certain customers. Electrical, valving, and pumping improvements were completed in 2003 to enhance the capability of KAWC's facilities to immediately and automatically respond to a pressure drop, and thereby avoid any service outage during a repeat of a similar event. These improvements were implemented at a cost of approximately $920,400.

The emergency scenario analysis studied the effect of interruption of any component of the KAWC system, such as a source of supply, treatment plant, or pump. The KAWC distribution facilities, which consist of 15 storage tanks, 13 booster stations, dedicated electrical service at each station, 20 individual pumping units, and 7 individual pumping units with standby power, have a high degree of reliability and can adequately respond to any of these scenarios.

KAWC is in need of additional water supply to meet current and future demands during a drought. Also, KAWC is in need of additional treatment capacity to meet future maximum day demands. This is described in Section J. The future additional source of supply and treatment facilities will significantly increase the reliability of the KAWC system, beyond the calculations shown in this report. Having more storage than is needed for equalization, fire protection, and reasonable emergency scenarios is not likely to provide any additional benefit to KAWC customers while potentially creating operating concerns. Further, those facilities would become even less likely to ever be beneficial once the needed additional supply and treatment facilities are in place.

Section K presents the recommended improvement project which KAWC proposes to undertake. The tank will be strategically located, and will provide additional emergency storage volume to meet equalization and fire protection needs. KAWC proposes to spend approximately $3.5 million for this additional storage facility. If the tank were to stay on the current schedule, by 2010, KAWC would then have 29.61 MG of finished water storage, or 69% of average day demand at that time.

In conclusion, this report provides a thorough analysis of KAWC's equalization, fire protection needs, and emergency readiness. It is felt that KAWC has an optimum amount of finished water storage and will continue to add storage as needed. Additional storage to meet a general standard of one-day storage volume would cost the ratepayers an additional $13 million. With the rate impact for additional water treatment and raw water facilities in the near future, KAWC needs to assure facility construction provides the appropriate benefits to the ratepayer. However, these facilities would provide little or no additional benefit, and in fact would be a detriment during daily operations due to increased O & M and energy costs, and water quality degradation. Many large water systems do not have one day finished water storage within the distribution system, and operate efficiently. It is recommended that the technical analysis of KAWC system operations and emergency scenarios as presented within this report be given precedence over a general standard for storage volume applied to all size systems. It is further recommended that KAWC's deviation from the one day storage requirement of 807 KAR 5:066 Section 4(4) be continued through 2020.