

RAW WATER CAPACITY MASTER PLAN

FOR THE

CITY OF CROSSVILLE, TENNESSEE

PROJECT NUMBER 4637

October 2019

WAUFORD

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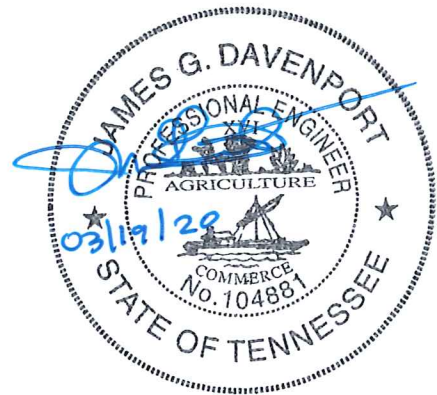
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CITY OF CROSSVILLE, TENNESSEE

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PRELIMINARY ENGINEERING REPORT
RAW WATER CAPACITY MASTER PLAN
CITY OF CROSSVILLE, TENNESSEE

I. EXECUTIVE SUMMARY

The purpose of this Preliminary Engineering Report (Report) is to present a raw water capacity master plan complete with alternatives analysis for the required improvements needed to increase the capacity of the raw water storage and water treatment facilities to meet the forecast 50-year demands for the City of Crossville and surrounding areas. The master plan described herein is based on current usage forecast; however, it should be noted that there are drawbacks to developing a rigid plan for a 20-year or 50-year horizon which is why this plan provides for the projected needs, but also allows for flexibility to react to unforeseen events during the next 20-year period. The only exception to flexibility in the master plan is the raising of the Meadow Park Lake Dam because of the time required to obtain a Corps of Engineers Section 404 Permit.

The future raw and finished water demands are described in the report titled Raw Water Study prepared by J.R. Wauford and Company, Consulting Engineers, Inc. in November 2017. The 20-year and 50-year estimated raw water usage forecasts are depicted in the following tables.

TABLE I-1
YEAR 2037 (20 YEAR) AND YEAR 2067 (50 YEAR)
RAW WATER USAGE FORECAST
MODERATE GROWTH FORECAST
(30% IN 20 YEARS AND 80% IN 50 YEARS)
CROSSVILLE, TENNESSEE

<u>Usage Entity</u>	<u>Year 2037 Flows</u>	<u>Year 2067 Flows</u>
City of Crossville	3.89 MGD	5.39 MGD
West Cumberland Utility District	0.46 MGD	0.63 MGD
Crab Orchard Utility District Growth	0.44 MGD	1.17 MGD
Industrial Growth Allotment	2.00 MGD	2.00 MGD
Unaccounted Water Estimate	1.27 MGD	1.71 MGD
Total Raw Water Demand	8.06 MGD	10.98 MGD

TABLE I-2
YEAR 2037 (20 YEAR) AND YEAR 2067 (50 YEAR)
RAW WATER USAGE FORECAST
HIGH GROWTH FORECAST
(50% IN 20 YEARS AND 100% IN 50 YEARS)
CROSSVILLE, TENNESSEE

<u>Usage Entity</u>	<u>Year 2037 Flows</u>	<u>Year 2067 Flows</u>
City of Crossville*	4.49 MGD	5.99 MGD
West Cumberland Utility District	0.53 MGD	0.70 MGD
Crab Orchard Utility District Growth	0.73 MGD	1.47 MGD
Industrial Growth Allotment	2.00 MGD	2.00 MGD
Unaccounted Water Estimate	1.44 MGD	1.89 MGD
Total Raw Water Demand	9.19 MGD	12.05 MGD

* The City of Crossville usage includes water furnished to the Grandview Utility District and the South Cumberland Utility District which furnishes water to the Fall Creek Falls Utility District

The proposed improvements include increasing the volume of Meadow Park Lake, improvements to the Meadow Park Lake and Holiday Hills Water Treatment Plants (WTP), and improvements to the raw and finished water conveyance facilities. The proposed improvements are separated into three phases described hereinafter.

Phase 1 - Improvements to Meadow Park Lake:

- Raise Meadow Park Lake Dam;
- Relocate Meadow Park Lake raw water intake;
- Construct Improvements to Meadow Park Lake Raw Water Line.

The estimated total project cost of Phase 1 is \$24,400,000 and should be implemented immediately after issuance of required permits. The amount of time to obtain permits to raise the Meadow Park Lake Dam may extend the time period required for Phase 1 considerably. It is imperative to move forward with the permitting process as the Phase 2 expansion of Meadow Park Lake WTP will likely be required in less than 10 years due to water demands.

Phase 2 - Expansion of Meadow Park Lake WTP:

- Expand Meadow Park Lake WTP From 3.5 MGD to 7.0 MGD.

The estimated total project cost of Phase 2 is \$13,400,000 and is expected to begin after the completion of Phase 1. The construction period for the expansion of Meadow Park Lake WTP is proposed to last approximately 24 months. The City must meet the Tennessee Department of Environment and Conservation (TDEC) requirement to not exceed 80% of the plant's rated capacity based on average daily usage. The expected year in which Phase 2 will be required is 2028 based on current water usage forecasts.

According to the moderate growth forecast shown hereinbefore, the Phase 3 expansion of Meadow Park Lake WTP or Holiday Hills WTP is expected to be required by the year 2040. The Phase 3 improvements are divided into two alternatives described as follows:

Phase 3, Alternative No. 1 - Transfer all raw water to Meadow Park Lake and consolidate treatment at one location:

- Improvements to Meadow Park Lake Raw Water Intake;
- Expand Meadow Park Lake WTP From 7.0 MGD to 12.25 MGD;
- Construct facilities to transfer raw water from Holiday Hills Lake to Meadow Park Lake;
- Construct improvements to provide for adequate transfer of treated water within the distribution system;
- Abandon the Holiday Hills WTP.

The estimated total project cost of Phase 3, Alternative No. 1 is \$30,900,000 and is expected to begin after the completion of Phase 2 and prior to the demand for finished water reaching 80% of the total capacity of both WTPs. The construction period for the Phase 3, Alternative No. 1 expansion of

Meadow Park Lake WTP is proposed to last approximately 24 months if construction work occurs concurrently.

Phase 3, Alternative No. 2 - Treat water at Meadow Park Lake and Holiday Hills WTP:

- New 5.5 MGD Holiday Hills WTP.

The estimated total project cost of Phase 3, Alternative No. 2 is \$26,800,000 and is expected to begin after the completion of Phase 2 and prior to the demand for finished water reaching 80 percent of the total capacity of both WTPs. The construction period for the Phase 3, Alternative No. 2 construction of a new Holiday Hills WTP is estimated to last approximately 24 months. The additional construction time proposed is needed because the existing Holiday Hills WTP is not being retrofitted requiring the new plant to be built adjacent to the site allowing the existing Holiday Hills WTP to be demolished afterward.

Phase 3, Alternative No. 1 results in consolidation of all water treatment at the Meadow Park Lake WTP and Phase 3, Alternative No. 2 results in continued use of the Meadow Park Lake WTP and Holiday Hills WTP. Both alternatives require additional raw water storage at Meadow Park Lake which will include raising the Meadow Park Lake Dam by approximately 18 feet. A general schedule for start and end dates for each phase is included in the Appendix.

II. EXISTING FACILITIES

A. Raw Water Supply

The City of Crossville's raw water supply is stored in three existing reservoirs located to the south and west of the City - Holiday Hills Lake, Meadow Park Lake, and Lake Tansi. Holiday Hills Lake, the only reservoir located within the City limits, was constructed in the early 1960's and is owned by the City. Holiday Hills Lake lies in the Obed River watershed of

the Upper Tennessee-Clinch/Emory River Basin. Meadow Park Lake, which is also owned by the City, was constructed in 1938 and underwent a dam renovation in 2012. Meadow Park Lake lies in the Caney Fork River watershed of the Upper Cumberland River Basin. Lake Tansi, originally named Harrison Lake, was constructed in the mid-1950s and is owned by the Lake Tansi Village Property Owners Association. Lake Tansi lies in the Daddy’s Creek and Obed Wild and Scenic River watersheds of the Upper Tennessee - Clinch/Emory River Basin. Pertinent information related to the three reservoirs is provided in the following table and was compiled by the Crossville Engineering Department utilizing GPS equipment for the Army Corp of Engineers bathymetric survey and the State of Tennessee GIS Mapping Program in 2001.

TABLE II-1
WATER SUPPLY RESERVOIRS
CROSSVILLE, TENNESSEE

	<u>Meadow Park Lake</u>	<u>Holiday Hills Lake</u>	<u>Lake Tansi</u>
Year Constructed	1938	1960	1959
Reservoir Volume	2,610 AC-FT (2)	3,573 AC-FT	9,000 AC-FT
Safe Yield (1)	3.58 MGD	5.34 MGD	3.50 MGD
Surface Area	250 Acres (2)	223 Acres	403 Acres
Normal Pool Elevation	1,818.20 Feet	1,761.25	1,861.71 Feet

Notes: (1) Safe yield values taken from reports prepared for the Corps of Engineers by others. (2) Volume and area calculated using bathymetric contours provided by the City of Crossville. This value is the total reservoir volume, not the available storage volume.

The City entered into a water-harvesting agreement with the Lake Tansi Village Property Owners Association in October 2009 to withdraw water from the reservoir. The City is permitted to withdraw water from Lake Tansi between October 31 and April 15 with a restriction that the lake must not fall four inches below the normal operating pool elevation of 1861.71 feet.

Water that is harvested from Lake Tansi can be pumped directly into Meadow Park Lake or to the Meadow Park Lake WTP. The transfer of water from Lake Tansi is also regulated by an inter-basin transfer permit issued by the TDEC limiting the daily transfer to 5.0 million gallons per day (MGD). There are provisions in the Lake Tansi water harvesting agreement that the City can exceed the previously mentioned withdrawal rates as well as lower the lake level below the levels in the agreement during a drought. A copy of the agreement between the City and the Lake Tansi Village Property Owners Association is included in the appendix of this report.

The Meadow Park Lake Dam was constructed in 1938. The normal pool elevation of Meadow Park Lake is 1,818.20 feet and the top of the Meadow Park Lake Dam is 1,821.5 feet. A spillway is located on each side of the dam with measurements of 49 feet by 4 feet and 54 feet by 4 feet respectively according to existing plans. At normal pool elevation the storage capacity of the lake is approximately 3,069 acre-feet. The channel below the dam is unshaped and remains in its natural sandstone with some gravel and soil present. Leakage appears to be coming from the downstream side through the subgrade interface. The outlet works for the existing dam is reportedly a 20 inch cast iron pipe at elevation 1,789.75 feet.

The Holiday Hills Lake Dam is considered an earth gravity dam and was constructed in 1963. In 2008 the spillway was widened, and a new 230 foot weir and bridge were constructed over the spillway. The normal pool elevation is 1,761.25 feet and the top of the dam elevation is 1781.0 feet. At normal pool elevation the storage capacity of the lake is approximately 3,573 acre-feet. The channel below the dam is unshaped and remains in its natural sandstone with some gravel and soil present.

Lake Tansi, originally called Lake Harrison until 1964, was formally opened to the public in 1961. The Lake Tansi Dam was constructed in 1959, originally to create a lake and serve as a local resort attraction. The normal

pool elevation is 1,861.71. At normal pool elevation the storage capacity of the lake is approximately 9,000 acre-feet.

B. Holiday Hills Water Treatment Plant

The Holiday Hills WTP was placed in operation as a 2.0 MGD conventional filtration plant in 1968. A renovation to double the capacity to 4.0 MGD was completed in 1976 which included adding additional filters, settling basins, flocculators, sludge basin, and clearwell. In 2013, a powdered activated carbon (PAC) building was added and improvements were made to the filter building and flocculation basins, but these modifications did not increase the plant's capacity. In 2018, the sludge collection system in the settling basins was replaced and the pipe gallery was painted. The current plant unit processes consist of two raw water pumps located at the Holiday Hills Lake raw water intake, a flash mixer, four flocculation basins and settling basins with tube settlers, eight conventional rapid sand filters, two-500,000 gallon clearwells, two high service pumps, a PAC building, and a residual solids storage tank.

C. Meadow Park Lake Water Treatment Plant

The original Meadow Park Lake WTP was believed to be constructed at the same time as the Meadow Park Lake Dam in 1938, and underwent expansions in 1952, 1961, and 1990. In 2001, the City constructed a new conventional filtration plant with a rated capacity of 3.5 MGD at a new site and demolished the original plant. According to the original plans, the current Meadow Park Lake WTP was designed to be expanded to 21 MGD although it may be unlikely to obtain permits to transfer the water needed to provide a 21 MGD raw water capacity to Meadow Park Lake. The plant unit processes consist of two raw water pumps located at the Meadow Park Lake raw water intake, an inline flash mixer, three flocculation basins and two settling basins, four dual media filters, one-1,000,000 gallon clearwell,

and four high service pumps. Currently two high service pumps distribute potable water to the high pressure zone and two high service pumps distribute potable water to the standard pressure zone. In 2012, a new powdered activated carbon building was constructed as well as baffle walls in the settling basins. In 2017, generators were replaced, and in 2018 a new chemical building was constructed to house caustic and coagulant.

D. Water Distribution System

The City of Crossville operates their water system using two separate pressure zones, but currently leave certain valves open allowing water from the high pressure zone to discharge to the standard pressure zone. The Meadow Park Lake WTP has the ability to pump to both pressure zones using two high service pumps dedicated to each zone while the Holiday Hills WTP only has the ability to pump to the standard pressure zone. The tanks and corresponding capacities for each pressure zone are shown in the following tables.

TABLE II-2
WATER STORAGE TANKS
STANDARD PRESSURE ZONE
CROSSVILLE, TENNESSEE

<u>Name</u>	<u>Volume</u>	<u>Overflow Elevation</u>
Cemetery Tank	1.0 MG	1991 ±
Cotton Patch Tank	1.0 MG	1990 ±
Woodmere Tank	1.0 MG	1992 ±

TABLE II-3
WATER STORAGE TANKS
HIGH PRESSURE ZONE
CROSSVILLE, TENNESSEE

<u>Name</u>	<u>Volume</u>	<u>Overflow Elevation</u>
Homestead Tank	1.0 MG	2069 ±
Lantana Tank	0.5 MG	2069 ±

Exhibit No. 1 in the appendix depicts the tank locations and boundaries of each pressure zone.

III. PHASE 1 IMPROVEMENTS

A. General

Phase 1 is proposed to increase the raw water storage capacity at the Meadow Park Lake and allow for future improvements to be implemented in a phased approach. Phase 1 improvements consist of the following:

- Raise Meadow Park Lake dam;
- Relocate Meadow Park Lake raw water intake;
- Construct improvements to Meadow Park Lake raw water line.

B. Raise Meadow Park Lake Dam

In order to consolidate water treatment at Meadow Park Lake, the Meadow Park Lake dam will need to be raised to increase the Meadow Park Lake water level about 18 feet to provide raw water storage that will meet the Year 2067 (50 year) forecast demands. The increased dam height will increase the storage volume of Meadow Park Lake, allowing additional transfer of Lake Tansi and Holiday Hills Lake water, although the daily maximum rate of transfer from Lake Tansi is not proposed to increase except during drought conditions.

TABLE III-1
PROPOSED PHASE 1 CHARACTERISTICS
AFTER RAISING MEADOW PARK LAKE DAM
CROSSVILLE, TENNESSEE

	<u>Meadow Park Lake</u>
Reservoir Volume (1)	8,490 AC-FT
Safe Yield	4.80 MGD
Surface Area (1)	510 Acres
Top Pool Elevation	1,836 Feet

Notes: (1) Volume calculated using bathymetric contours and shoreline contours provided by the City of Crossville. Area calculated using shoreline contours provided by the City of Crossville

Considering the current size and construction method of the dam, the proposed method to raise the height of the Meadow Park Lake Dam is by using roller compacted concrete (RCC).

RCC is a construction method consisting of placing concrete with conventional or high-density asphalt paving equipment and then compacting with rollers. RCC has the same basic ingredients as conventional concrete: cement, water, and aggregate, such as gravel or crushed stone. Unlike conventional concrete, it is a drier mix, stiff enough to be compacted by vibratory rollers. Typically, RCC is constructed without joints. A protective layer of class A concrete will likely be necessary for the exposed faces of the dam. For Meadow Park Lake Dam, the preliminary concept is to install RCC along the downstream face of the existing dam in lifts up to the proposed new top elevation of 1,840.20. With the use of RCC it is possible that the entire top of the dam can function as the overflow spillway although an intake structure may be constructed to allow multiport take off of reservoir water for downstream purposes. Use of the entire top of the dam as the emergency spillway will reduce the head created by the flow associated with the regulatory probable maximum storm event thereby allowing the dam to be higher and provide more storage. These

characteristics make RCC a simpler and more economical solution than traditional gravity dam construction. The improvements to the Meadow Park Lake dam are estimated to cost \$19,930,000 as shown on Cost Estimate No. 1 and depicted in Exhibit Nos. 4A and 4B in the Appendix.

Raw water is currently transferred from Lake Tansi to Meadow Park Lake via the use of an existing intake and raw water pumping station and transported through an existing 30-inch pipe. No improvements are expected to be needed for the Lake Tansi raw water intake, pumping station or water line.

C. Relocate Meadow Park Lake WTP Raw Water Intake

The existing Meadow Park WTP raw water intake is a conventional type intake consisting of a concrete wetwell located on the bank of Meadow Park Lake. Raw water enters the intake through one of two pipes which are located at invert elevations 1,802.60 and 1,812.60. The normal pool elevation is elevation 1,818.20. The raw water is screened by a drum style screen attached to the end of the influent pipe. The screened water enters the pump suction wells and is transported to the Meadow Park Lake WTP by one of two-60 HP vertical turbine style pumps each with a nominal capacity of 2,450 GPM (3.5 MGD) at 75 feet TDH. In 2018, a new generator was installed at this facility.

Since the Meadow Park Lake Dam is proposed to be raised, the existing Meadow Park Lake WTP raw water intake will flood if left in its current location. As a result, it is recommended that the existing Meadow Park Lake WTP raw water intake be left in place as a flooded junction box and a new raw water intake be constructed at a higher elevation. Construction of a new raw water intake will include a new wetwell, concrete building, electrical, mechanical, monorail system, painting, site grading and new pumps with variable frequency drives (VFDs) for increased flow at an

estimated cost of \$4,470,000 as shown on Cost Estimate No. 2 and depicted in Exhibit No. 5 in the Appendix.

The existing raw water pumps have a rated capacity of 2,450 GPM (3.5 MGD) at 75 feet TDH each. Although these pumps have provided good service, the improvements included in the alternatives require the Meadow Park Lake WTP to produce 4,850 GPM (7.0 MGD) in Phase 2 and 8,500 GPM (12.25 MGD) in Phase 3. The existing pumps will need to be replaced with three new 4,250 GPM (6.125 MGD) pumps with variable frequency drives operating at reduced speed to produce 2,450 GPM (3.5 MGD) each in the Phase 1 expansion and capable of producing 8,500 GPM (12.25 MGD) when two pumps are operated together at full speed.

D. Improvements to Meadow Park Lake Raw Water Line

The raw water line consists of approximately 1,200 L.F. of 20-inch pipe installed in 1999. The future expansion of the Meadow Park Lake WTP will require larger pumps to be installed at the intake for a Phase 2 design point of 4,850 GPM (7.0 MGD) and a Phase 3 design point of 8,500 GPM (12.25 MGD). The existing 20-inch pipe will have a velocity of approximately 5.0 fps at 4,850 GPM (7.0 MGD) and 8.7 fps at 8,500 GPM (12.25 MGD). Changes in the location of the Meadow Park Lake WTP raw water intake will require a portion of the raw water line to be replaced. Although a velocity of approximately eight feet per second will not likely cause damage, the construction of a new parallel raw water line should be evaluated when the plant is expanded to 12.25 MGD for redundancy and energy consumption.

IV. PHASE 2 IMPROVEMENTS

A. General

Phase 2 is proposed to increase the treatment capacity at the Meadow Park Lake WTP to meet projected needs from about year 2028 until about year 2040 and consists of the following improvements:

- Expand Meadow Park Lake WTP from 3.5 MGD to 7.0 MGD.

B. Expand Meadow Park Lake WTP From 3.5 MGD to 7.0 MGD

1. General

The expansion of the Meadow Park Lake WTP is proposed to increase the capacity of the existing WTP from 3.5 MGD to 7.0 MGD. The previous design of the Meadow Park Lake WTP included space for such expansion, and will require new flocculation and settling basins, new filters and pipe gallery, new transfer pumps, new air scour blowers, and new high service pumps at an estimated cost of \$13,400,000 in year 2019 dollars as shown on Cost Estimate No. 3 and Exhibit No. 6.

2. Flash Mixing

The 20-inch raw water line enters the Meadow Park Lake WTP site and passes through a venturi tube as well as a 20-inch butterfly valve prior to entering a flanged static mixer located at the side of the filter building. At the existing flash mix, permanganate, caustic and coagulant are added and mixed with the raw water. The water is then discharged through a 20-inch water line into the flocculation basins. The existing static mixer is a Koch Static Mixing Unit with two elements. The pressure drop with the increase in flow is less than 1.0 psi per element which is still within the capabilities of the

existing mixer. A new flow splitter box with equal length weirs should be installed to promote equal split of the flow to each flocculation basin.

3. Flocculation and Settling Basins

The mixed raw water flows into a series of flocculation basins with the mixing energy decreasing as flow passes downstream. Each basin utilizes two identical three-compartment flocculators before entering the settling basins. The flocculators agitate the particles in the mixed water to encourage inter-particle contact but are gentle enough to prevent disintegration of existing flocculated particles. The condition of the existing flocculators should be evaluated for replacement during the design phase.

Each flocculation basin is 20 feet by 20 feet 8 inches and the depth is approximately 12 feet for a volume of 111,000 gallons total for all three basins. The detention times are shown in the following table.

TABLE IV-1
MEADOW PARK LAKE WTP
FLOCCULATION BASIN DETENTION TIMES

<u>Flow</u>	<u>Detention Time</u>
1.0 MGD	159 min
2.0 MGD	79 min
3.0 MGD	53 min
3.5 MGD	45 min
7.0 MGD	23 min
10.5 MGD	15 min
12.25 MGD	13 min

According to TDEC's Division of Water Resources the design criteria for Community Public Water Systems "the recommended detention time for flocculation basins is 45 minutes".

After passing through the flocculation basins, the flocculated water passes through a baffle wall into one of two rectangular settling basins. The basins are each approximately 106 feet long by 30 feet wide and approximately 12 feet deep yielding a volume of 286,000 gallons in each basin or 572,000 gallons total. The detention time of the settling basin at varying plant flows is shown in the following table with all basins in operation.

TABLE IV-2
MEADOW PARK LAKE WTP
SETTLING BASIN DETENTION TIMES

<u>Flow</u>	<u>Detention Time</u>
1.0 MGD	14.2 hrs
2.0 MGD	7.1 hrs
3.0 MGD	4.7 hrs
3.5 MGD	4.0 hrs
7.0 MGD	2.0 hrs
10.5 MGD	1.3 hrs
12.25 MGD	1.2 hrs

According to TDEC's Division of Water Resources the design criteria for Community Public Water Systems "requires a minimum detention time of 4.0 hours although this may be reduced to 1.0 hours if tube settlers are implemented". The maximum loading rate for tube settlers is 2.5 gpm/sf which yields a minimum tube settler area of 490 square feet per basin at a flow of 3.5 MGD, and 980 square feet per basin at a flow of 7.0 MGD.

Both existing basins are in good condition. The overflow weirs and support structure were installed during the construction of the Meadow Park Lake WTP in 2001 and both are in decent condition.

The settled water flows through two 24-inch pipelines into the filters at a velocity of 0.87 feet per second at 3.5 MGD. These velocities are adequate to limit the potential for floc to shear after the settling basins which can shorten the filter run times.

New flocculation and settling basins identical in size and configuration to the existing basins and proposed to be located adjacent to the existing flocculation and settling basins.

4. Conventional Dual Media Filters

There are currently four conventional dual media filters in the Meadow Park Lake WTP with a capacity of 0.875 MGD each with dimensions of 13 feet 3 inches by 11 feet 6 inches yielding a surface area of 152 square feet. The overall plant flows, individual filter flows, and filtration rates are shown in the following table.

TABLE IV-3
MEADOW PARK LAKE WTP
FILTRATION RATES

<u>Plant Flow</u>	<u>Individual Filter Flow</u>	<u>Filtration Rate</u>
1.0 MGD	175 gpm	1.15 gpm/sf
2.0 MGD	350 gpm	2.30 gpm/sf
3.0 MGD	525 gpm	3.45 gpm/sf
3.5 MGD	613 gpm	4.03 gpm/sf
7.0 MGD	1,225 gpm	8.06 gpm/sf
10.5 MGD	1,825 gpm	12.01 gpm/sf
12.25 MGD	2,125 gpm	13.98 gpm/sf

With one filter out of service due to backwashing, the individual filtration rate in the remaining three filters is 5.38 gpm/sf at the current capacity of 3.5 MGD. The filtered water discharges through rate of flow controllers to the 18-inch combined filtered water line which discharges to the transfer pumping station and then through a 24-inch water line to the 1,000,000 gallon clearwell.

All filters are reported to utilize a perforated stainless steel underdrain in addition to 18-inches of anthracite, and 12-inches of sand. Two air scour blowers with 4-inch air piping were installed to aid in cleaning the filter bed.

Backwash water for each filter is supplied by gravity from the existing clearwell. This flow rate is within the typical backwash flow rate required for adequate cleaning which is between 15 and 20 gpm/sf.

Transfer pumps are connected to the same backwash line in order to pump finished water to the clearwell. These pumps appear to be in good condition. Two new transfer pumps are proposed to be installed for the new filters. These pumps serve to pump filtered water to the clearwell and should be capable of pumping 2,450 GPM (3.5 MGD) at 50 feet TDH.

Additionally, two new blowers are proposed to be installed to provide air scour during backwash for the new filters. The blowers are proposed to be placed to the side of the filters. Each blower should be capable of being valved for use on either of the new filters.

5. Clearwells

On-site generated sodium hypochlorite (Miox) is used as a disinfectant and is injected into the filtered water and then discharges to a 1,000,000 gallon circular concrete clearwell. The contact time for the clearwell is shown in the following table using an average baffling condition.

TABLE IV-4
MEADOW PARK LAKE WTP
CLEARWELL CT TIMES

<u>Plant Flow</u>	<u>CT Times</u> <u>(1,000,000 gal.)</u>
1.0 MGD	7.15 hrs
2.0 MGD	3.57 hrs
3.0 MGD	2.38 hrs
3.5 MGD	2.03 hrs
7.0 MGD	1.02 hrs
10.5 MGD	0.68 hrs
12.25 MGD	0.58 hrs

The inactivation ratios for this clearwell are shown in the following table using pH = 8.0, chlorine residual = 1.98 mg/l, and a temperature of 0.5 degrees Celsius.

TABLE IV-5
MEADOW PARK LAKE WTP
CLEARWELL INACTIVATION RATIOS

<u>Plant Flow</u>	<u>Inactivation Ratio</u> <u>(1,000,000 gal.)</u>
1.0 MGD	16.12
2.0 MGD	7.31
3.0 MGD	4.88
3.5 MGD	4.17
7.0 MGD	2.09
10.5 MGD	1.40
12.25 MGD	1.18

The minimum required inactivation ratio is 1.0 according to the rules of the Tennessee Department of Environment and Conservation. As a result, the existing clearwell approximately half full will meet the inactivation ratio requirement at flows up to 7.0 MGD and no additional clearwell volume is required at 7.0 MGD to meet only the disinfection criteria. However, it is recommended that a new 1,000,000 gallon clearwell be installed during Phase 2 improvements to provide additional distribution system storage and to allow the operators additional flexibility when operating the expanded plant.

6. High Service Pumping

The Meadow Park Lake WTP is equipped with a high service pumping facility containing two horizontal split case pumps each capable of transporting 1,050 GPM at 283 feet TDH to the high pressure zone and two horizontal split case pumps each capable of transporting 1,400 GPM at 260 feet TDH to the standard pressure zone.

Currently the system is operated using two pressure zones, but the City chooses to allow water to be transported through throttled valves from the high pressure zone to the standard pressure zone. With three of the four pumps running together to the both pressure zones, they should be capable of producing 2,450 GPM. However, the Meadow Park Lake WTP would not meet the duality requirements of TDEC for high service pumping if the pressure zones are separated. It is recommended that the existing high service building and pumps remain in place and a new high service building be constructed housing space for four new pumps. One 1,050 GPM pump and one 1,400 GPM pump are proposed to be installed during Phase 2 leaving additional space for proposed Phase 3 improvements. Appropriate distribution system improvements will be required to transport finished water as usage increases.

7. Process Waste Handling

The process waste handling facilities were constructed in 2001 and consist of two large in-ground sludge lagoons measuring 96 feet square with the sides sloped at 3:1 and containing approximately 250,000 gallons each for a total of 500,000 gallons. The theory of operation is solids are discharged to the basins from a 20-inch pipe and settle to the bottom and clear liquid flow through one of two pipes to Meadow Park Lake.

The design of a Waste Sludge Pumping Station was completed in 2019 to enable the City to pump waste from filter backwash and settling basin sludge through a force main to the wastewater treatment plant. During a backwash cycle of the filters only a small portion of the backwash flow is captured while most of flow continues through the overflow pipe and into the sludge lagoons. The backwash flow is allowed to discharge to the lagoons due to the

dilute solids content. Conversely, all of the settling basin blowdown waste is concentrated at a lower flow rate and is pumped to the wastewater treatment plant.

8. Chemical Storage and Feed Facilities

The chemical feed equipment consists of the following:

Sodium Permanganate	Fed at the intake in liquid form. Currently use Stenner feed pump, one 600 gallon vertical storage tank.
Sodium Bicarbonate	Fed at the intake in liquid form. Currently use Stenner feed pump, on 250 gallon feed tank.
Polymer (Coagulant)	Fed at the flash mix in liquid form. Currently use Verderflex feed pump, one 250 gallon day tank, and one interior 6,000 gallon vertical storage tank.
Caustic Soda	Fed at the flash mix in 50 percent liquid form. Currently use Verderflex feed pumps, one 100 gallon day tank, and one interior 6,000 gallon horizontal storage tank.
Powder Activated Carbon	Fed at the settling basins using saturator and potable make up water.
Phosphoric acid	Fed at the filter effluent in liquid form using a 600 gallon tank using a Stenner pump.
On-site generated Sodium Hypochlorite (MIOX)	Fed pre-filter and post-filter using two-1,000 gallon tanks and Baldor feed pumps.
Sodium Thiosulfate	Fed at the filter effluent in 30 percent liquid form. Currently use Stenner feed pump, one 600 gallon vertical storage tank.
Hydrofluosilicic Acid	Fed at the filter effluent in liquid form using a 600 gallon tank using a Stenner pump.

The chemical feed rates will be increased when the plant is expanded to 7.0 MGD. Replacement of tanks and pumps should take into consideration the frequency and size of chemical deliveries for plant expansions as well as the mandatory minimum storage requirements of TDEC.

V. PHASE 3, ALTERNATIVE NO. 1 IMPROVEMENTS

A. General

Phase 3, Alternative No. 1 is proposed to consolidate water treatment at the Meadow Park Lake WTP and eliminate the Holiday Hills WTP. In order to do so the following will need to occur:

- Improvements to Meadow Park Lake Raw Water Intake;
- Expand Meadow Park Lake WTP from 7.0 MGD to 12.25 MGD;
- Construct facilities to transfer raw water from Holiday Hills Lake to Meadow Park Lake;
- Construct improvements to provide for adequate transfer of treated water within the distribution system;
- Abandon the Holiday Hills WTP.

B. Improvements to Meadow Park Lake Raw Water Intake

The pumps proposed in the Phase 1 improvements to the Meadow Park Lake raw water intake consist of three new 4,250 GPM (6.125 MGD) pumps operated by variable frequency drives at reduced speed to produce 2,450 GPM (3.5 MGD) each. Phase 3 will require two pumps to run simultaneously, each producing 4,250 GPM (6.125 MGD) by increasing the operating speed.

C. Expand Meadow Park Lake WTP From 7.0 MGD to 12.25 MGD

1. General

The Phase 3, Alternative No. 1 expansion of the Meadow Park Lake WTP includes increasing the capacity of the existing WTP from 7.0 MGD to 12.25 MGD. The previous design of the Meadow Park Lake WTP included space for such expansion. The required improvements will include new flocculation and settling basins, new filters and pipe gallery, new transfer pumps, new blowers, and new high service pumps at an estimated cost of \$21,300,000 in year 2019 dollars for Phase 3, Alternative No. 1 as shown on Cost Estimate No. 4 and depicted in Exhibit No. 7 in the Appendix. Each existing process is described in depth in the Phase 2 section. Only the modifications required in Phase 3 are listed hereinafter.

2. Flash Mixing

The pressure drop with the increase in flow to 12.25 MGD is less than 1.0 psi per element which is still within the capabilities of the existing mixer; therefore, no changes are expected to be made to the flash mixing process during Phase 3, Alternative No. 1.

3. Flocculation and Settling Basins

New flocculation and settling basins, one being identical in size and configuration to the existing basins, and one being half of the size of the existing basins are proposed in Phase 3, Alternative No. 1 located adjacent to the proposed Phase 2 flocculation and settling basins. The expansion will increase the capacity of the Meadow Park Lake WTP from 7.0 MGD to 12.25 MGD in Phase 3.

4. Conventional Dual Media Filters

Four new conventional dual media filters will be required at the Meadow Park Lake WTP in Phase 3, Alternative No. 1 with a capacity of 0.875 MGD each and a surface area of 152 square feet. The filtered water will discharge through rate of flow controllers to the 18-inch combined filtered water line which discharges to the transfer pumping station and then through a 24-inch water line to one of the 1,000,000 gallon clearwells.

All filters should utilize a perforated stainless steel underdrain in addition to 18-inches of anthracite, and 12-inches of sand. Two air scour blowers with 4-inch air piping should be installed to aid in cleaning the filter bed.

Backwash water for each filter is proposed to be supplied by gravity from one of the existing clearwells. The flow rate should be verified to be within the typical backwash flow rate required for adequate cleaning which is between 15 and 20 gpm/sf.

Two new transfer pumps are proposed to be installed for the new filters in Phase 3, Alternative No. 1. These pumps transfer filtered water to the clearwell and should be capable of pumping 3,675 GPM at 50 feet TDH.

Additionally, two new blowers are proposed to be installed to provide air scour during backwash for the new filters in Phase 3, Alternative No. 1. The blowers are proposed to be placed to the side of the filters. Each blower should be capable of being valved for use on either of the new filters.

5. Clearwells

For a flow of 12.25 MGD the existing and proposed clearwell added in Phase 2 would still have sufficient storage based on inactivation ratios outlined hereinbefore. However, it is recommended that the existing 1,000,000 gallon clearwell be replaced during the Phase 3, Alternative No. 1 improvements due to the useful life of the existing tank being limited and to yield flexibility in operation.

6. High Service Pumping

Phase 2 includes recommendations that the existing high service building and pumps remain in place and a new high service building be constructed housing space for four new pumps. One 1,050 GPM pump and one 1,400 GPM pump were proposed to be installed during Phase 2, and two 3,650 GPM pumps are proposed to be installed during Phase 3, Alternative No. 1. Appropriate distribution system improvements will be required to transport finished water as usage increases.

7. Process Waste Handling

Additional storage space will be required for the process waste handling facilities during the Phase 2 and Phase 3 design phases to accommodate the additional load. A third waste sludge lagoon will need to be added. The Waste Sludge Pumping Station will be adequate to handle the increase in plant capacity as long as only one filter is backwashed at a time.

8. Chemical Storage and Feed Facilities

The chemical feed rates will be increased when the plant is expanded to 12.25 MGD. Replacement of tanks and pumps should take into consideration the frequency and size of chemical deliveries

for plant expansions as well as the mandatory minimum storage requirements of TDEC. A new chemical building, either as an expansion of the existing chemical building or completely new construction, will be needed for the additional chemical storage space required.

D. Holiday Hills Lake Raw Water Intake

The existing Holiday Hills Lake raw water intake will need modifications to allow it to transport sufficient raw water to Meadow Park Lake. The existing 2,400 GPM (3.5 MGD) vertical turbine style pumps are proposed to be replaced by two 7,000 GPM (10.0 MGD) vertical turbine style pumps with VFDs. Additionally, a new raw water intake and electrical building are proposed to be constructed to house the new pumps, VFDs and upgraded electrical equipment. Approximately 26,000 linear feet of 24-inch raw water line is proposed to be routed from the modified Holiday Hills Lake raw water intake to Meadow Park Lake. The modifications to the Holiday Hills Lake raw water intake including the new 24-inch raw water line are estimated to cost \$5,500,000 as shown on Cost Estimate No. 5 and depicted in Exhibit Nos. 2 and 8 in the Appendix.

E. Treated Water Distribution Line

Improvements included in Phase 3, Alternative No. 1 will require the Meadow Park Lake WTP to pump water to both pressure zones without the use of the Holiday Hills WTP. Currently there are 10-inch to 14-inch water lines that run between the existing Meadow Park Lake WTP and the Holiday Hills WTP. These particular lines will need to be replaced with approximately 30,000 linear feet of 16-inch water line, along with upsizing of a few other sections of pipe within the standard pressure zone to allow for ample service. The improvements to the distribution system included in

Phase 3, Alternative No. 1 are estimated to cost \$3,800,000 as shown on Cost Estimate No. 6 and depicted in Exhibit No. 2 in the Appendix.

F. Abandon Holiday Hills WTP

Improvement included in Phase 3, Alternative No. 1 no longer require the use of the Holiday Hills WTP. The plant was constructed in 1968 and doubled in capacity in 1976. Significant improvements would be required to increase the capacity of the plant and then the existing facilities would also need major renovations. Considering that the Holiday Hills WTP will likely be in excess of 75 years old when Phase 3 is implemented it is proposed to be demolished in Phase 3, Alternative No. 1. The improvements to the Holiday Hills Lake raw water intake and raw water line will still need to be undertaken as outlined hereinbefore. The demolition of the Holiday Hills WTP is estimated to cost \$300,000 as shown on Cost Estimate No. 7 and depicted in Exhibit No. 9 in the Appendix.

VI. PHASE 3, ALTERNATIVE NO. 2 IMPROVEMENTS

A. General

Phase 3, Alternative No. 2 is proposed to continue the use of both the Meadow Park and Holiday Hills water treatment plants. In order to do so the following will need to take place after the completion of Phase 2:

- Construct a new 5.5 MGD Holiday Hills WTP.

It should be noted that the existing Holiday Hills WTP is being proposed to be replaced and not expanded in Phase 3, Alternative No. 2 due to the age of the facility when this phase is expected to be implemented. The estimates given for the construction of the new Holiday Hills WTP are based on known technologies for water treatment facilities although the design will most likely be modified to consider technological advances and regulatory requirements. A proposed schematic plan is shown in the following figure:

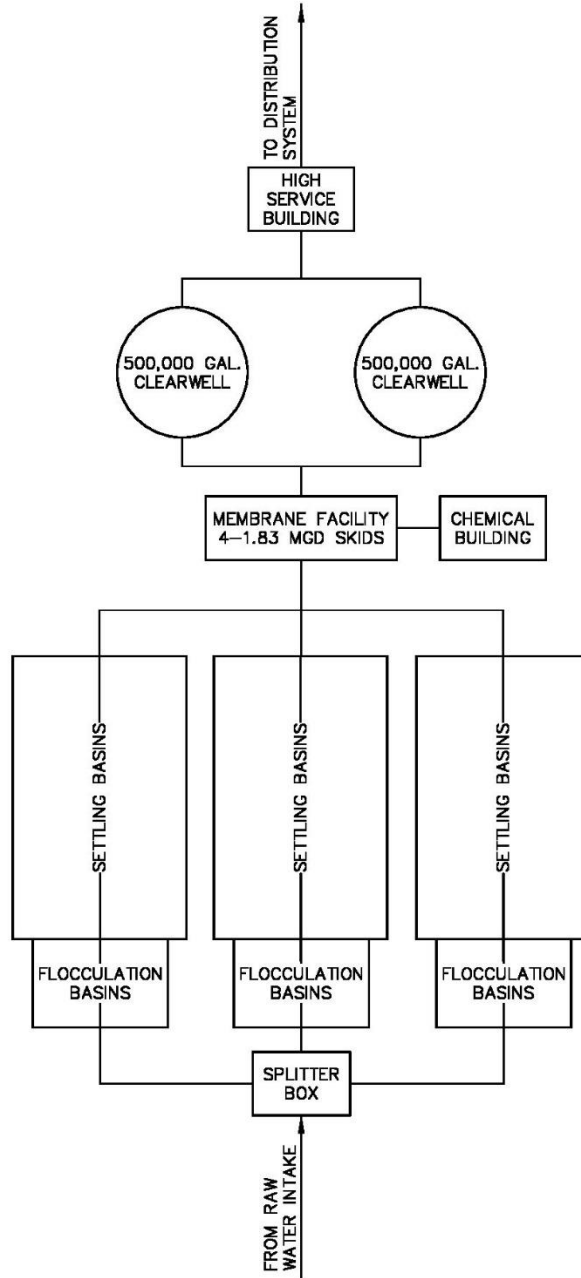


FIGURE VI-1. PROPOSED HOLIDAY HILLS 5.5 MGD WTP SCHEMATIC PLAN

B. Construct New 5.5 MGD Holiday Hills WTP

1. General

The construction of a new Holiday Hills WTP is proposed to increase the capacity from 4.0 MGD to 5.5 MGD. The City of Crossville owns three lots to the north of the existing WTP site which are proposed to serve as the location for the proposed new WTP as part of the Phase 3, Alternative No. 2 improvements. The required improvements will include a new raw water intake electrical building, new raw water pumps, new flocculation and settling basins, new laboratory and filter building, new chemical storage, new high service building and new high service pumps at an estimated cost of \$26,800,000 in year 2019 dollars as shown on Cost Estimate No. 8 and depicted in Exhibit Nos. 3, 10 and 11 in the Appendix.

2. Raw Water Intake

The existing Holiday Hills WTP raw water intake is a conventional type intake consisting of a concrete wetwell located adjacent to Holiday Hills Lake. Raw water is currently at sufficient depth in the lake at the intake location due to the downstream Holiday Hills Lake Dam. Raw water enters the intake through one of four sluice gates which vary from invert elevation 1,744.20 to 1,750.95. The normal pool elevation is elevation 1,761.25 feet. The raw water is screened by a trash rack the condition of which needs to be evaluated. The screened water enters the pump suction wells and is transported to the Holiday Hills WTP by one of two 50 HP vertical turbine style pumps each with a nominal capacity of 2,400 GPM (3.5 MGD) at 63 feet TDH. In 2012, a building was constructed on top of the existing intake pad at which time new electrical and HVAC were added.

The structure of the intake appears to be in good condition. However, the pumps, motors and valves are in need of replacement due to their years of continuous service. The electrical, lighting, heating and ventilating systems were added in 2013 and appear to be in good condition.

The proposed improvements include the installation of two new 3,800 GPM (5.5 MGD) vertical turbine style pumps with VFDs which will replace the existing pumps. All new electrical and mechanical equipment is proposed to be installed in a new building constructed adjacent to the intake.

3. Raw Water Line

The raw water line consists of approximately 576 L.F. of 18-inch pipe installed in 1976 to replace an existing 12-inch raw water pipeline. The future expansion of the Holiday Hills WTP would require larger pumps to be installed at the intake for a design point of 5.5 MGD or 3,800 GPM. The 18-inch pipe will have a velocity of approximately 4.85 fps when flowing at 3,800 GPM which is acceptable and should not exceed the pipes original pressure rating. However, as proposed hereinbefore, the location of the new water treatment plant will require an extension of the existing raw water line. Likewise, the useful life of the raw water line will be nearing it's end and should be considered for replacement.

4. Flash Mixing

The 18-inch raw water line is proposed to enter the WTP site and pass through a venturi tube as well as an 18-inch butterfly valve prior to entering a mechanical flash mix located at the rear of the filter building. At the flash mix, chemicals are proposed to be added into a solution trough and mixed with the raw water. The water will then

enter into a splitter box and discharge equally into the flocculation basins with the use of weirs.

5. Flocculation and Settling Basins

The mixed raw water is proposed to flow into a series of flocculation basins with the mixing energy decreasing as flow passes downstream. Each basin utilizes two identical three-compartment flocculators before entering the settling basins. The flocculators agitate the particles in the mixed water to encourage inter-particle contact but are gentle enough to prevent disintegration of existing flocculated particles. Particles grow by colliding with other particles and sticking together. Detention time is necessary for the formation of floc. Temperature and pH also affect the flocculation process.

Each flocculation basin is sized based on the required detention time given by TDEC. The proposed size of each flocculation basin is 20 feet by 20 feet yielding a surface area for each basin of 400 SF. The depth is proposed to be approximately 10 feet for a volume of 180,000 gallons total for all six basins. The flow detention times up to the maximum of 5.5 MGD are shown in the following table.

TABLE VI-1
HOLIDAY HILLS WTP
FLOCCULATION BASIN DETENTION TIMES

<u>Flow</u>	<u>Detention Time</u>
1.0 MGD	257 min
2.0 MGD	129 min
3.0 MGD	86 min
4.0 MGD	64 min
5.0 MGD	51 min
5.5 MGD	47 min

The recommended detention time for flocculation basins is 45 minutes given by the TDEC design criteria for Community Public

Water Systems. After passing through the flocculation basin, the flocculated water is required to pass through a baffle wall into one of six rectangular settling basins. The basins are proposed to each be approximately 96 feet long by 24 feet wide and approximately 10 feet deep yielding a volume of 172,340 gallons in each basin or 1,034,040 gallons total. The detention time of the settling basin at varying plant flows is shown in the following table with all basins in operation.

TABLE VI-2
HOLIDAY HILLS WTP
SETTLING BASIN DETENTION TIMES

<u>Flow</u>	<u>Detention Time</u>
1.0 MGD	24.8 hrs
2.0 MGD	12.4 hrs
3.0 MGD	8.3 hrs
4.0 MGD	6.2 hrs
5.0 MGD	5.0 hrs
5.5 MGD	4.5 hrs

The TDEC design criteria for Community Public Water Systems requires a minimum detention time of 4.0 hours although this may be reduced to 1.0 hour if tube settlers are implemented. The maximum loading rate for tube settlers is 2.5 gpm/sf which yields a minimum tube settler area of 253 square feet per basin at a flow of 5.5 MGD.

The settled water is proposed to flow through three separate 18-inch pipelines into the filters at a velocity of 1.6 feet per second at 5.5 MGD. This velocity is lower than the 2.0 feet per second maximum and decrease the potential for floc to shear after the settling basins.

6. Filtration

The latest proven technology in water supply is the use of membrane filters in lieu of the conventional sand-anthracite filters. Membranes remove very fine particles and are rated for 4 log removal of giardia

and cryptosporidium and 3.5 log removal of viruses. Over the past several years, the price of membranes has decreased and the components to be used in this technology have been developed and improved. Although it is not known whether a new technology will be available when Phase 3 improvements are considered, the basis for construction estimates for the new Holiday Hill WTP is membrane technology being implemented for filtration at this time.

Membrane filtration technology uses skids or trains as the basis for sizing and future expansion. It is proposed to construct four 1.83 MGD trains in or adjacent to the proposed lab building and settling and flocculation basins. Since one skid must be out of service part of the time for cleaning the membranes, the rated capacity would be 5.5 MGD with three trains in operation. Space should be left for additional expansion as proposed during the design phase of the new Holiday Hills WTP.

7. Clearwells

On-site generated sodium hypochlorite (Miox) is proposed to be used as a disinfectant and is proposed to be injected into the filtered water which then will discharge to the two 500,000 gallon clearwells. Calculations are based on the continued use of sodium hypochlorite as a disinfectant, however new clearwells will need to be constructed due to age of the existing structures. One clearwell was constructed in 1968 and the second was added in 1976. Two new 500,000 gallon circular clearwells are used for calculations. The contact times for one clearwell operating alone and with both clearwells in operation are shown in the following table using an average baffling condition.

TABLE VI-3
HOLIDAY HILLS WTP
CLEARWELL CT TIMES

<u>Plant Flow</u>	<u>CT Times</u> <u>(500,000 gal.)</u>	<u>CT Times</u> <u>(1,000,000 gal.)</u>
1.0 MGD	3.57 hrs	7.15 hrs
2.0 MGD	1.78 hrs	3.57 hrs
3.0 MGD	1.18 hrs	2.38 hrs
4.0 MGD	0.90 hrs	1.78 hrs
5.0 MGD	0.72 hrs	1.43 hrs
5.5 MGD	0.67 hrs	1.32 hrs

The inactivation ratios for this clearwell are shown in the following table using pH = 7.5, chlorine residual = 1.83 mg/l, and a temperature of 0.5 degrees Celsius.

TABLE VI-4
HOLIDAY HILLS WTP
CLEARWELL INACTIVATION RATIOS

<u>Plant Flow</u>	<u>Inactivation Ratio</u> <u>(500,000 gal.)</u>	<u>Inactivation Ratio</u> <u>(1,000,000 gal.)</u>
1.0 MGD	8.2	16.4
2.0 MGD	4.1	8.2
3.0 MGD	2.7	5.5
4.0 MGD	2.1	4.1
5.0 MGD	1.6	3.3
5.5 MGD	1.5	3.0

The minimum required inactivation ratio is 1.0 according to the rules of the Tennessee Department of Environment and Conservation. As a result, two existing clearwells nearly full will meet the inactivation ratio requirement at flows up to 5.5 MGD, and no additional clearwell volume will be required.

8. High Service Pumping

The Holiday Hills WTP is proposed to be equipped with a high service pumping facility containing three vertical turbine pumps with

two pumps capable of transporting 3,850 GPM when operating together. A building large enough to contain these pumps and electrical equipment is proposed as well.

9. Process Waste Handling

The existing process waste handling facilities were constructed in 1976 and consists of a large basin 39 feet 3 inches wide by 79 feet 9 inches long with a side water depth that varies from 10 feet to 10 feet 6 inches containing approximately 250,000 gallons. A sump pump pit is located adjacent to the process waste handling facility. The theory of operation is that the basin receives flow from a 16-inch pipe, the solids settle to the bottom and clear liquid flow through one of two pipes to the sump pump pit. The clear liquid is then pumped to the City of Crossville's Wastewater Treatment Plant. Solids are occasionally removed and deposited on-site. A new process waste handling facility is proposed to be constructed at the new Holiday Hills WTP site due to the age of the concrete when Phase 3 improvements are considered.

10. Chemical Storage and Feed Facilities

New chemical storage and feed facilities will be required for the increase in production at the new Holiday Hills WTP. It is speculated that the City will continue with the use of the existing chemicals, however, generic tank sizing and building footprint required for the typical plant size of 5.5 MGD were used for determining a cost estimate. These items will need to be investigated more closely when Phase 3 is under design.

VII. CAPITAL COST SUMMARY AND ALTERNATIVE COMPARISON

A. Phase 1 Improvements

- Raise Meadow Park Lake Dam;
- Relocate Meadow Park Lake WTP Raw Water Intake;
- Improvements to Meadow Park Lake Raw Water Line.

The estimated total project cost of Phase 1 is \$24,400,000 in 2019 dollars as shown on Cost Estimate No. 9.

B. Phase 2 Improvements

- Expand Meadow Park Lake WTP from 3.5 MGD to 7.0 MGD.

The estimated total project cost of Phase 2 is \$13,400,000 in 2019 dollars as shown on Cost Estimate No. 9.

C. Phase 3, Alternative No. 1 Improvements - Transfer all raw water to Meadow Park Lake and consolidate treatment at one location:

- Expand Meadow Park Lake WTP from 7.0 MGD to 12.25 MGD;
- Construct facilities to transfer raw water from Holiday Hills Lake to Meadow Park Lake;
- Construct improvements to provide for adequate transfer of treated water within the distribution system;
- Abandon the Holiday Hills WTP.

The estimated total project cost of Phase 3, Alternative No. 1 is \$30,900,000 in 2019 dollars as shown on Cost Estimate No. 9.

D. Phase 3, Alternative No. 2 Improvements - Treat water at Meadow Park Lake and Holiday Hills WTP:

- Expand Holiday Hills WTP to 5.5 MGD.

The estimated total project cost for Phase 3, Alternative No. 2 is \$26,800,000 in 2019 dollars as shown on Cost Estimate No. 9.

E. Alternative Comparison

An alternative comparison between both Phase 3 alternatives takes into consideration the initial cost of building facilities, staffing needs, chemical demands and energy costs and maintenance costs. Due to the nature of the proposed Phase 3 improvements and variability of construction costs, new cost estimates for each alternative should be completed based on available technologies at the time these projects are implemented. A present worth analysis of each alternative should be prepared based on current labor and operation and maintenance costs prior to selecting and implementing an alternative. It is premature at this time to prepare a present worth analysis of each alternative due to the extended time prior to implementation and unknown factors that will likely change prior to implementation.

1. Alternative No. 1 - Consolidate Treatment at One Location

The major benefits for the transfer of all raw water to Meadow Park Lake and consolidating treatment at one location as outlined in Phase 3, Alternative No. 1 include less overall power consumption. Likewise, staffing requirements would decrease due to consolidating operations at one location. It is understood that two operator positions could be eliminated which would save the City of Crossville the costs of salaries and benefits paid to these two employees. Elimination of the need to maintain more than one facility would be another benefit to consolidating treatment at one location. Having all chemicals delivered to one location would also benefit the City. Full truck loads of chemicals delivered at one location would save money versus half loads or splitting delivery locations. The decreased cost

of operation should be considered when comparing capital costs of each alternative.

2. Alternative No. 2 - Continue Treatment at Two Locations

The major benefits for continuing to treat water at both the Holiday Hills WTP and the Meadow Park Lake WTP are flexibility in distribution within the system. Likewise, one plant may be able to be shut down for temporary maintenance while the other plant temporarily increases production. The initial costs of building a new 5.5 MGD Holiday Hills WTP are currently estimated to be less than expanding the Meadow Park Lake WTP from 7.0 MGD to 12.25 MGD and constructing distribution system improvements.

The drawbacks for continuing to treat water at both locations is increased maintenance. Although it is likely that the construction of a new 5.5 MGD Holiday Hills WTP would be more efficient than the existing facilities, maintenance would still be required at both locations. There would also be greater staffing requirements for the use of two facilities. Two extra employees would likely be required versus consolidating treatment at one location. The additional operation and maintenance costs should be considered when comparing updated estimated capital costs of each alternative prior to implementation.

VIII. PERMITTING REQUIREMENTS

Permitting of the proposed alternatives described herein will be a factor in the time it takes to begin construction. J.R. Wauford and Company, along with the City of Crossville has already been in discussion with several of the entities involved to expedite the process. The significant permits required for each alternative are as follows:

A. Phase 1 Improvements

Raise Meadow Park Lake Dam

- TDEC Section 401 Water Quality Certification - Aquatic Resource Alteration Permit (ARAP)
- Corps of Engineers (COE) Section 404 Permit

Relocate Meadow Park Lake WTP Raw Water Intake

- Corps of Engineers (COE) Section 404 Permit

B. Phase 2 Improvements

Expand Meadow Park Lake WTP from 3.5 MGD to 7.0 MGD

- TDEC Section 401 Water Quality Certification - ARAP for increased raw water withdrawal (potential)
- TDEC Inter-basin transfer permit for additional Lake Tansi water transfer (potential)

C. Phase 3, Alternative No. 1 Improvements - Transfer All Raw Water to Meadow Park Lake and Consolidate Treatment at One Location

Expand Meadow Park Lake WTP from 7.0 MGD to 12.25 MGD

- TDEC Section 401 Water Quality Certification - ARAP for increased raw water withdrawal (potential)

Expand Holiday Hills Raw Water Intake

- TDEC Section 401 Water Quality Certification - ARAP for increased raw water withdrawal (potential)
- TDEC Inter-basin transfer permit to transfer Holiday Hills Lake raw water
- TVA Section 26a Permit (potential)

Treated Water Distribution Line

- TDEC Inter-basin transfer permit (potential)

Abandon Holiday Hills WTP

- None Required

D. Phase 3, Alternative No. 2 Improvements - Treat Water at Meadow Park Lake and Holiday Hills WTP

Expand Holiday Hills WTP to 5.5 MGD

- TDEC Section 401 Water Quality Certification - ARAP for increased raw water withdrawal (potential)
- TVA Section 26a Permit (potential)

IX. RECOMMENDATION

In order to construct any of the improvements described hereinbefore, it is imperative that the permitting phase for the raising of the Meadow Park Lake Dam begin immediately. Additional storage for water is required before the City will be able to meet the demands for increased customer demand. The permitting process can take a significant amount of time but has fortunately already been discussed with several of the entities involved to speed up the process. Regardless, the timeline for meeting the future demand for water hinges on receiving permission to raise the Meadow Park Lake Dam.

Once the permit for raising the Meadow Park Lake Dam is secure, design for the Phase 1 improvements should commence immediately. Phase 1 improvements include raising the Meadow Park Lake Dam about 18 feet and relocating the Meadow Park Lake WTP raw water intake. These two construction projects can be undertaken at the same time and would last approximately 24 months at a combined estimated cost of \$24,400,000. Phase 1 improvements must be completed prior to Phase 2 improvements.

Phase 2 improvements which include expanding the Meadow Park Lake WTP to 7.0 MGD is expected to be required by 2028 based on current water usage forecasts. It is recommended to have Phase 1 improvements completed prior to 2028 because according to TDEC's 80% rule and based on future expected demand, the design for the expansion of the Meadow Park Lake WTP to 7.0 MGD will be required near this timeframe. The estimated time of construction and costs for the Phase 2 Improvements is 24 months and \$13,400,000. Phase 2 improvements are required prior to moving into either of the Phase 3 alternatives.

The two Phase 3 alternatives will each be capable of effectively supplying the same amount of water to the distribution system. However, the first alternative consolidates treatment at one location while the second alternative continues the use of two water treatment plants. It is recommended that when the Phase 3 improvements are required that the City of Crossville re-examine the feasibility of each alternative based on the most current regulations and treatment alternatives available. Each alternative will have benefits and considerations that may be better understood at the time of needed expansion.

Appendix

Schedule

4637 Crossville Raw Water Capacity Master Plan

Select a period to highlight at right. A legend describing the charting follows.

Period Highlight: 9 Plan Duration Actual Start % Complete Actual (beyond plan) % Complete (beyond plan)

ACTIVITY	PLAN START	PLAN DURATION	ACTUAL START	ACTUAL DURATION	ESTIMATE COST 2019 DOLLARS	PERCENT COMPLETE	YEAR																												
							2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047
Phase 1	2019	10	2019	8	\$24,400,000	0%																													
Phase 2	2027	6	2029	2	\$13,400,000	0%																													
Phase 3 Alt. No. 1	2031	10	2037	2	\$30,900,000	0%																													
Phase 3 Alt. No. 2	2031	10	2037	2	\$26,800,000	0%																													

Cost Estimates

COST ESTIMATE NO. 1
PHASE 1 IMPROVEMENTS
MEADOW PARK LAKE DAM IMPROVEMENTS
CROSSVILLE, TENNESSEE
WAUFORD PROJECT NO. 4637

<u>Item</u>	<u>Description</u>	<u>Cost</u>
1.	Tree Clearing (300 Acres @ \$2,000/Acre)	\$600,000
2.	Dam Site Preparation	\$250,000
3.	Foundation Preparation (800 C.Y. @ \$1,300/C.Y.)	\$1,040,000
4.	Intake and Outlet Structure (100 C.Y. @ \$1,300/C.Y.)	\$130,000
5.	Roller Compacted Concrete (20,000 C.Y. @ \$600/C.Y.)	\$12,000,000
6.	Class "A" Concrete Protection (1,200 C.Y. @ @1,000/C.Y.)	\$1,200,000
7.	Finished Grading and Rip-rap	<u>\$100,000</u>
	ESTIMATED CONSTRUCTION COST	\$15,320,000
	CONSTRUCTION CONTINGENCIES (20%)	<u>\$3,010,000</u>
	1. Budgeted for Construction	\$18,330,000
	2. Engineering: Planning	\$185,000
	Design	\$920,000
	Bidding & Award	\$15,000
	During Construction (24 Months)	<u>\$480,000</u>
	TOTAL ESTIMATED PROJECT COST	\$19,930,000

ENR CONSTRUCTION COST INDEX – 11311 (AUGUST 2019)

COST ESTIMATE NO. 2
PHASE 1 IMPROVEMENTS
MEADOW PARK LAKE WTP RAW WATER INTAKE IMPROVEMENTS
CROSSVILLE, TENNESSEE
WAUFORD PROJECT NO. 4637

<u>Item</u>	<u>Description</u>	<u>Cost</u>
1.	Site Development, Excavation and Grading	\$975,000
2.	Structural Concrete (400 C.Y. @ \$1,500/C.Y.)	\$600,000
3.	Interior Piping	\$150,000
4.	Miscellaneous Metals	\$50,000
5.	Building Construction (600 S.F. @ \$300/S.F.)	\$180,000
6.	Equipment Installation	\$120,000
7.	Electrical (Including Generator Relocation)	\$350,000
8.	Process Painting and Coating	\$75,000
9.	Miscellaneous Concrete and Paving	\$75,000
10.	Process Equipment	\$660,000
	Raw Water Pumps and VFDs (3)	\$450,000
	Instrumentation and Controls	\$150,000
	Gates	\$60,000
		<hr/>
	ESTIMATED CONSTRUCTION COST	\$3,325,000
	CONSTRUCTION CONTINGENCIES (20%)	<u>\$665,000</u>
	1. Budgeted for Construction	\$3,900,000
	2. Engineering: Design	\$240,000
	Bidding & Award	\$15,000
	During Construction (15 months)	\$300,000
	O & M and Start-Up	<u>\$15,000</u>
	TOTAL ESTIMATED PROJECT COST	\$4,470,000

ENR CONSTRUCTION COST INDEX – 11311 (AUGUST 2019)

COST ESTIMATE NO. 3
PHASE 2 IMPROVEMENTS
EXPANSION OF MEADOW PARK
LAKE WTP FROM 3.5 MGD TO 7.0 MGD
CROSSVILLE, TENNESSEE
WAUFORD PROJECT NO. 4637

<u>Item</u>	<u>Description</u>	<u>Cost</u>
1.	Site Development and Grading	\$100,000
2.	Structural Concrete (3,500 C.Y. @ \$1,300/C.Y.)	\$4,550,000
3.	Interior Piping	\$500,000
4.	Site Piping	\$250,000
5.	Miscellaneous Metals	\$50,000
6.	Building Construction and Renovation (3,450 S.F. @ \$250/S.F.)	\$862,500
7.	Equipment Installation	\$350,000
8.	Electrical	\$1,000,000
9.	Process Painting and Coating	\$75,000
10.	Miscellaneous Concrete and Paving	\$75,000
11.	Process Equipment	\$2,300,000
	Settling Basin Sludge Rakes (2)	\$500,000
	Flocculators (2)	\$100,000
	Filter Troughs, Underdrains and Media	\$400,000
	Transfer Pumps (2)	\$100,000
	Blowers (2)	\$200,000
	High Service Pumps (2)	\$200,000
	Pipe Gallery Valves	\$250,000
	Instrumentation and Controls	\$550,000
	ESTIMATED CONSTRUCTION COST	\$10,112,500
	CONSTRUCTION CONTINGENCIES (20%)	\$2,037,500
	1. Budgeted for Construction	\$12,150,000
	2. Engineering: Design	\$725,000
	Bidding & Award	\$15,000
	During Construction (24 months)	\$480,000
	O & M and Start-Up	<u>\$30,000</u>
	TOTAL ESTIMATED PROJECT COST	\$13,400,000

ENR CONSTRUCTION COST INDEX – 11311 (AUGUST 2019)

COST ESTIMATE NO. 4
PHASE 3, ALTERNATIVE NO. 1 IMPROVEMENTS
EXPANSION OF MEADOW PARK
LAKE WTP FROM 7.0 MGD TO 12.25 MGD
CROSSVILLE, TENNESSEE
WAUFORD PROJECT NO. 4637

<u>Item</u>	<u>Description</u>	<u>Cost</u>
1.	Site Development and Grading	\$200,000
2.	Structural Concrete (6,150 C.Y. @ \$1,300/C.Y.)	\$7,995,000
3.	Interior Piping	\$600,000
4.	Site Piping	\$600,000
5.	Miscellaneous Metals	\$100,000
6.	Building Construction and Renovation (4,900 S.F. @ \$250/S.F.)	\$1,225,000
7.	Equipment Installation	\$500,000
8.	Electrical	\$1,400,000
9.	Process Painting and Coating	\$200,000
10.	Miscellaneous Concrete and Paving	\$100,000
11.	Process Equipment	\$3,700,000
	Settling Basin Sludge Rakes (3)	\$750,000
	Flocculators (3)	\$150,000
	Filter Troughs, Underdrains and Media	\$600,000
	Transfer Pumps (4)	\$200,000
	Blowers (4)	\$400,000
	High Service Pumps (2)	\$200,000
	Pipe Gallery Valves	\$400,000
	Instrumentation and Controls	\$1,000,000
	ESTIMATED CONSTRUCTION COST	\$16,620,000
	CONSTRUCTION CONTINGENCIES (20%)	<u>\$3,155,000</u>
	1. Budgeted for Construction	\$19,775,000
	2. Engineering: Design	\$1,000,000
	Bidding & Award	\$15,000
	During Construction (24 months)	\$480,000
	O & M and Start-Up	<u>\$30,000</u>
	TOTAL ESTIMATED PROJECT COST	\$21,300,000

ENR CONSTRUCTION COST INDEX – 11311 (AUGUST 2019)

COST ESTIMATE NO. 5
PHASE 3, ALTERNATIVE NO. 1 IMPROVEMENTS
HOLIDAY HILLS LAKE RAW WATER INTAKE MODIFICATIONS
CROSSVILLE, TENNESSEE
WAUFORD PROJECT NO. 4637

<u>Item</u>	<u>Description</u>	<u>Cost</u>
1.	24-Inch Raw Water Line (26,000 L.F. @ \$100/L.F.)	\$2,600,000
2.	Structural Concrete (100 C.Y. @ \$1,300/C.Y.)	\$130,000
3.	Site Development and Grading	\$25,000
4.	Interior Piping	\$75,000
5.	Miscellaneous Metals	\$25,000
6.	Building Construction (550 S.F. @ \$300/S.F.)	\$165,000
7.	Equipment Installation	\$100,000
8.	Electrical	\$350,000
9.	Process Painting and Coating	\$25,000
10.	Miscellaneous Concrete and Paving	\$25,000
11.	Process Equipment	\$575,000
	Control Valves	\$75,000
	Raw Water Pumps and VFDs (2)	\$300,000
	Instrumentation and Controls	\$200,000
	ESTIMATED CONSTRUCTION COST	\$4,095,000
	CONSTRUCTION CONTINGENCIES (20%)	\$860,000
	1. Budgeted for Construction	\$4,955,000
	2. Engineering: Design	\$270,000
	Bidding & Award	\$15,000
	During Construction (12 months)	\$240,000
	O & M and Start-Up	\$20,000
	TOTAL ESTIMATED PROJECT COST	\$5,500,000

ENR CONSTRUCTION COST INDEX – 11311 (AUGUST 2019)

COST ESTIMATE NO. 6
PHASE 3, ALTERNATIVE NO. 1 IMPROVEMENTS
TREATED WATER DISTRIBUTION LINE
CROSSVILLE, TENNESSEE
WAUFORD PROJECT NO. 4637

<u>Item</u>	<u>Quantity</u>	<u>Description</u>	<u>Unit Price</u>	<u>Cost</u>
1.	4 E.A.	Connection to Existing Water Lines	\$ 10,000/E.A.	\$40,000
2.	30,000 L.F.	Install 16-inch PVC Water Line, Open Cut	\$ 80/L.F.	\$2,400,000
3.	3 E.A.	New Air Release Valve Assembly	\$ 8,000/E.A.	\$24,000
4.	3 E.A.	New Blow-Off Assembly	\$ 5,000/E.A.	\$15,000
5.	30,000 L.F.	Roadway and Easement Repair	\$ 10/L.F.	<u>\$300,000</u>
		ESTIMATED CONSTRUCTION COST		\$2,779,000
		CONSTRUCTION CONTINGENCIES (20%)		<u>\$571,000</u>
		1. Budgeted for Construction		\$3,350,000
		2. Engineering: Design		\$200,000
		Bidding & Award		\$10,000
		During Construction (12 months)		<u>\$240,000</u>
		TOTAL ESTIMATED PROJECT COST		\$3,800,000

ENR CONSTRUCTION COST INDEX – 11311 (AUGUST 2019)

COST ESTIMATE NO. 7
PHASE 3, ALTERNATIVE NO. 1 IMPROVEMENTS
DEMOLITION OF HOLIDAY HILLS WTP
CROSSVILLE, TENNESSEE
WAUFORD PROJECT NO. 4637

<u>Item</u>	<u>Description</u>	<u>Cost</u>
1.	Building Demolition	\$75,000
2.	Structural Concrete Demolition	\$100,000
3.	Environmental Remediation	\$50,000
4.	Salvage Structural Iron/Steel	<u>(\$50,000)</u>
	ESTIMATED CONSTRUCTION COST	\$175,000
	CONSTRUCTION CONTINGENCIES (20%)	<u>\$35,000</u>
	1. Budgeted for Construction	\$210,000
	2. Engineering: Design	\$30,000
	Bidding & Award	\$10,000
	During Construction (3 months)	<u>\$50,000</u>
	TOTAL ESTIMATED PROJECT COST	\$300,000

ENR CONSTRUCTION COST INDEX – 11311 (AUGUST 2019)

COST ESTIMATE NO. 8
PHASE 3 ALTERNATIVE NO. 2 IMPROVEMENTS
NEW 5.5 MGD HOLIDAY HILLS WTP
CROSSVILLE, TENNESSEE
WAUFORD PROJECT NO. 4637

<u>Item</u>	<u>Description</u>	<u>Cost</u>
1.	Site Development, Excavation and Grading	\$500,000
2.	Structural Concrete (4,500 C.Y. @ \$1,500/C.Y.)	\$6,750,000
3.	Interior Piping	\$750,000
4.	Site Piping	\$750,000
5.	Miscellaneous Metals	\$400,000
6.	Metal Building Construction and Renovation (12,000 S.F. @ \$200/S.F.)	\$2,400,000
7.	Equipment Installation	\$1,000,000
8.	Electrical	\$2,000,000
9.	Process Painting and Coating	\$300,000
10.	Miscellaneous Concrete and Paving	\$250,000
11.	Process Equipment	\$5,750,000
	Raw Water Pumps & VFDs (2)	\$300,000
	Settling Basin Sludge Rakes (6)	\$1,200,000
	Flocculators (6)	\$300,000
	Membrane Skids	\$3,000,000
	High Service Pumps (3)	\$300,000
	Instrumentation and Controls	\$650,000
	 ESTIMATED CONSTRUCTION COST	 \$20,850,000
	CONSTRUCTION CONTINGENCIES (20%)	<u>\$4,150,000</u>
	1. Budgeted for Construction	\$25,000,000
	2. Engineering: Design	\$1,275,000
	Bidding & Award	\$15,000
	During Construction (24 months)	\$480,000
	O & M and Start-Up	<u>\$30,000</u>
	 TOTAL ESTIMATED PROJECT COST	 \$26,800,000

ENR CONSTRUCTION COST INDEX – 11311 (AUGUST 2019)

COST ESTIMATE NO. 9
COST ESTIMATE SUMMARY
RAW WATER STUDY
CITY OF CROSSVILLE, TENNESSEE
WAUFORD PROJECT NO. 4637

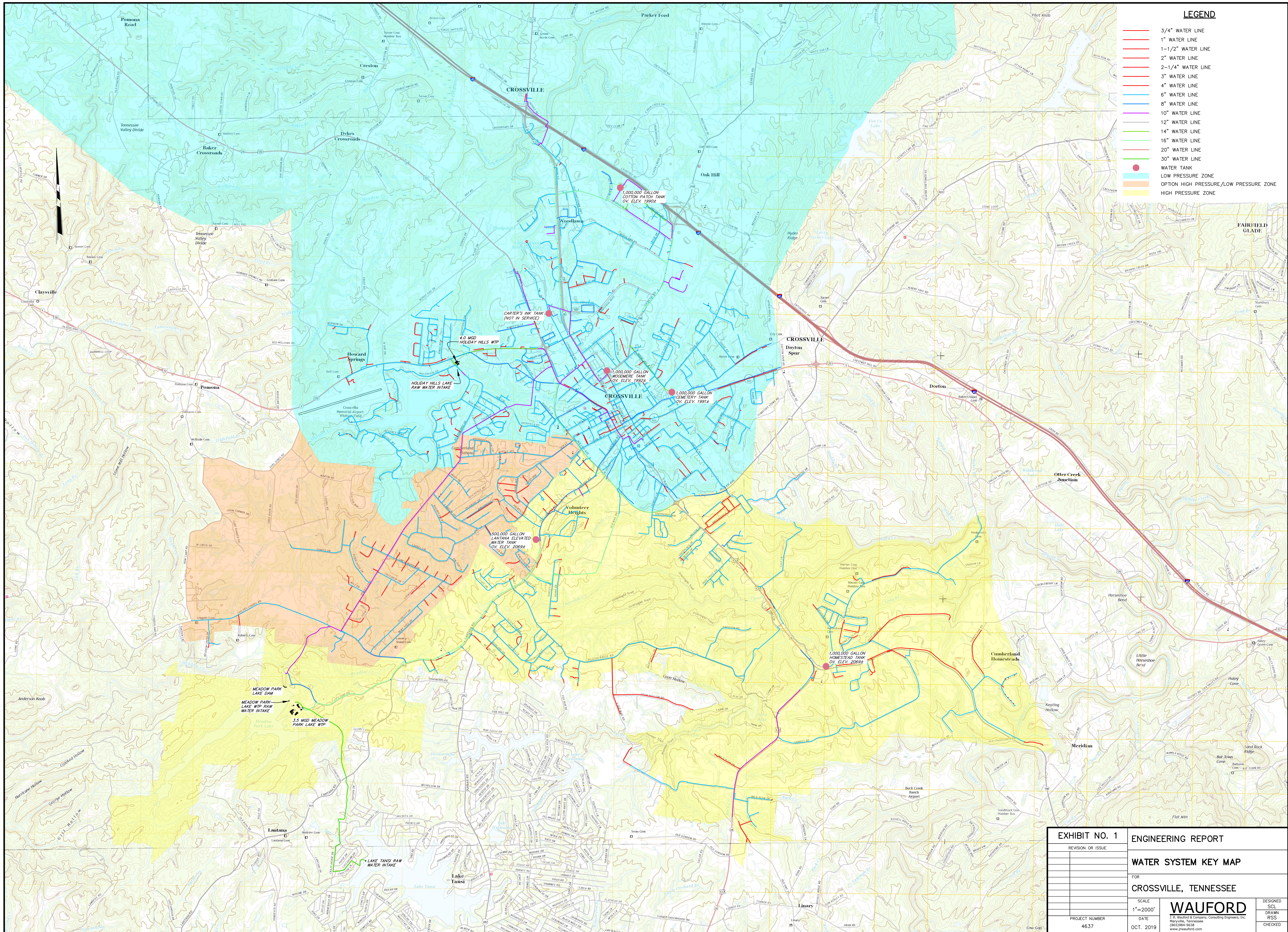
Proposed Improvements - Phase 1		
<u>Description</u>	<u>Cost Estimate No.</u>	<u>Estimated Cost</u>
Meadow Park Lake Dam Improvements	CE-1	\$19,930,000
Meadow Park Lake WTP Raw Water Intake Improvements	CE-2	<u>\$4,470,000</u>
TOTAL ESTIMATED PROJECT COST		<u>\$24,400,000</u>

Proposed Improvements - Phase 2		
<u>Description</u>	<u>Cost Estimate No.</u>	<u>Estimated Cost</u>
Expand Meadow Park Lake WTP From 3.5 MGD to 7.0 MGD	CE-3	<u>\$13,400,000</u>
TOTAL ESTIMATED PROJECT COST		<u>\$13,400,000</u>

Proposed Improvements - Phase 3, Alternative No. 1		
<u>Description</u>	<u>Cost Estimate No.</u>	<u>Estimated Cost</u>
Expand Meadow Park Lake WTP From 7.0 MGD to 12.25 MGD	CE-4	\$21,300,000
Holiday Hills Lake Raw Water Intake Improvements	CE-5	\$5,500,000
New Treated Water Distribution Line	CE-6	\$3,800,000
Demolition of Holiday Hills WTP	CE-7	\$300,000
TOTAL ESTIMATED PROJECT COST		<u>\$30,900,000</u>

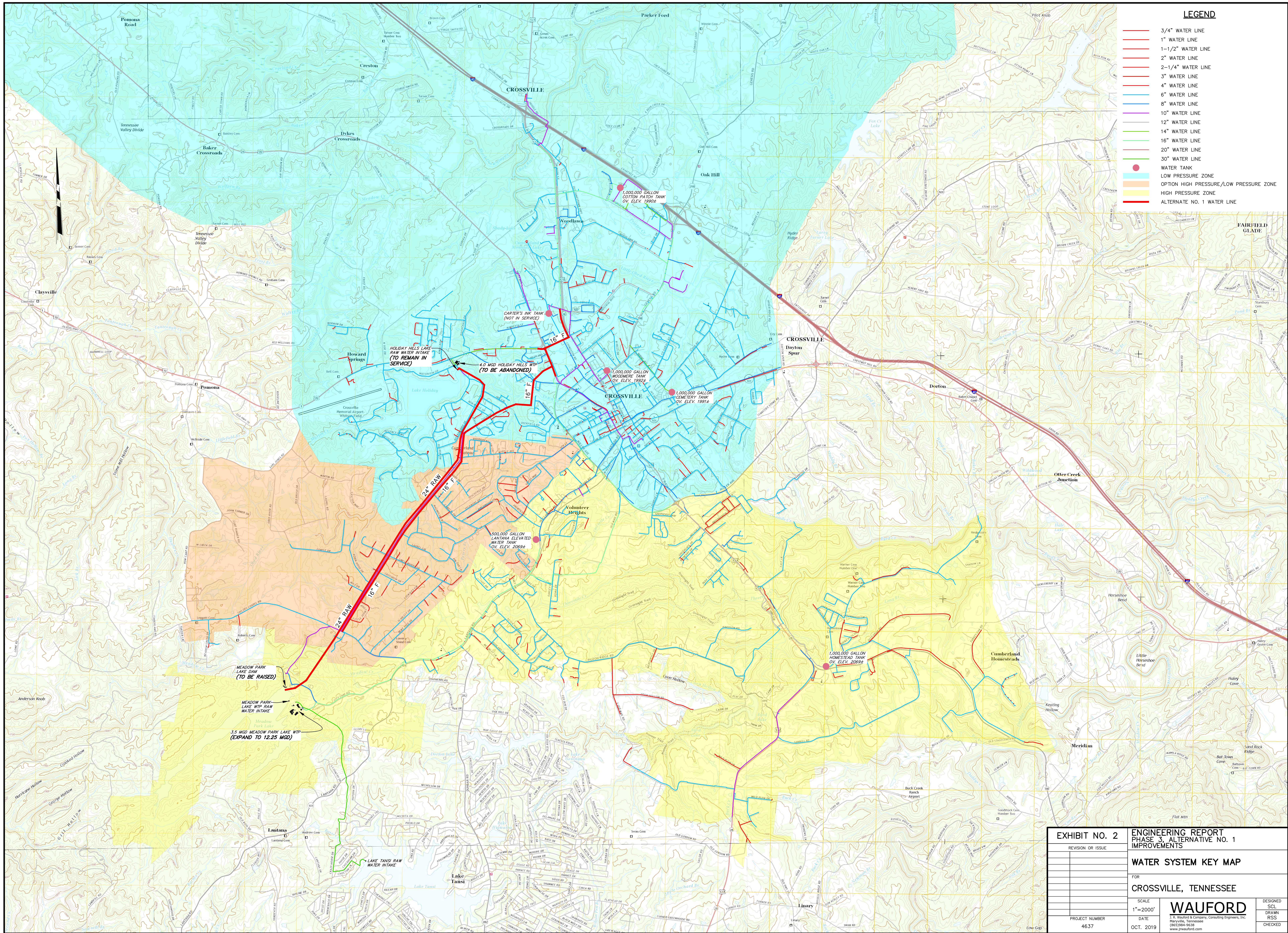
Proposed Improvements - Phase 3, Alternative No. 2		
<u>Description</u>	<u>Cost Estimate No.</u>	<u>Estimated Cost</u>
Construct New 5.5 MGD Holiday Hills WTP	CE-8	<u>\$26,800,000</u>
TOTAL ESTIMATED PROJECT COST		<u>\$26,800,000</u>

Exhibits



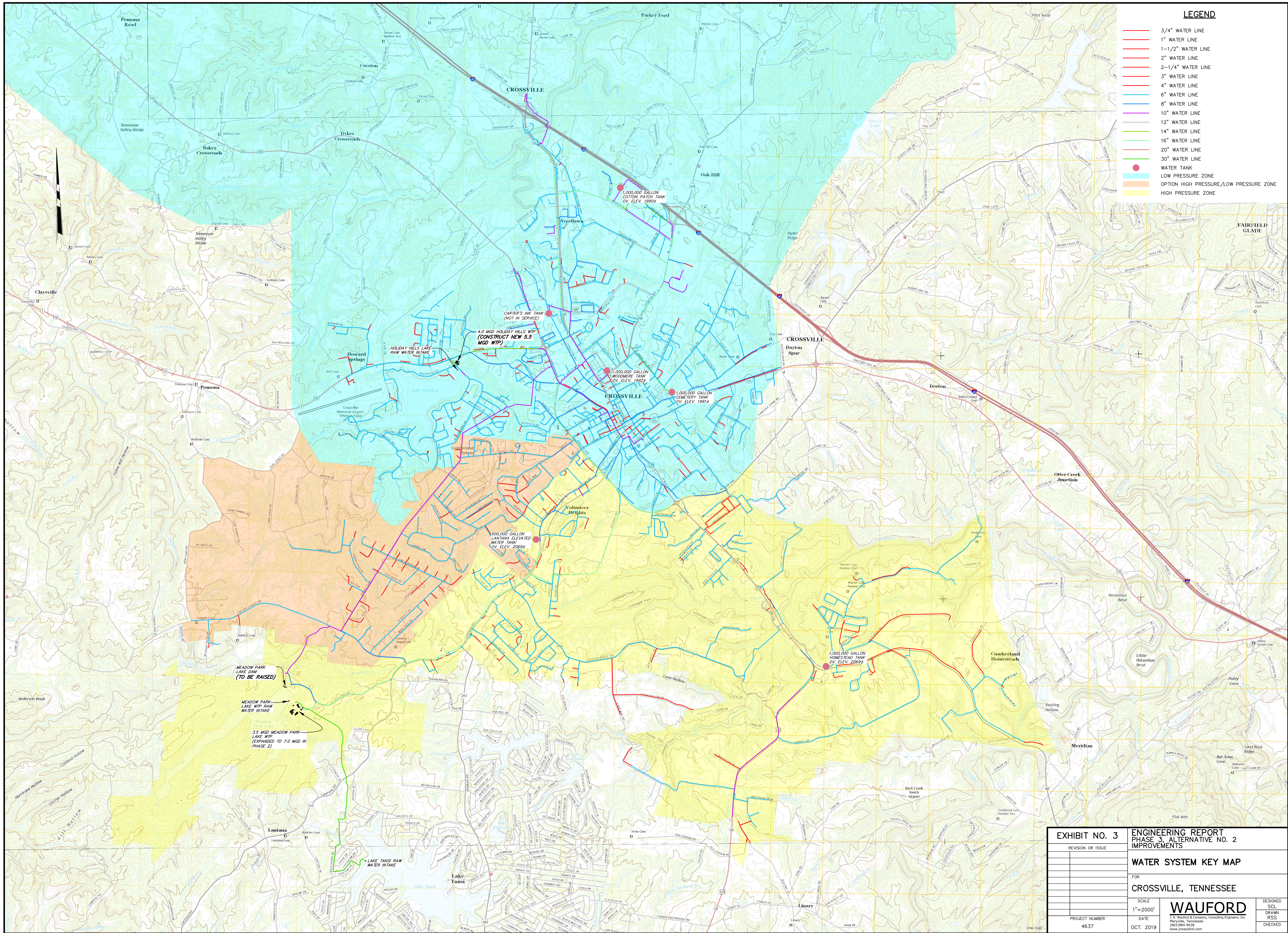
- LEGEND**
- 3/4" WATER LINE
 - 1" WATER LINE
 - 1-1/2" WATER LINE
 - 2" WATER LINE
 - 2-1/4" WATER LINE
 - 3" WATER LINE
 - 4" WATER LINE
 - 6" WATER LINE
 - 8" WATER LINE
 - 10" WATER LINE
 - 12" WATER LINE
 - 14" WATER LINE
 - 16" WATER LINE
 - 20" WATER LINE
 - 30" WATER LINE
 - WATER TANK
 - LOW PRESSURE ZONE
 - OPTION HIGH PRESSURE/LOW PRESSURE ZONE
 - HIGH PRESSURE ZONE

EXHIBIT NO. 1		ENGINEERING REPORT	
REVISION OR ISSUE		FOR	
		WATER SYSTEM KEY MAP	
		FOR	
		CROSSVILLE, TENNESSEE	
SCALE		WAUFORD	
1" = 2000'		J. R. Wauford & Company, Consulting Engineers, Inc.	
PROJECT NUMBER		DATE	
4637		OCT. 2019	
		DESIGNED	
		SCJ	
		DRAWN	
		RSS	
		CHECKED	



- LEGEND**
- 3/4" WATER LINE
 - 1" WATER LINE
 - 1-1/2" WATER LINE
 - 2" WATER LINE
 - 2-1/4" WATER LINE
 - 3" WATER LINE
 - 4" WATER LINE
 - 6" WATER LINE
 - 8" WATER LINE
 - 10" WATER LINE
 - 12" WATER LINE
 - 14" WATER LINE
 - 16" WATER LINE
 - 20" WATER LINE
 - 30" WATER LINE
 - WATER TANK
 - LOW PRESSURE ZONE
 - OPTION HIGH PRESSURE/LOW PRESSURE ZONE
 - HIGH PRESSURE ZONE
 - ALTERNATE NO. 1 WATER LINE

EXHIBIT NO. 2		ENGINEERING REPORT	
REVISION OR ISSUE		PHASE 3 ALTERNATIVE NO. 1	
		IMPROVEMENTS	
WATER SYSTEM KEY MAP			
FOR			
CROSSVILLE, TENNESSEE			
SCALE		1" = 2000'	
PROJECT NUMBER		DATE	
4637		OCT. 2019	
		WAUFORD	
		J. R. Wauford & Company, Consulting Engineers, Inc. 844 W. Main St., Crossville, Tennessee (615) 946-9638 www.jrwaford.com	
		DESIGNED SCJ DRAWN RSS CHECKED	



LEGEND

- 3/4" WATER LINE
- 1" WATER LINE
- 1-1/2" WATER LINE
- 2" WATER LINE
- 2-1/4" WATER LINE
- 3" WATER LINE
- 4" WATER LINE
- 6" WATER LINE
- 8" WATER LINE
- 10" WATER LINE
- 12" WATER LINE
- 14" WATER LINE
- 16" WATER LINE
- 20" WATER LINE
- 30" WATER LINE
- WATER TANK
- LOW PRESSURE ZONE
- OPTION HIGH PRESSURE/LOW PRESSURE ZONE
- HIGH PRESSURE ZONE

EXHIBIT NO. 3	
REVISION OR ISSUE	
PROJECT NUMBER	4637

ENGINEERING REPORT
PHASE 3, ALTERNATIVE NO. 2
IMPROVEMENTS

WATER SYSTEM KEY MAP

FOR
CROSSVILLE, TENNESSEE

SCALE
1" = 2000'

DATE
OCT. 2019

DESIGNED
 SCI

DRAWN
 RSS

CHECKED

WAUFORD
 J. R. Wauford & Company, Consulting Engineers, Inc.
 644 W. Hwy. 1, Crossville, Tennessee
 (865) 946-9638
 www.jrwauford.com

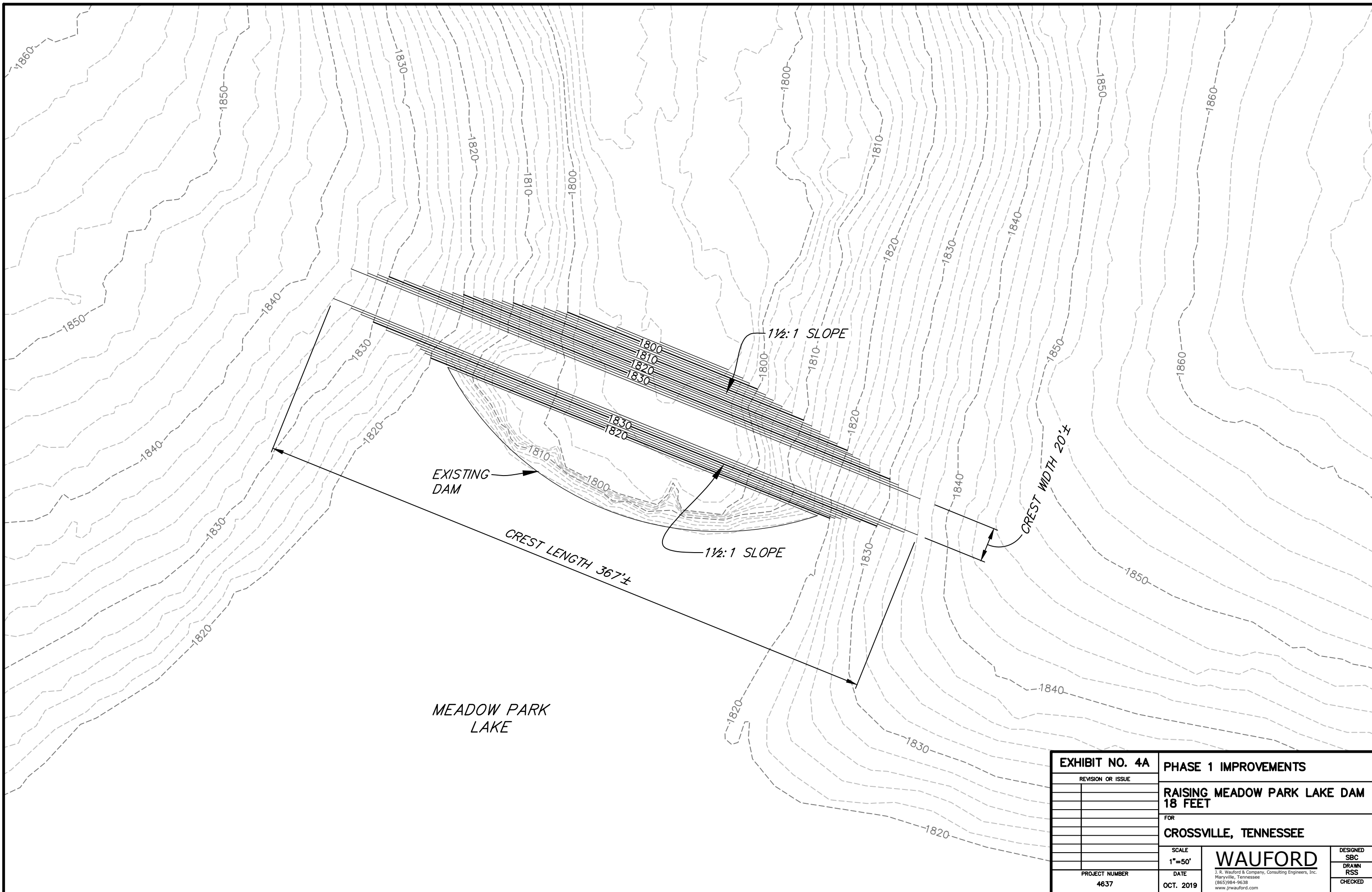
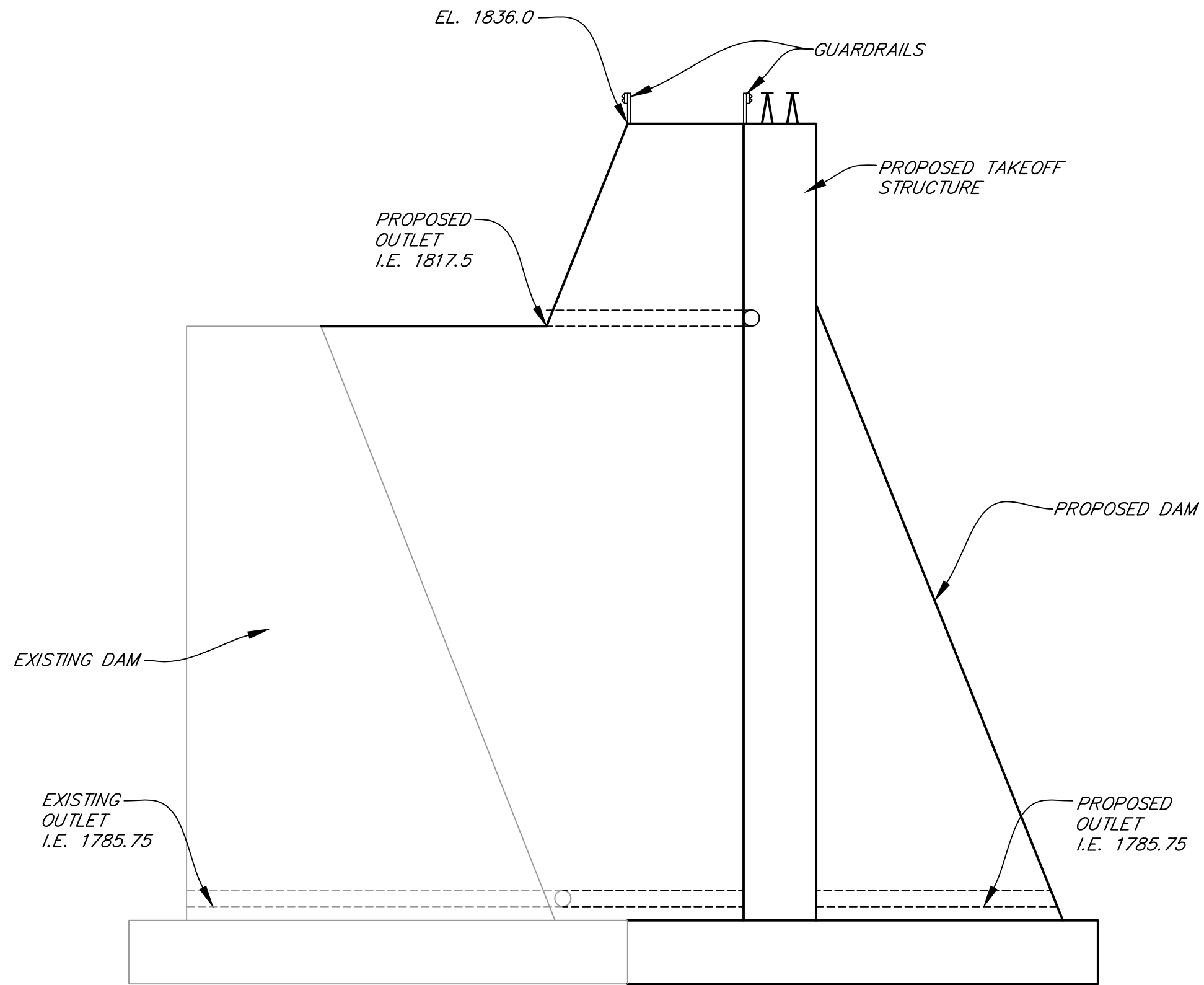
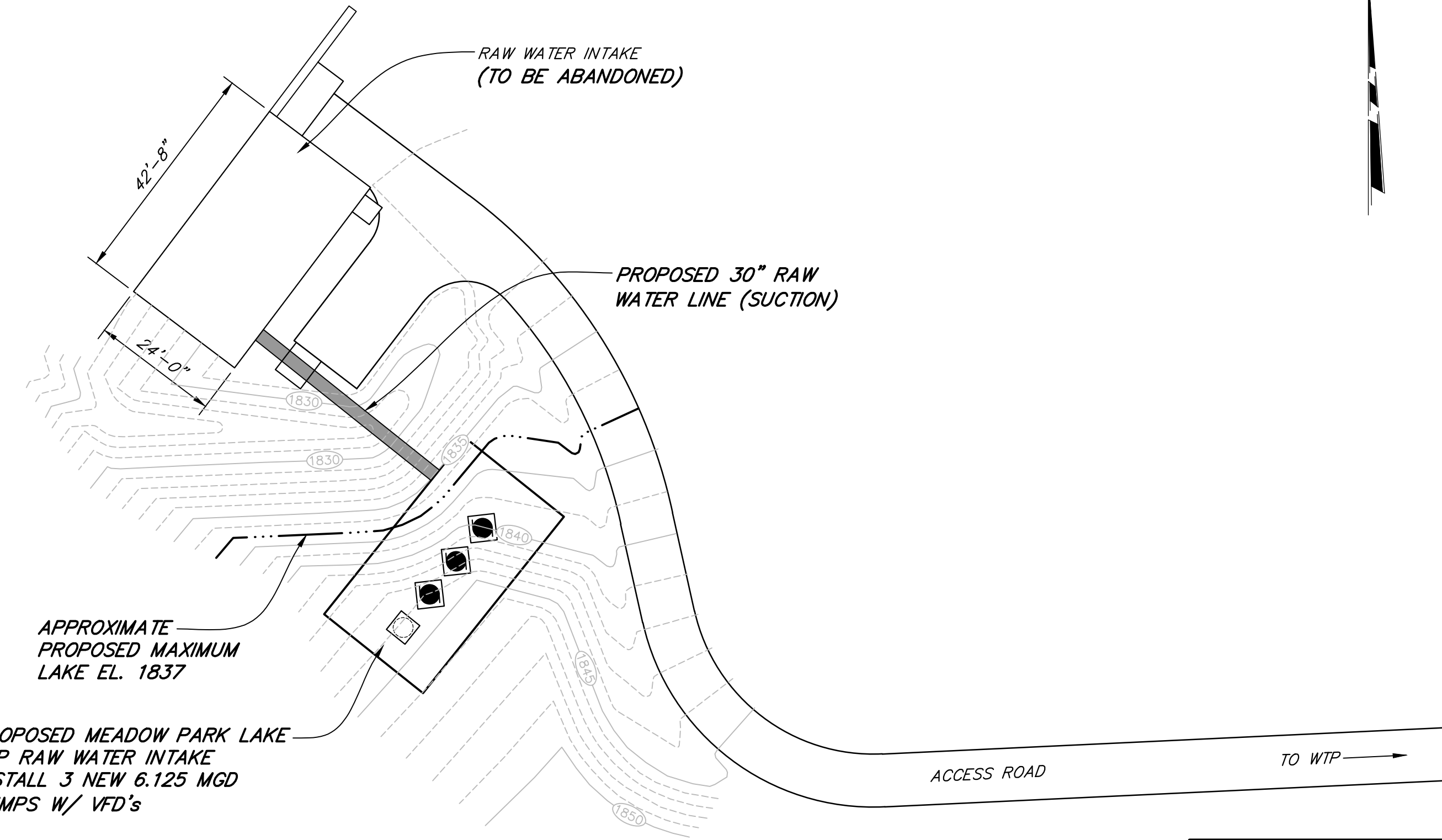


EXHIBIT NO. 4A		PHASE 1 IMPROVEMENTS	
REVISION OR ISSUE		RAISING MEADOW PARK LAKE DAM 18 FEET	
		FOR	
		CROSSVILLE, TENNESSEE	
SCALE		1"=50'	
PROJECT NUMBER		DATE	
4637		OCT. 2019	
		WAUFORD <small>J. R. Wauford & Company, Consulting Engineers, Inc. Maryville, Tennessee (865)984-9638 www.jrwauford.com</small>	
		DESIGNED SBC	
		DRAWN RSS	
		CHECKED	



SECTION

EXHIBIT NO. 4B		PHASE 1 IMPROVEMENTS	
REVISION OR ISSUE		RAISING MEADOW PARK LAKE DAM 18 FEET	
		FOR	
		CROSSVILLE, TENNESSEE	
		SCALE	DESIGNED
		NO SCALE	SBC
		DATE	DRAWN
PROJECT NUMBER		OCT. 2019	RSS
4637			CHECKED
		WAUFORD <small>J. R. Wauford & Company, Consulting Engineers, Inc. Maryville, Tennessee (865)984-9638 www.jrwauford.com</small>	



RAW WATER INTAKE
(TO BE ABANDONED)

PROPOSED 30" RAW
WATER LINE (SUCTION)

APPROXIMATE
PROPOSED MAXIMUM
LAKE EL. 1837

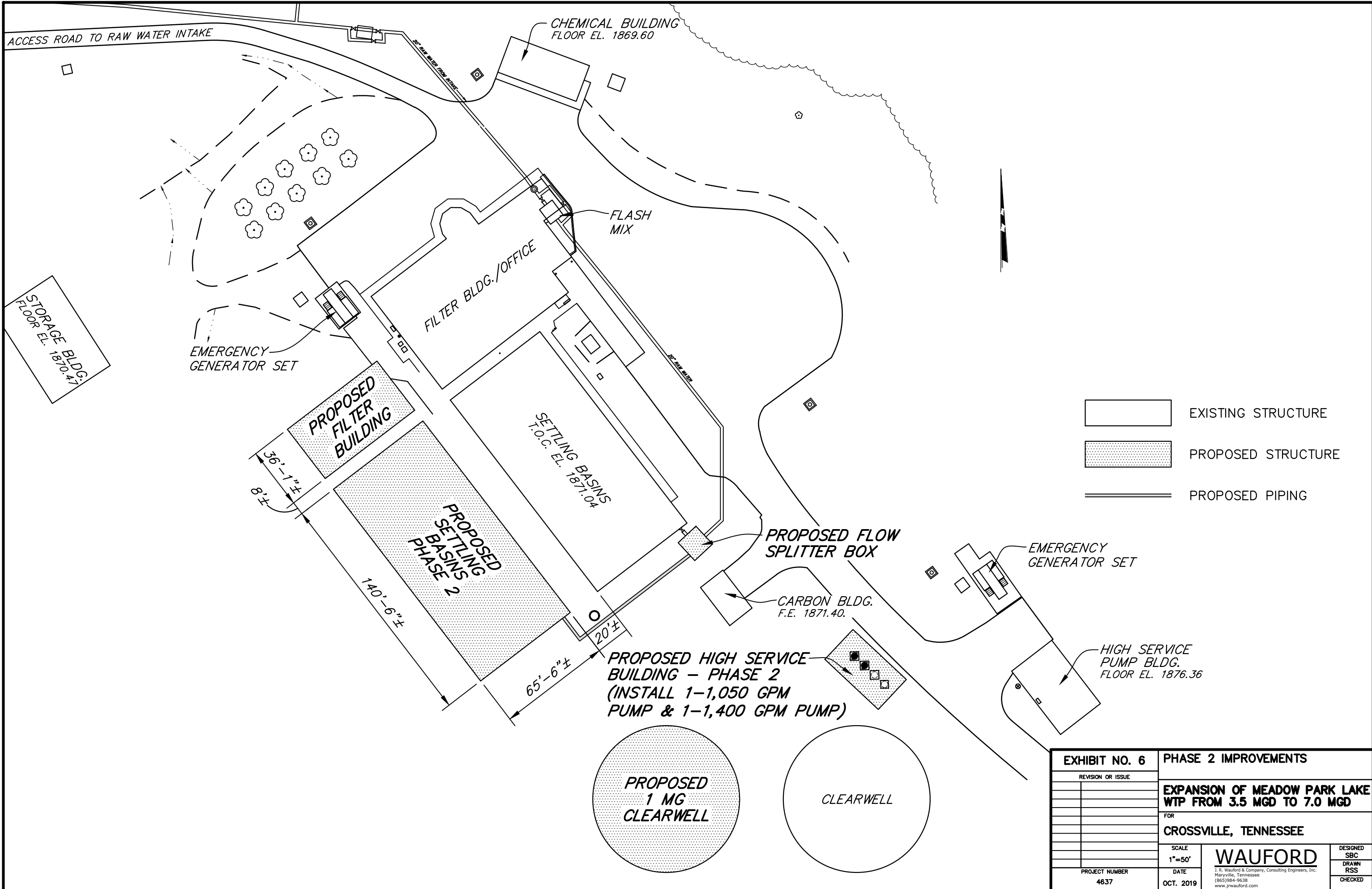
PROPOSED MEADOW PARK LAKE
WTP RAW WATER INTAKE
INSTALL 3 NEW 6.125 MGD
PUMPS W/ VFD's

ACCESS ROAD

TO WTP →

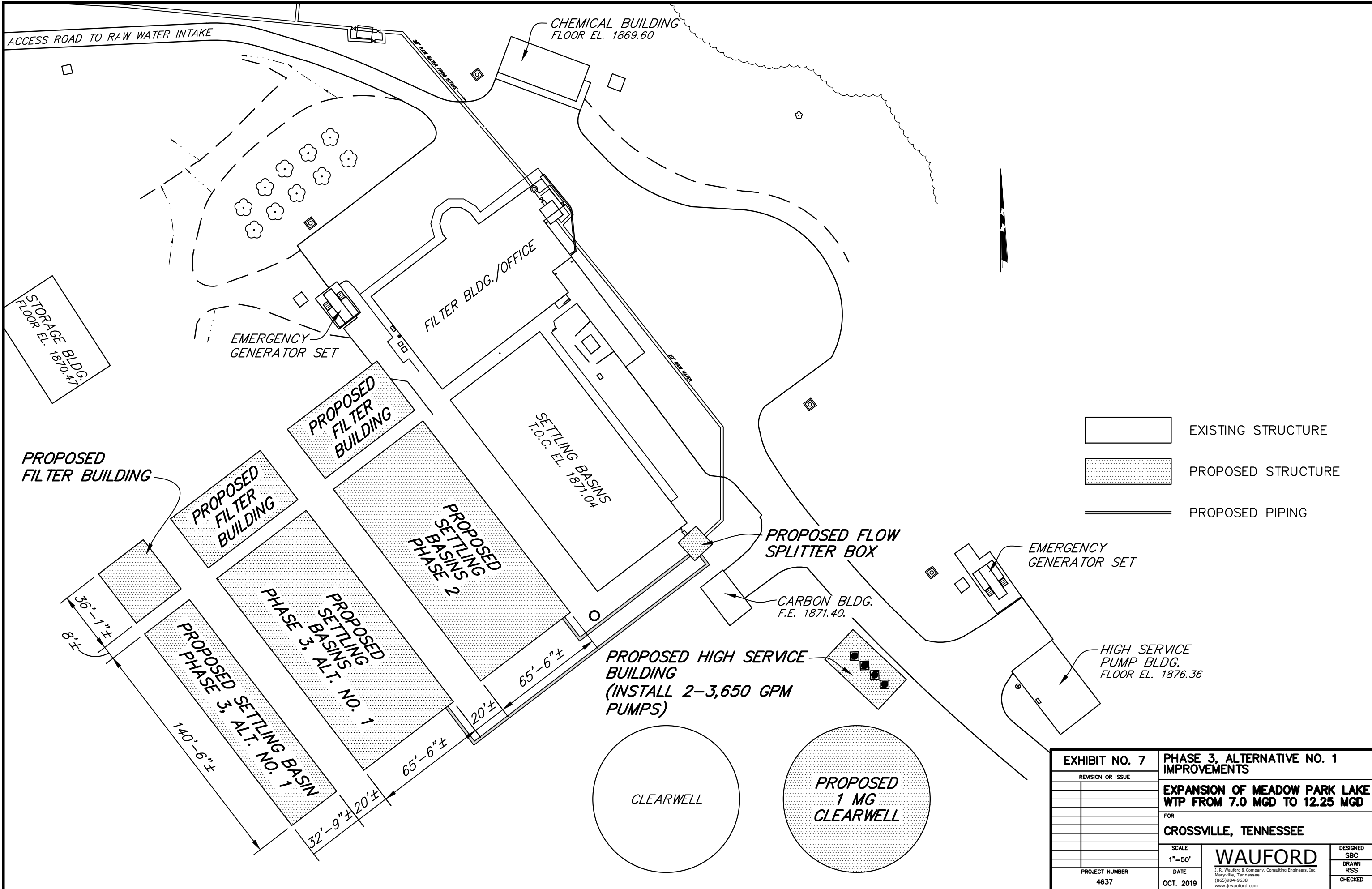
● PROPOSED PUMP

EXHIBIT NO. 5		PHASE 1 IMPROVEMENTS	
REVISION OR ISSUE		IMPROVEMENTS TO MEADOW PARK LAKE WTP RAW WATER INTAKE	
		FOR	
		CROSSVILLE, TENNESSEE	
SCALE		1"=20'	
PROJECT NUMBER		DATE	
4637		OCT. 2019	
		WAUFORD	
		J. R. Wauford & Company, Consulting Engineers, Inc. Maryville, Tennessee (865)984-9638 www.jrwauford.com	
		DESIGNED SBC	
		DRAWN RSS	
		CHECKED	



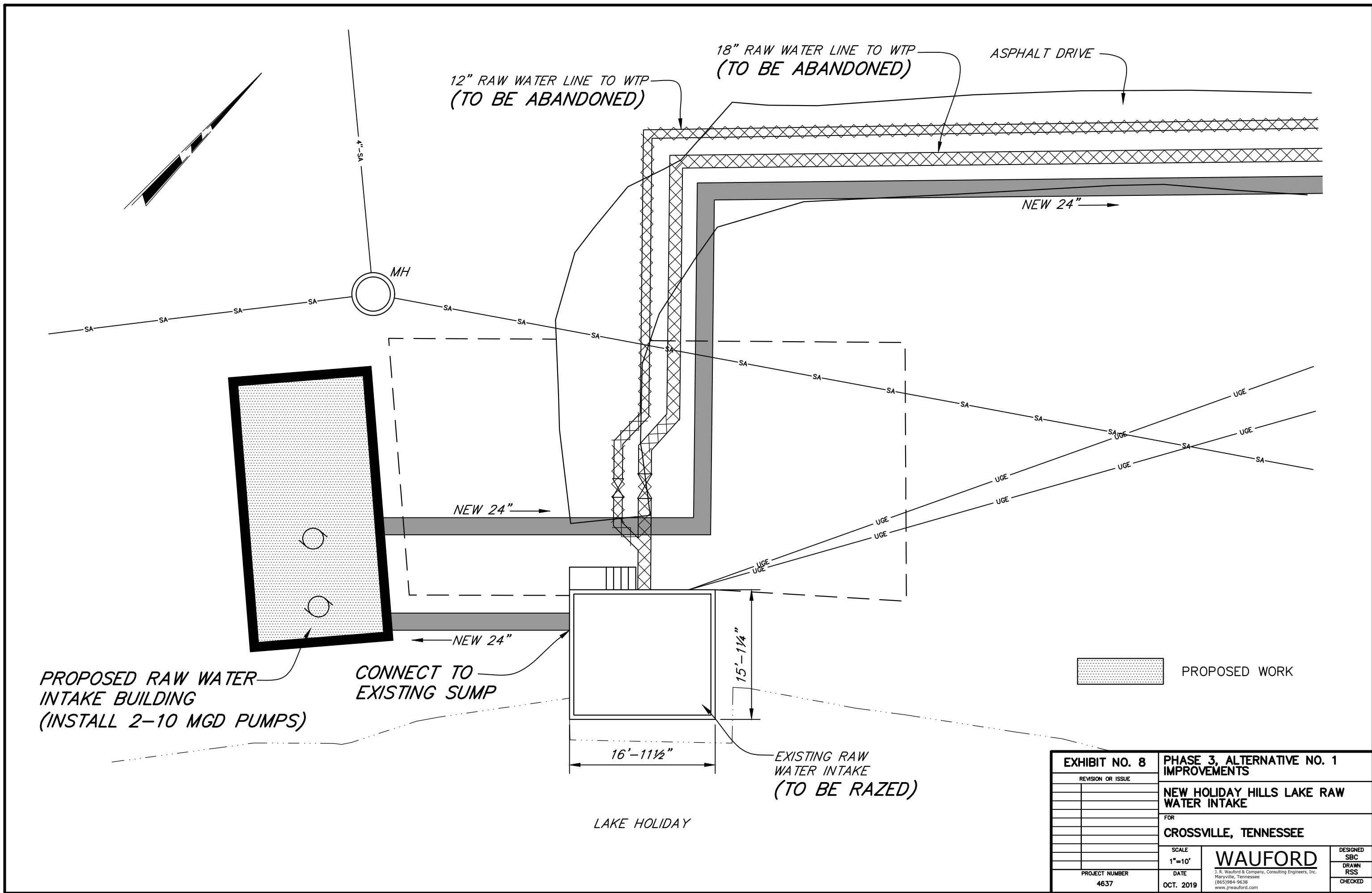
- EXISTING STRUCTURE
- PROPOSED STRUCTURE
- PROPOSED PIPING

EXHIBIT NO. 6		PHASE 2 IMPROVEMENTS	
REVISION OR ISSUE		EXPANSION OF MEADOW PARK LAKE WTP FROM 3.5 MGD TO 7.0 MGD FOR CROSSVILLE, TENNESSEE	
SCALE	1"=50'	WAUFORD <small>J. R. Wauford & Company, Consulting Engineers, Inc. Maryville, Tennessee (865)984-9638 www.jrwauford.com</small>	DESIGNED SBC
PROJECT NUMBER	4637		DRAWN RSS
DATE	OCT. 2019	CHECKED	



- EXISTING STRUCTURE
- PROPOSED STRUCTURE
- PROPOSED PIPING

EXHIBIT NO. 7		PHASE 3, ALTERNATIVE NO. 1 IMPROVEMENTS	
REVISION OR ISSUE		EXPANSION OF MEADOW PARK LAKE WTP FROM 7.0 MGD TO 12.25 MGD	
		FOR	
		CROSSVILLE, TENNESSEE	
		SCALE	WAUFORD
		1"=50'	
PROJECT NUMBER		DATE	DESIGNED
4637	OCT. 2019	RSS	CHECKED
		<small>J. R. Wauford & Company, Consulting Engineers, Inc. Maryville, Tennessee (865)984-9638 www.jrwauford.com</small>	



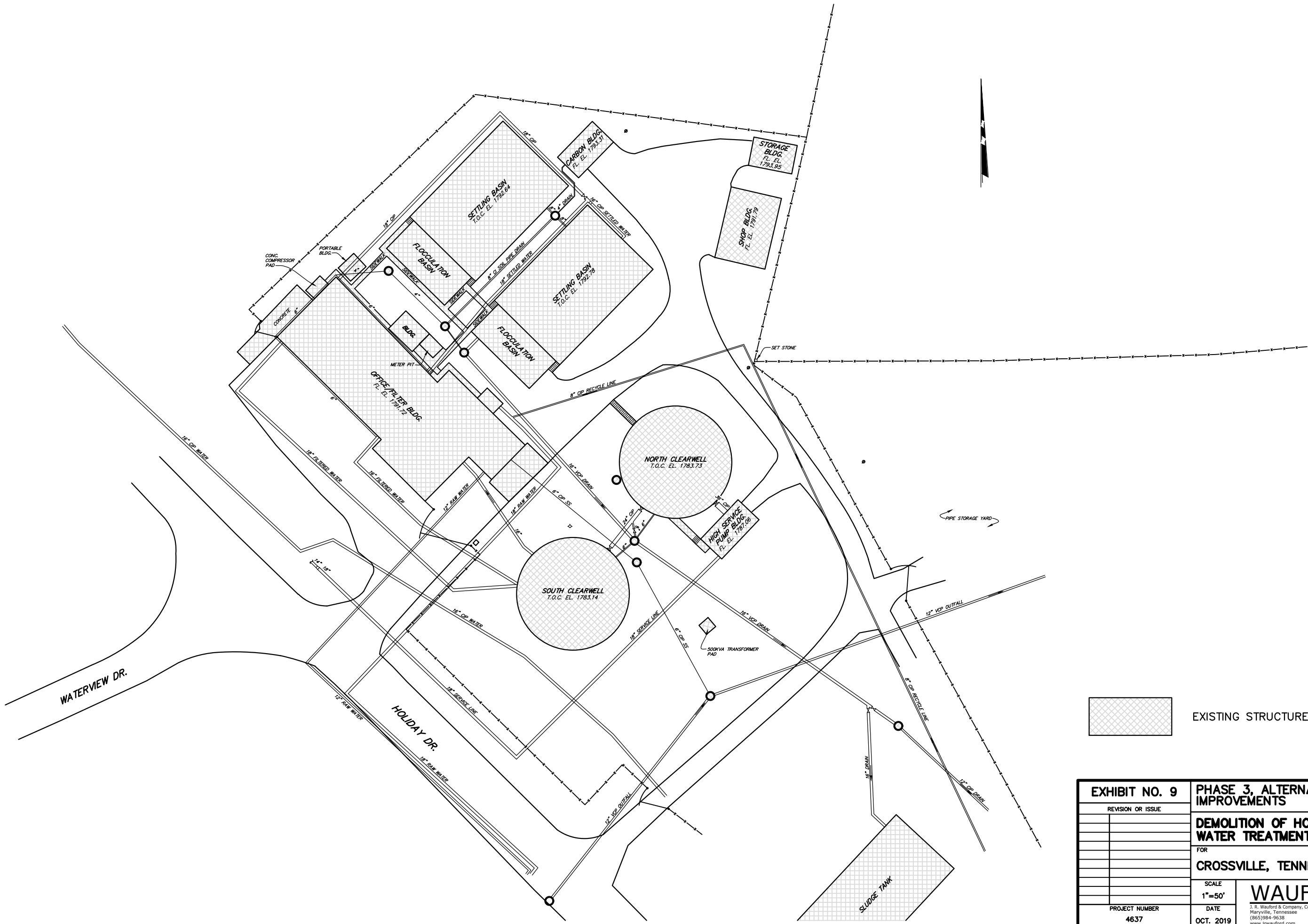
PROPOSED RAW WATER INTAKE BUILDING (INSTALL 2-10 MGD PUMPS)

CONNECT TO EXISTING SUMP

EXISTING RAW WATER INTAKE (TO BE RAZED)

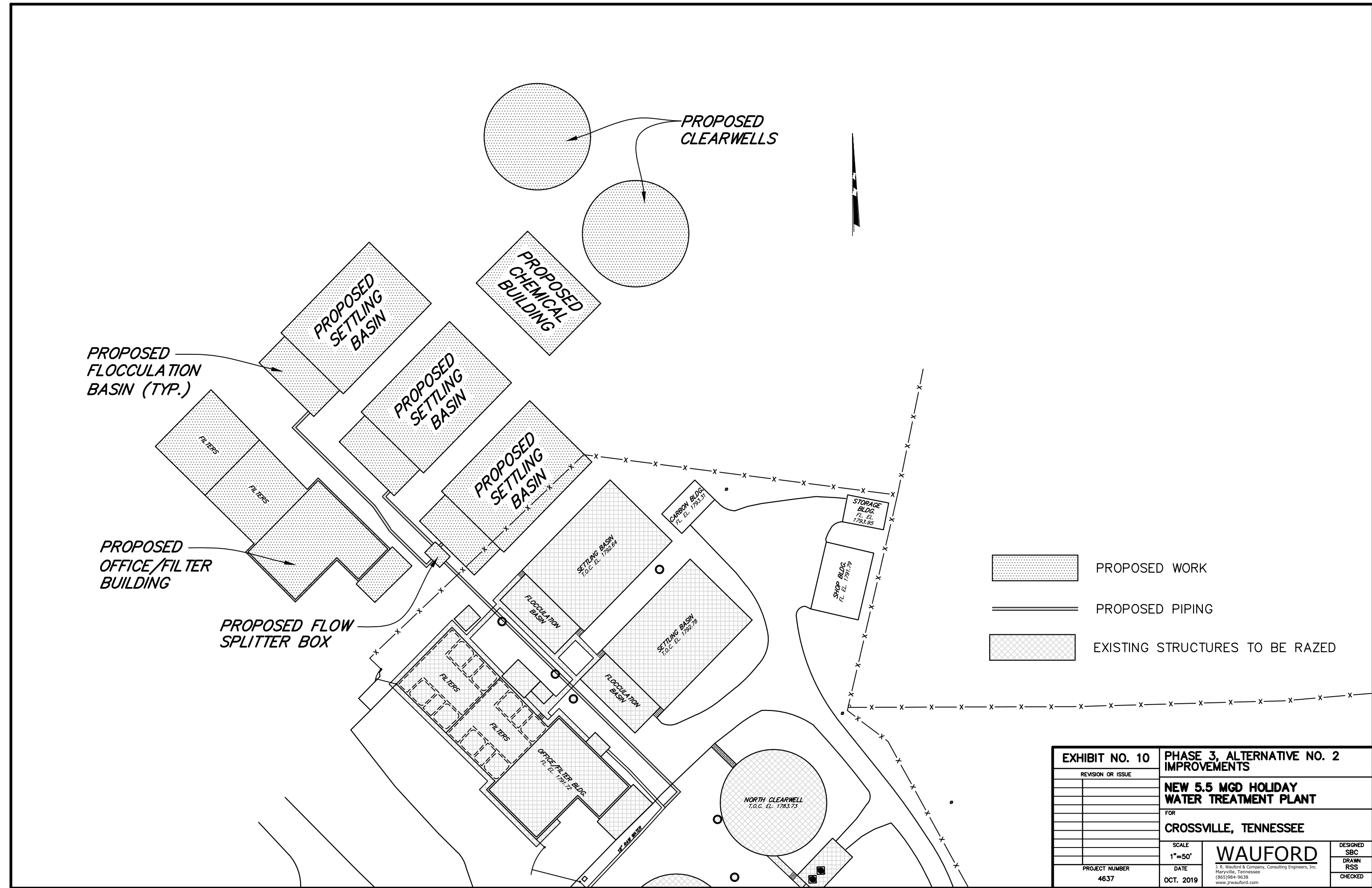
 PROPOSED WORK

EXHIBIT NO. 8		PHASE 3, ALTERNATIVE NO. 1 IMPROVEMENTS	
REVISION OR ISSUE		NEW HOLIDAY HILLS LAKE RAW WATER INTAKE	
		FOR	
		CROSSVILLE, TENNESSEE	
SCALE		1"=10'	
PROJECT NUMBER		DATE	
4637		OCT. 2019	
		WAUFORD	
		J. R. Wauford & Company, Consulting Engineers, Inc. Maryville, Tennessee (865)984-9638 www.jrwauford.com	
		DESIGNED SBC	
		DRAWN RSS	
		CHECKED	



 EXISTING STRUCTURES TO BE RAZED

EXHIBIT NO. 9		PHASE 3, ALTERNATIVE NO. 1 IMPROVEMENTS	
REVISION OR ISSUE		DEMOLITION OF HOLIDAY HILLS WATER TREATMENT PLANT	
		FOR	
		CROSSVILLE, TENNESSEE	
SCALE		1"=50'	
PROJECT NUMBER		DATE	
4637		OCT. 2019	
		WAUFORD	
		J. R. Wauford & Company, Consulting Engineers, Inc. Maryville, Tennessee (865)984-9638 www.jrwauford.com	
		DESIGNED SBC	
		DRAWN RSS	
		CHECKED	



PROPOSED FLOCCULATION BASIN (TYP.)

PROPOSED SETTLING BASIN

PROPOSED SETTLING BASIN

PROPOSED SETTLING BASIN

PROPOSED CLEARWELLS

PROPOSED CHEMICAL BUILDING

PROPOSED OFFICE/FILTER BUILDING

PROPOSED FLOW SPLITTER BOX

SETTLING BASIN
T.O.C. EL. 1792.04

SETTLING BASIN
T.O.C. EL. 1792.78

FILTERS

FILTERS

OFFICE/FILTER BLDG.
FL. EL. 1791.72

NORTH CLEARWELL
T.O.C. EL. 1783.73

CARBON BLDG.
FL. EL. 1793.31

STORAGE BLDG.
FL. EL. 1793.95

SHOP BLDG.
FL. EL. 1791.79

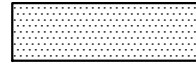


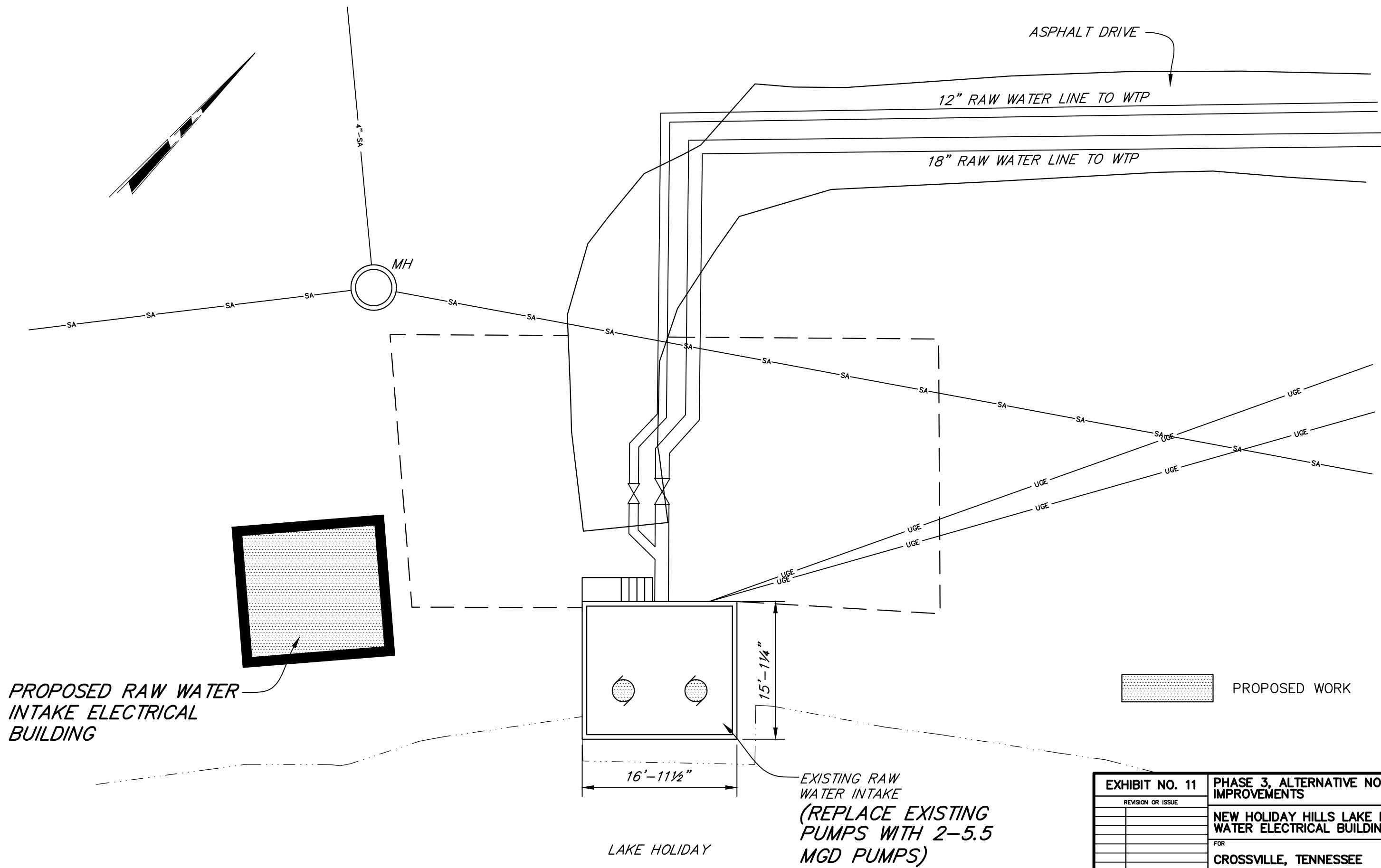
-  PROPOSED WORK
-  PROPOSED PIPING
-  EXISTING STRUCTURES TO BE RAZED

EXHIBIT NO. 10		PHASE 3, ALTERNATIVE NO. 2 IMPROVEMENTS	
REVISION OR ISSUE		FOR	
		NEW 5.5 MGD HOLIDAY WATER TREATMENT PLANT	
		FOR	
		CROSSVILLE, TENNESSEE	
SCALE		WAUFORD	
1"=50'		DESIGNED	
PROJECT NUMBER		DATE	
4637		OCT. 2019	
		DRAWN	
		RSS	
		CHECKED	
		<small>J. R. Wauford & Company, Consulting Engineers, Inc. Maryville, Tennessee (865) 984-9638 www.jrwauford.com</small>	



PROPOSED RAW WATER INTAKE ELECTRICAL BUILDING

 PROPOSED WORK

EXISTING RAW WATER INTAKE
(REPLACE EXISTING PUMPS WITH 2-5.5 MGD PUMPS)

EXHIBIT NO. 11		PHASE 3, ALTERNATIVE NO. 2 IMPROVEMENTS	
REVISION OR ISSUE		NEW HOLIDAY HILLS LAKE RAW WATER ELECTRICAL BUILDING	
		FOR	
		CROSSVILLE, TENNESSEE	
SCALE		1"=10'	
PROJECT NUMBER		DATE	
4637		OCT. 2019	
		WAUFORD	
		J. R. Wauford & Company, Consulting Engineers, Inc. Maryville, Tennessee (865)984-9638 www.jrwauford.com	
		DESIGNED SBC	
		DRAWN RSS	
		CHECKED	

**Water Harvesting Agreement
With Lake Tansi Village
Property Owners Association**

Water Harvesting Agreement

This Water Harvesting Agreement, ("Agreement"), entered into by and between the City of Crossville, a municipality of the State of Tennessee, ("City"), and Lake Tansi Village Property Owners Association, Inc., a Tennessee non-profit corporation, ("POA"), as of this 2nd day of October, 2009 ("Effective Date").

WITNESSETH:

WHEREAS, the POA owns, controls, operates, administers an impoundment known as Lake Tansi, which is located in Lake Tansi Village in Cumberland County, Tennessee;

WHEREAS, the City is a municipality located in Cumberland County, Tennessee, that provides water within and outside of its municipal boundaries to approximately 16,448 customers, including residents of the Lake Tansi community, through the South Cumberland Utility District, ("South Cumberland"), which residents are located outside the City's municipal boundaries;

WHEREAS, the Cumberland Plateau has suffered drought conditions in the previous two years, highlighting the vulnerability of the area's raw water supply and the need to collect, draw or harvest water for the City's impoundments at Meadow Park Lake and Lake Holiday;

WHEREAS, the City faces an imminent need to repair the dam of its Meadow Park Lake impoundment, which repair requires the significant draw down of the pool level of Meadow Park Lake;

WHEREAS, drought conditions notwithstanding, the commercial, residential and industrial growth in the City's Urban Growth Boundary, and in its current potable water service regions and customer areas within Cumberland County, Tennessee, is accelerating and increasing by double digit percentages, thereby creating an exponentially greater demand annually for potable water from the City, including a greater demand in the Tansi community;

WHEREAS, even the POA community of Lake Tansi Village, which is served by the South Cumberland, relies entirely for its potable water needs upon that purchased from the City by South Cumberland under an existing contract with the City;

WHEREAS, growth and development, as well as maintenance of current potable water needs for the Lake Tansi community and other customers of the City, are largely dependent upon the supply of water by the City and the City's ability to secure additional water sources, especially during, but not limited to, times of exigent circumstances wherein water resources may not be abundant or economically accessed;

WHEREAS, harvesting water from local resources, including Lake Tansi, especially those proximately located to existing City impoundments, is advisable according to recent engineering studies to be both economically more affordable, by a wide margin, than any other studied option, (much more so than harvesting from the Tennessee River and the Caney Fork River), and will afford a significantly higher quality raw water supply;

WHEREAS, the City maintains that harvesting water from Lake Tansi will have no significant environmental impact, and this option has been determined by the City to be environmentally friendlier than harvesting water from either the Tennessee River or the Caney Fork River;

WHEREAS, the City acknowledges and agrees that such harvesting is best accomplished in cooperation with the POA in a manner that balances the City's needs for additional raw water supply to serve the area's potable water demands with the POA's desire to minimize any resulting disruptions to the water levels of Lake Tansi so as to maintain and preserve the quality of enjoyment that Lake Tansi provides the POA, its approximately 7,000 property owners, their families and guests; both parties recognizing the importance of maintaining the recreational and aesthetic attributes, and resulting economic benefits, that this water resource provides as a major tourism attraction for the Cumberland County area;

WHEREAS, the POA is willing, pursuant to the terms and conditions of this Agreement to permit the City to draw, collect and harvest water from Lake Tansi, and to convey the rights incidental to the same to the City in consideration of the promises and covenants made by the City to the POA contained in this Agreement;

WHEREAS, the relationships created under this Agreement will better enable the City to meet the potable water demands of all of its customers, not the least of which include the members of the POA and other residents of the Lake Tansi community;

WHEREAS, the POA has full power and authority to enter into this Agreement and abide by its terms and conditions, to convey the water rights described and contemplated herein, and the POA is in good standing with the Secretary of the State of Tennessee;

WHEREAS, the City also has full power and authority to enter into this Agreement and abide by its terms and conditions and has taken all requisite action to make this contract and each of its provisions a binding obligation of the City.

NOW, THEREFORE, for and in consideration of \$10.00, and other good and valuable consideration, including the mutual promises set forth herein below, the receipt and sufficiency of which are hereby acknowledged, the parties hereto agree to be bound as follows:

1. **Warranties**. The parties hereto acknowledge and represent that the recitals set forth above are true and accurate. Additionally, the POA warrants and represents to the City that it has the authority to enter into this Agreement and all indentures, deeds, bills of sale and other agreements arising out of, or contemplated by this Agreement, or reasonably made necessary by the same; that the POA's ownership interest in the easements, water, water rights, property and property rights that it agrees hereunder to convey unto the City related to Lake Tansi, (collectively the "Rights") ("Water" is defined hereinafter) is expressly limited and confined to those property interests owned and possessed by the POA through the deeds it holds for Lake Tansi, which deeds and the property area owned by the POA are more fully described in that certain legal description attached hereto and incorporated herein by reference as **Exhibit "A"**; that to the best of the POA's knowledge the Rights and Water are unencumbered and free and clear of all liens, mortgages, security interests and charges of any nature whatsoever; that no other entity or individual, including, without limitation, governmental entity or utility district, holds or owns an interest or title of any kind or type whatsoever in or to the Rights and Water; provided, however, that nothing in this section shall be interpreted or construed by the City as a conveyance or warranty by the POA with respect to any riparian interests or similar property rights, if any such rights exist at all, that may be owned or exist in favor of any owner of property adjoining or proximate to Lake Tansi or which may arise from the waters flowing there from. In addition, the City warrants and represents to the POA that it has the authority to enter into this Agreement and abide by its terms and conditions.

2. **Representations**. The POA covenants and represents to the City that it is lawfully formed and in good standing in the State of Tennessee; that to the best of its knowledge and belief there are no encumbrances, liens, judgments, or bankruptcies affecting the Rights, Water and licenses granted herein to the City; that to the best of its knowledge and belief there exist no matters that would impair, deter or in some fashion prevent the POA from entering into this Agreement or from fulfilling its obligations hereunder; that it has taken all necessary steps, if any, under any applicable declarations, its formation documents and by-laws, as may be amended, or which may be required by law to lawfully bind the POA to this Agreement; and that no membership votes or other actions are necessary to bind the POA to this Agreement. Additionally, the City covenants and represents to the POA that it is lawfully formed in the State of Tennessee; that to the best of its knowledge and belief there exists no matters that would impair,

deter or in some fashion prevent the City from entering into this Agreement or from fulfilling its obligations hereunder, except for such matters as are expressly provided for in this Agreement; and that it has taken all necessary steps, if any, under the City's charter and other governing instruments, as may be amended, or which may be required by law to lawfully bind the City to this Agreement.

3. **Transfer of Rights.** The POA hereby transfers, conveys, deeds and grants, and does here and now in fact transfer, convey, deed and grant unto the City, subject to the terms and conditions of this Agreement, the following described water from Lake Tansi and the related interests and rights described in this Agreement that are owned and possessed by the POA as a result of the property interests conveyed unto the POA by the deeds described in the legal description attached as **Exhibit "A"**, (collectively, the "Water"), it being acknowledged and agreed by the City that such transfer of rights in the Water by the POA expressly excludes any riparian interests or similar property rights, if any such rights exist at all, that may be owned or exist in favor of any owner of property adjoining or proximate to Lake Tansi or which may arise from the waters flowing there from:

(a) **Overflow Water.** All water that would flow over the spillways of the dam of Lake Tansi but for the City's capture and harvesting of the same as permitted by this Agreement. This water may be taken by the City at any time of the year without charge.

(b) **Seasonal Excess Water.** Between October 15 of each year and April 15 of the following year, the City may take all water in Lake Tansi between the invert elevation of the spillway of Lake Tansi, which is designated as the elevation of 1,861.71 feet in accordance with the registered land surveyor's certificate attached to this Agreement as **Exhibit "B"** (the "Spillway Elevation"), and that certain point which is four (4) inches below the Spillway Elevation.

(c) **Planned Water Releases.** If the POA is reducing or intends to reduce the level of Lake Tansi through pumps, valves, siphoning or through any other means to allow property owners to perform dock maintenance or for any other purposes, the POA shall be required to give as much advance notice to the City of such intent as is reasonably possible, but not less than the lesser of (i) ninety (90) days or (ii) the amount of notice the POA receives before it reduces Lake Tansi for such purposes. In such situations, the POA shall notice the City of the dates the City may commence and must terminate its permitted draw down of water and the lake elevation level below which Lake Tansi may not be lowered by the City in such situation, which shall in no event be lower than twenty-four (24) inches below the Spillway Elevation, unless the POA consents in writing to a lower limitation for a particular planned release. Upon any such notice from the POA, the City may pump, remove, transfer, convey or draw down water as contemplated in this **Section 3(c)**, but shall not be required to do so. Both parties acknowledge and agree that the water released in the situations covered by this

subsection is a valuable resource and will cooperate to the fullest extent possible to coordinate with each other on the timing and implementation of such releases so as to avoid any unnecessary waste of such resource.

(d) Emergency Water. The City is also hereby permitted by the POA to harvest water from Lake Tansi, in addition to, and beyond the amounts defined above in Section 3(a) through Section 3(c), inclusive, of this Agreement at any time during the calendar year, under the conditions and circumstances defined below, (“Emergency Conditions”):

(i) Emergency Conditions shall be defined to include the following:

- (A) extreme drought conditions for Cumberland County as declared by any duly constituted and authorized public authority of either the State of Tennessee or relevant federal agencies that adversely affects or seriously threatens the adequacy of the City’s then existing raw water supply or the reasonably anticipated raw water supply that will be required during such drought conditions;
- (B) catastrophic failure of an impoundment of the City or any of its component parts or the treatment plants associated with the same including, without limitation, catastrophic failure, breach or destruction of a dam or the catastrophic failure or destruction of a water treatment facility, regardless of the cause of the event resulting in such catastrophe that adversely affects or seriously threatens the adequacy of the City’s then existing raw water supply or the reasonably anticipated raw water supply that will be required during such catastrophe;
- (C) any condition, circumstance or event wherein the Holiday Lake treatment system is temporarily taken off line or otherwise rendered unusable for a temporary period of time, including, but not limited to, events of power failure or equipment failure for any reason, and which adversely affects or seriously threatens the adequacy of the City’s then existing raw water supply or the reasonably anticipated raw water supply that will be required during such interruption;
- (D) events, circumstances and conditions resulting from acts of God, and foreign or domestic terrorist attacks that adversely affects or seriously threatens the adequacy of the City’s then existing raw water supply or the reasonably anticipated raw water supply that will be required during such situation; and
- (E) contamination or threatened contamination of the water or raw water run-off or supply to any of the City’s impoundments such that, in order to protect the public health, safety and welfare of the customers of the City, water cannot be

harvested from the affected body of water, which declared contamination would require the certified determination of the relevant state agency or agencies and must result in a need for additional raw water beyond the City's then existing raw water supply or the reasonably anticipated raw water supply that will be required during such situation.

(ii) However, the right to withdraw, transport and convey additional raw water from Lake Tansi for any of the Emergency Conditions defined above shall not arise and accrue to the City until such time as the City shall have met the following conditions precedent:

- (A) the City must first use all reasonably available raw water resources from Lake Holiday and Meadow Park Lake as reasonably certified by its then consulting engineer for such purposes;
- (B) the City must enforce its then current drought ordinance conditions; and
- (C) the City must give as much advance notice to the POA as reasonably possible regarding the known nature and extent of the Emergency Condition, its efforts to meet the demands of such Emergency Condition, and the date on which the City anticipates beginning the harvesting of water beyond and in addition to, the amounts permitted in Section 3(a) through Section 3(c), inclusive, of this Agreement.

(iii) Under no circumstances shall additional raw water, beyond and in addition to the amounts permitted under Section 3(a) through Section 3(c), inclusive, of this Agreement be harvested by the City for an Emergency Condition as defined herein (i) for a period longer than sixty (60) days for a single Emergency Condition or (ii) at any time if the level of Lake Tansi is below an elevation that is more than twenty-four (24) inches below the Spillway Elevation, unless the POA consents in writing to a lower level for such withdrawal. It is understood by the parties hereto that multiple or subsequent Emergency Conditions could occur in a single calendar year and thereafter, such that, therefore, the limitation of sixty (60) days for the harvesting of water for an Emergency Condition, shall not be restricted to only (1) period of sixty (60) days per calendar year. Neither the declaration of an Emergency Condition by the City nor its subsequent harvesting of water for a period of sixty (60) days shall prevent the City from declaring, at any time in the future, and exercising its rights hereunder, subsequent Emergency Conditions as the same may arise, provided each such Emergency Condition arises from separate events or situations and are not resulting from the same event or situation that triggered the initial declaration of an Emergency Condition.

(iv) With regard to all raw water withdrawn by the City from Lake Tansi during an Emergency Condition, which raw water is below the limitation point of four (4) inches as set forth in Section 3(b) of this Agreement, the City shall pay unto the

POA a price per one thousand (1,000) gallons of water so harvested according to the formula for the same set forth on Exhibit "C" attached hereto and incorporated herein by reference thereto. Such amount shall be paid to the POA within thirty (30) days of a statement for the same duly presented by the POA to the City.

(e) Construction Period Water. It is acknowledged by the parties hereto that the City must complete repairs on its Meadow Park Lake dam imminently, and that, unrelated to the mandate to repair the dam, it may also, if permitted to do so by the relevant government agencies, enter into a construction project to raise such dam, following the repairs, and that additional raw water will be necessary during the time of, and with regard to, such repair and construction. Accordingly, subject to the limitations and other requirements provided in this subsection (e), the POA hereby grants unto the City an additional right, separate and apart from the water and related rights already granted herein, to harvest and withdraw water from Lake Tansi for a one-time withdrawal period of not more than sixty (60) days, (even in the event that the pool level of Lake Tansi is below the limitation of four inches (4") under Section 3(b) of this Agreement), for the purposes set forth in this subsection (e), which right to withdraw must be exercised, if at all, by the City within two years from one year after the Effective Date, at the expiration of which two (2) year period, (plus the remaining days of harvesting in the event that the right was exercised and initiated within the last sixty (60) days of such two year period), the right to harvest under this specific subsection (e) shall expire. In the event that the City exercises its rights under this subsection (e), it shall be subject to the following limitations and requirements:

(A) the City must give as much advance notice to the POA as reasonably possible regarding the nature and extent of the construction period withdrawal, the planned rate of withdraw, the date on which the City anticipates beginning the withdrawal, and its planned duration;

(B) the City shall be prohibited from withdrawing more than two million gallons per day (2,000,000 gpd) from Lake Tansi during such withdrawal under this subsection (e), which limitation shall not affect the City's harvesting rights under Sections 3(a) through Section 3(c), inclusive, of this Agreement;

(C) in no event shall the level of Lake Tansi be drawn below an elevation that is more than twelve (12) inches below the Spillway Elevation, unless the POA consents in writing to a lower level for such withdrawal;

(D) no such withdrawal shall occur during the period beginning on July 1 of any year through September 15 of that year without the prior written consent of the POA, which shall be reasonably granted if the then

current level of Tansi Lake is sufficient to provide the City with such withdrawal; and

(E) the City shall pay unto the POA a price per one thousand (1,000) gallons of water so withdrawn in accordance with the same formula and payment terms applicable to withdrawals for Emergency Conditions prescribed in Section 3(d)(iv) of this Agreement.

(f) Appurtenant Water Rights. All rights reasonably incidental to or necessary for the harvesting, transfer and transportation of the Water as described in Section 3(a) through Section 3(e), inclusive, of this Agreement and contemplated by this Agreement, including those real property interests and easements, if any, to Meadow Park Lake and the treatment and filtration facility of the City located on Meadow Park Lake in Cumberland County, Tennessee, required from the POA that are identified on and incorporated herein by reference as Exhibit "D" subject to the requirements of Section 4 of this Agreement. Provided, however, that nothing contained in this subsection (f) shall be construed or interpreted to apply to any riparian interests or similar property rights, if any such rights exist at all, that may be owned or exist in favor of any owner of property adjoining or proximate to Lake Tansi or which may arise from the waters flowing there from.

4. Easements and Other Necessary Property Rights. The POA further agrees to grant, deed, transfer and convey, and does here and now, in fact, grant, deed, transfer and convey, to the City all the necessary property rights, licenses and easements reasonably necessary or incidental, both permanent and temporary, for the harvesting process, including placement, affixation and construction of fixtures, pumps and such other equipment as may be necessary, including, without limitation, submersible pumps, pipes and equipment, along with the right to inspect, maintain and replace the same, provided such interests in the POA's property are reasonably identified as to their location and use in Exhibit "D". The POA shall execute such muniments of title, instruments, bill of sale, and other documents as may be reasonably necessary to transfer and convey such property rights for which it is obligated to transfer and convey hereunder. City reserves the right to make reasonable changes to the location and area of such property interests and easements provided it obtains the POA's written consent in advance, which consent shall not be unreasonably withheld if the requested change imposes no material burden or hardship on the POA. The City also agrees to provide the POA with (i) final plans and specification for all the City's water harvesting facilities that are constructed or installed in connection with this Agreement on any property owned by the POA at least thirty (30) days prior to such construction or installation and (ii) a copy of a final as-built survey for all such facilities within sixty (60) days of their completion unless otherwise waived by the POA in writing. The POA shall also fully cooperate and assist, at the City's expense, in the acquisition of other easements, licenses and permits that may reasonably be required by the City for such process and for such placement of such fixtures, equipment and pipes. The POA agrees that if necessary it will further

transfer, convey, deed and grant unto the City such non-exclusive easements in its easement and setback areas in the Lake Tansi Village over which it has the authority to grant and convey the same, including, without limitation, such utility easements, setback areas and common areas as may be reasonably necessary for the purposes contemplated herein, (all such licenses and easements contemplated in this Agreement known collectively herein as the "Easements") subject to the requirements of this section that the location and use of the Easements be described on Exhibit "D". The POA agrees to execute and allow to be recorded such muniments of title as are deemed reasonably necessary by the City to evidence as notice to the world the Easements, Water and Rights conveyed herein. The POA hereby agrees to execute and cause to be recorded such written easement documents, for both temporary and permanent Easements, for the same.

5. **Impoundment Fee.** In exchange for all the Water, Rights and Easements conveyed to the City herein, except as set forth in **Section 3(d)(iv)** and **Section 3(e)** of this Agreement, the City shall pay unto the POA a lump sum impoundment fee in the amount of Five Hundred Fifty Thousand Dollars (\$550,000.00) (the "Impoundment Fee"). The Impoundment Fee is a one-time payment to the POA by the City, to be paid in certified funds at the closing described below. Provided, however, City acknowledges and agrees that no part of the Impoundment Fee shall represent any consideration paid by the City to the POA for any riparian interests or similar property rights, if any such rights exist at all, that may be owned or exist in favor of any owner of property adjoining or proximate to Lake Tansi or which may arise from the waters flowing there from. In addition to the Impoundment Fee, the City shall reimburse as frequently as annually to the POA fifty percent (50%) of the costs and expenses reasonably necessary for the maintenance and repair of the Lake Tansi dam, but only such costs and expenses as are actually paid by the POA to a non-affiliated third party for such repairs and maintenance.

6. **Exclusivity.** Subject to the exceptions provided in this section, the POA covenants and agrees that it shall not grant any other individual or entity, whether for profit, non-profit, governmental, utility district or otherwise, the right to withdraw, extract, collect, or harvest water from Lake Tansi, it being agreed and understood that the City has the sole and exclusive right to collect, extract, withdraw and harvest water from Lake Tansi under the terms of this Agreement. It is further specifically represented and acknowledged by the POA and the City that the efforts of any other individual or entity, including without limitation, any other municipality, governmental agency or authority, or utility district, to withdraw, extract, remove or harvest water from Lake Tansi, and the actual withdrawal, removal, collection or harvesting of the same, would be materially detrimental and significantly detrimental to the potable water system of the City and its ability to fulfill its obligations as the major purveyor of potable water in Cumberland County, Tennessee. The City, by this Agreement, has, and is hereby granted, by the POA, a priority first and exclusive right to extract raw water for its needs, under the limits defined herein, as such purveyor of potable water, and that there is insufficient raw water volume in Lake Tansi to grant additional or further rights to harvest the same to

any other individual or entity, including, without limitation, any governmental agency or utility district, even if such additional grant or conveyance is by involuntary means. Further, the POA shall not grant, transfer or convey, whether voluntarily or involuntarily, any interests, rights, licenses, or easements to, in, for or regarding the Lake Tansi impoundment, and its dam, spillway, and raw water, ("Property Interests"), without the prior written consent of the City, which consent shall not be unreasonably withheld; and, in no case, shall the POA grant, transfer or convey a Property Interest which would result, directly or indirectly, in a material degradation of the quantity or quality of the raw water in Lake Tansi or an impairment to the City's rights and benefits under this Agreement. Notwithstanding the foregoing, the POA may continue to irrigate its existing golf course from the water of Lake Tansi, and owners of residences on lots adjacent to Lake Tansi may continue to use water from Lake Tansi for the purpose of personal, residential, gardening and lawn irrigation. However, and notwithstanding any term or provision herein to the contrary, no such irrigation for residential, lawn and garden purposes shall be permitted during Emergency Conditions as defined in this Agreement.

7. **Forbearance.** The City shall not seek by condemnation or other means, unless otherwise agreed in writing by the POA, any additional water from Lake Tansi, other than that which is granted herein, including, without limitation, any water, water rights or rights appurtenant thereto, for a period of forty (40) years from the Effective Date. Provided, however, the City may seek condemnation against the POA during the first three (3) years of this Agreement if necessary to clear title to any of the water rights or rights appurtenant thereto that were contemplated to have been transferred and conveyed to the City by the POA under the terms of this Agreement.

8. **Required Permits.** The City shall be responsible for obtaining all necessary permits for the extraction and harvesting of the Water and the conveyance of the same in its system, but the POA shall cooperate and assist the City where reasonably necessary, in the process of obtaining such permits and hereby agrees not to hinder any such permitting process or take detrimental action regarding the same. City further agrees that it shall not commence any construction on the POA's property for any of the necessary facilities required for such extraction and harvesting until each of the required permits are in place unless otherwise agreed to in writing by the POA. In the event the City fails to obtain any required permit for the extraction and harvesting of the Water and the conveyance of the same in its system within three (3) years of the Effective Date, the POA at its option may declare such failure a default under this Agreement and may upon thirty (30) days prior notice to the City elect to terminate this Agreement. In the event of such termination, all the rights conveyed to the City by the POA under this Agreement shall terminate and revert back to the POA and the POA shall pay back to the City the Impoundment Fee required by **Section 5** of this Agreement but shall be entitled to all sums paid to it by the City under **Section 17** of this Agreement.

9. **Design and Monitoring Equipment Requirements.** The City intends to harvest the Water by means of an intake facility to be constructed in Lake

Tansi. The City agrees that the intake facility will have a wetwell type structure with intake pipes with wedge wire type screens on them at lake levels so as to not interfere with recreation water craft and that are designed to reasonably suppress noise to any nearby residents. The Water will be pumped from the City's wetwell facility to Meadow Park Lake through a 36" diameter pipe. The pipe line conveying the Water from Lake Tansi to Meadow Park Lake will be designed to either discharge into Meadow Park Lake or directly into the City's treatment plant at Meadow Park Lake. As provided in **Section 11** of this Agreement, the City shall be totally responsible for the cost of design and construction of the facilities, as well as all maintenance, repair and replacement costs associated with the same. The POA shall have approval rights for the design of all City facilities and equipment installed on its property; however, this approval cannot be unreasonably withheld or delayed. Any structures erected by the City that are visible to sight, including without limitation the wetwell facility and any equipment housing shall be approved by the POA's ACC to the extent such approval is required by any applicable Declaration of Covenants and Restrictions for Lake Tansi, with a right of prompt appeal of any such decision by the ACC to the POA's board of directors, it being agreed by the POA that such approval by the POA's ACC or its board of directors will not be unreasonably withheld or a cause for unreasonable delay in the completion of such facilities by the City. The City further agrees that it will design and install reliable and accurate pump and lake level monitoring equipment that will provide for simultaneous and continuous reporting to the City and POA of both the elevation levels of Lake Tansi and the amount of water that is harvested by the City from Lake Tansi at all times, subject to any applicable federal or state laws restricting the release of such information. Such equipment shall be maintained by the City in good operating condition at all times at the City's expense. The design and the plans and specifications of such monitoring equipment shall be submitted to the POA for prior written approval prior to the ordering and installation of such equipment by the City, which approval by the POA shall not be unreasonably denied or delayed. The POA shall have a right of access and inspection of such equipment during all reasonable hours, and the City agrees that that the readings and other monitoring data from such equipment will be provided simultaneously to the POA by telemetry or other telecommunications process at the same time the City receives such monitoring data unless such simultaneous reporting is prohibited by federal or state law, in which case such data shall be provided in a manner sufficient to allow the POA to audit the City's compliance with the terms and conditions of this Agreement.

10. Future Planning for Raw Water Needs. The City agrees to review its long-term water needs on at least a five (5) year frequency. In the event that the projections in such raw water study or review indicate a need for significantly additional raw water ten (10) years in the future, the City will take all reasonably appropriate action to address the future needs in a timely fashion. All such projection reports and raw water reviews shall be shared with the POA. City acknowledges and agrees that its failure to undertake such reviews and to adequately plan for the future water needs of its residents and utility customers can place an undue burden on the POA and unfairly tax the Lake Tansi resource. It is mutually agreed that certain studies by the

scientific community suggest that climate changes may alter the rainfall patterns. These conditions are beyond the control of either party to this Agreement; however, it may have either a positive or a negative impact on this Agreement. Climate change shall be addressed in each of the studies required by this section.

11. **Construction and Maintenance Costs.** The cost and expenses associated with the construction, placement and connection of the fixtures, fittings, pipes and equipment, and including labor necessary with regard to the same, for the collection and harvesting of the Water and the conveyance of the same shall be solely that of the City. City shall also be responsible for the maintenance, repair and replacement of such fixtures, fittings, pipes and equipment, which shall be kept in a good order and proper operating condition by the City at all time, subject to reasonable wear and tear customarily expected for such utility facilities.

12. **Increased Regulatory Costs.** For so long as the City shall continue to use Lake Tansi as a potable water supply, the City agrees to pay all reasonable costs and expenses incurred by or assessed against the POA by a state or federal government or regulatory body, agency, authority or similar entity, except in cases of gross negligence by the POA or unlawful acts by the POA, to comply with any law, regulation, order or any other directive of such entity that is prescribed or imposed as a result of the City's use of Lake Tansi for such public purpose.

13. **Third-Party Acquisition Costs.** Where it is necessary to pay for easements and real property interests not owned or controlled by the POA, for the purposes of the project contemplated herein, such payments and costs associated therewith shall be solely those of the City. Where the POA owns or controls the real property rights reasonably necessary for such project, the POA shall grant that which is reasonably necessary unto the City with no additional obligation of payment or otherwise by the City.

14. **Safe Dams Administrator.** The POA, unless otherwise provided in writing by the City, shall remain, at all times relevant to this Agreement, the owner, operator, and administrator of the Lake Tansi impoundment, and shall be solely responsible for the permitting and administration of the same and shall maintain compliance with all applicable laws, ordinances, statutes and regulations with regard to the same, including, without limitation compliance with the Tennessee Safe Dams Act, all at the sole expense of the POA, except for the contribution of fifty percent (50%) for dam repair and maintenance as defined above. The City shall have no liability or obligation for the permitting, regulation, administration and operation of the impoundment, except as pertains directly to the City's water harvesting operations contemplated hereunder, or under **Section 8** or **Section 12** of this Agreement. Notwithstanding the foregoing, in the event that the POA, with regard to the impoundment, is served with a notice of violation as to any applicable regulation or permit; fails to comply with any applicable regulation, statute, ordinance or law regarding

the same; or otherwise takes an action, or fails to act, in a manner which either directly or indirectly affects the integrity of the impoundment, the quality of the water therein or the raw water supply to the same, or impairs, or may reasonably be interpreted to impair, the rights and benefits of the City hereunder, the POA hereby grants to the City the right, license, privilege and authority to take such action or actions as the City deems reasonably necessary to cure the same, and the City may, in its sole and unfettered discretion, charge the POA for all costs and expenses reasonably incidental to the same except as set forth in Section 8 or Section 12 of this Agreement.

15. **Indemnity.** The City shall indemnify and hold harmless the POA (including its directors, officers and employees) from the claims of all persons, firms or corporations, if any, that arise or result from the City's acquisition or taking of any water or property interests from Lake Tansi or related thereto pursuant to this Agreement, including, specifically, and without limitation, all claims, if any, for riparian property interests whether adjoining, or in proximity to, Lake Tansi, and shall defend all actions, if any, at law or in equity brought against the POA asserting such claims. The City shall also indemnify and hold harmless the POA (including its directors, officers and employees) for all of its reasonable legal expenses and any court costs incurred as a result of any such claim being filed against the POA or such individuals. In addition, the City shall indemnify and hold harmless the POA (including its directors, officers and employees) from the claims of all persons, firms or corporations, if any, that arise or result from the City's ownership, operation or maintenance of any of its facilities and equipment constructed or installed as a result of this Agreement or which are related to or arising from the City's water harvesting rights conveyed herein and shall defend all actions, if any, at law or in equity brought against the POA (including its directors, officers and employees) asserting such claims. The City shall also indemnify and hold harmless the POA (including its directors, officers and employees) for all of its reasonable legal expenses and any court costs incurred as a result of any such claim being filed against the POA or such individuals. Provided, however, and notwithstanding any provision in this section to the contrary, this indemnity shall not apply to any claim or action that results from or arises solely on account of any negligence by the POA (or its directors, officers or employees) or from conduct by any such person that amounts to willful, wanton or gross negligence.

16. **Governing Law.** This Agreement and its terms and conditions shall be interpreted according to the laws of the State of Tennessee. All claims and actions arising out of this Agreement between the parties hereto shall be brought in the Chancery Court for Cumberland County, Tennessee, which court shall have sole and exclusive jurisdiction and venue.

17. **Professional Fees.** Subject to the limitations of this section, the City shall pay the POA's reasonable legal, engineering and appraisal costs arising from or otherwise incurred in connection with the preparation, negotiation and execution of this Agreement and the determination of any consideration to be paid by City to the POA for

the Water and Rights conveyed by this Agreement. Such costs shall be paid by the City to the POA within thirty (30) days of the POA's presentment of an invoice to the City for the same. Notwithstanding the foregoing, the City shall not be liable or obligated to pay the POA for any such legal, engineering or appraisal costs in excess of Sixty Thousand & no/100 Dollars (\$60,000.00).

18. Default and Waiver. In the event that either party hereunder shall fail to abide or otherwise keep any of the covenants as herein provided, the non-defaulting party shall provide the party alleged to be in default with thirty (30) days written notice of such default, during which notice period the party alleged to be in default must either satisfactorily cure such default or commence and diligently prosecute the necessary action to cure the default where the same is incapable of being cured fully within such period of thirty (30) days. In the event such default continues thereafter, the non-defaulting party shall be entitled to any and all remedies available to it under this Agreement or at law or in equity, including without limitation, specific performance as provided by **Section 23** of this Agreement, an award of money damages or other remedy at law or in equity.

Notwithstanding any right or remedy otherwise provided by this section, the City agrees that if it withdraws any water in violation or excess of any limitation contained in this Agreement, whether such limitation is based on quantity, the time of year or the elevation of Lake Tansi, it shall pay the POA a surcharge rate per each 1,000 gallons of water in violation or so overdrawn equal to two times the then current rate established by **Exhibit "C"** of this Agreement. Such surcharge rate shall be in lieu of any other rate per thousand gallons that would otherwise be due under this Agreement. The City acknowledges and agrees that such surcharge rate shall not be construed as a penalty or liquidated damages amount, but represents a fair measure of the compensation due the POA in such situations and shall be in addition to any other rights or remedies the POA has under this Agreement for such default by the City.

The City further agrees that in the event it shall fail for any reason to commence or complete the announced repairs (but excluding any planned construction to increase its elevation) to the Meadow Park Lake dam and construction of its raw water pipeline connecting Lake Tansi to Meadow Park Lake on or before January 1, 2015, or cease to diligently prosecute the performance of such work within such time period, then the conveyance of the Water, Rights and Easements by this Agreement shall lapse and all such rights conveyed herein shall revert back to the POA and its successors and assigns upon the POA's repayment to the City of the Impoundment Fee, provided the POA first gives the City thirty (30) days written notice of such default to the City and the City thereafter fails to satisfactorily cure such default within thirty (30) days or to commence and diligently prosecute the necessary action to do so if the default is incapable of being cured in such thirty (30) day time period.

The parties further agree that no delay or omission to exercise any right, power or remedy accruing upon the occurrence of any breach or default of a party under this Agreement shall impair any such right, power or remedy of any other party, nor shall it be construed to be a waiver of any such breach or default, or an acquiescence therein, or of any similar breach or default thereafter occurring, nor shall any waiver of any single breach or default be deemed a waiver of any other breach or default theretofore or thereafter occurring. Any waiver, permit or consent or approval of any kind or character on the part of a party of any provision or condition of this Agreement must be in writing and shall be effective only to the extent specifically set forth in such writing.

19. **Counterparts.** Either party hereto may cause this Agreement to be executed in multiple counterparts, and may cause one of the counterpart originals to be recorded in the Register's Office of Cumberland County, Tennessee, as notice to the world of the terms and conditions of this Agreement, and thereby encumber the POA, the Lake Tansi impoundment, and all property appurtenant thereto by the terms and conditions of this Agreement.

20. **Entire Agreement.** This Agreement and its referenced exhibits contain all the agreements, conditions, understandings, representations and warranties made between the parties hereto with respect to the subject matter hereof and supersede all prior written or oral offers, counter-offers, proposals, contracts, guarantees or discussions, commitments, arrangements or understandings with respect thereto. There are no representations, restrictions, agreements, promises, inducements, statements of intention, warranties, covenants or undertakings with respect to the matters or transactions contemplated hereby other than those expressly set forth herein. The parties acknowledge that they have not relied upon any oral representations from any of the parties or their agents or attorneys. All exhibits referenced in this Agreement are incorporated into this Agreement by reference as if the provisions of such exhibits had been stated herein verbatim.

21. **Amendment.** No modification, revision or amendment of this Agreement shall be binding unless made in a written document that is signed by all of the parties and which is approved by the POA's Board of Directors and the City's City Council. The language used in this Agreement will be deemed to be the language chosen by the parties hereto to express their mutual intent, and no rule of strict construction will be applied.

22. **Severability.** Any term or provision of this Agreement that is construed as prohibited or unenforceable under applicable law shall be ineffective to the extent of such prohibition or unenforceability without invalidating the remaining provisions of this Agreement. In the event such provision of this Agreement is so held invalid, the parties shall promptly renegotiate in good faith new provisions to restore this Agreement as near as possible to its original intent and effect and, to the extent practical, renegotiate or replace the obligation or covenant that is prohibited or unenforceable in a

manner that is reasonably fair to the parties in view of its original intent and desired effect. To the extent permitted by applicable law, the parties hereto hereby waive any provision of law that renders any provision hereof prohibited or unenforceable in any respect.

23. Specific Performance and Other Remedies. The parties hereto recognize that any breach of the terms of this Agreement may give rise to irreparable harm for which money damages would not be an adequate remedy and accordingly agree that, in addition to all other remedies available to the parties, any non-breaching party shall be entitled to enforce the terms of this Agreement by a decree of specific performance without the necessity of proving the inadequacy of money damages as a remedy. Unless otherwise specified, no remedy conferred upon either party in this Agreement is intended to be exclusive of any other remedy provided or permitted in it or by law. Each remedy shall be cumulative and in addition to every other remedy given hereunder or now or later existing at law, in equity or by statute.

24. Closing. Closing shall occur on or before October 15, 2009, at which time all muniments of title, indentures, bills of sale, deeds and easements for the Water, Easements, and Rights conveyed herein shall be executed and delivered by the POA to the City, and the City shall deliver, in certified funds, the Impoundment Fee. The form of such muniments of title, indentures, bills of sale, deeds and easements shall be subject to the prior approval of the POA, which approval shall not be unreasonably withheld.

25. Notice. All notices or communications which this instrument requires or permits to be given shall be in writing and shall be mailed or delivered to the respective addresses set forth below, and to such other address as may be designated in writing by either party. When notice is by mail, it shall be sent certified with postage prepaid and shall be complete upon its deposit in the U.S. Mail.

To POA as follows:

Lake Tansi Village POA
5050 Shoshone Loop
Crossville, TN 38572
Attention: General Manager

FAX: 931-788-1262

To City as follows:

City of Crossville
99 Municipal Avenue
Crossville, TN 38555
Attention: City Manager

FAX: 931-484-7713

26. **Mutual Cooperation.** The parties agree that they will cooperate with each other in all matters that are reasonably necessary or desirable to facilitate the performance of their respective obligations under this Agreement. Each of the parties hereto further agrees to do any act or thing and execute any and all instruments that are reasonably necessary and proper to make effective the provisions of this Agreement and perform their respective obligations contemplated under this Agreement. The parties further agree to take such lawful and reasonable measures and actions as may be necessary to ensure that this Agreement is not abrogated or set aside by the respective successor boards or legislative bodies of the parties to this Agreement.

27. **No Third Party Beneficiaries.** This Agreement and its benefits shall inure to the parties hereof, and their respective successors and assigns and shall not be construed to benefit any third party.

28. **Survival.** The provisions of this Agreement regarding any indemnity or any other covenant to which a party would have a reasonable expectation of continuance shall survive the transfer of property interests conveyed by this Agreement, and with respect to any such continuing covenant that is an obligation of the City, shall be a covenant that “runs with the land” and shall continue to obligate the City so long as it shall retain the ownership of such property interests conveyed by this Agreement.

29. **Attorneys’ Fees.** In the event that any of the parties hereto retains an attorney as a result of the breach by one party of any of the terms, covenants and provisions of this Agreement, the non-breaching party shall be entitled to recover the reasonable attorneys’ fees, court costs, and all costs of collection incurred by the non-breaching party as a result of such breach.

30. **Approval.** The execution of this Agreement by the President of the POA, was authorized by resolution of the POA’s Board of Directors duly adopted at a meeting of such board on October 1, 2009, a copy of which resolution is attached hereto as **Exhibit E.** The execution of this Agreement by the Mayor of the City of Crossville, Tennessee, was authorized by resolution of the City Council of Crossville duly adopted at a meeting of such council on October 2, 2009, a copy of which resolution is attached hereto as **Exhibit F.**

[This space intentionally left blank, signature page next]

IN WITNESS WHEREAS, the parties hereto have executed this Agreement on the day and date first above written.

LAKE TANSI VILLAGE PROPERTY OWNERS ASSOCIATION, INC.

By: [Signature]

Its: President of POA

THE CITY OF CROSSVILLE

By: [Signature]

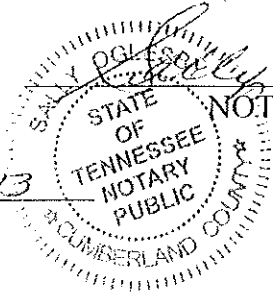
Its: Mayor

Lake Tansi Water Harvesting Agreement (Final) (10-05-09).doc

State of Tennessee)
)
County of Cumberland)

Before me, the undersigned authority, a Notary Public in and for said State and County, personally appeared Jerry Davenport, with whom I am personally acquainted, (or proved to me on the basis of satisfactory evidence), and who, upon oath, acknowledged himself to be the President of **Lake Tansi Village Property Owners Association, Inc.**, and that he as such President, being authorized so to do executed the foregoing instrument for the purposes therein contained by signing the name of Lake Tansi Village Property Owner's Association, Inc. by himself as such President.

WITNESS my hand and seal of office this the 7^B day of October, 2009.

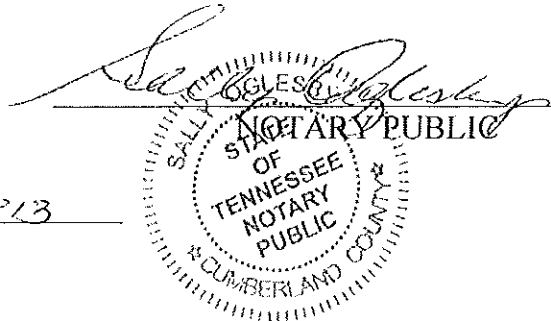

NOTARY PUBLIC

My commission expires: 2/5/2013

State of Tennessee)
)
County of Cumberland)

Before me, the undersigned authority, a Notary Public in and for said State and County, personally appeared **J. H. Graham, III**, with whom I am personally acquainted, (or proved to me on the basis of satisfactory evidence), and who, upon oath, acknowledged himself to be Mayor of the **City of Crossville**, and that he as such Mayor, being authorized so to do executed the foregoing instrument for the purposes therein contained by signing the name of the City of Crossville by himself as such Mayor.

WITNESS my hand and seal of office this the 7^B day of October, 2009.


NOTARY PUBLIC

My commission expires: 2/5/2013

EXHIBIT "A"

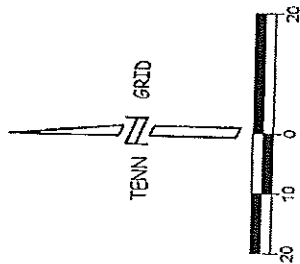
Lying and being in the THIRD CIVIL DISTRICT of Cumberland County, Tennessee, bounded and described as follows:

A tract of land lying at the upper extremities of Basses Creek encompassing what is commonly known as Lake Tansi Lake and Dam, being more particularly described as follows:

Commencing at the northerly corner of Leisure Brook Estates Unit #1, a previously filed subdivision of Lake Tansi Village, thence South 45° 45' 00" East for a distance of 278.00 feet to the point of beginning; thence South 9° 25' 00" East for a distance of 145.10 feet; thence South 47° 20' 00" East for a distance of 395.37 feet to the northeast corner of Lot 9, Leisure Brook Estates; thence South 64° 41' 37" East for a distance of 1805.49 feet; thence North 74° 19' 27" East for a distance of 380.32 feet to a point on the shoreline of Lake Tansi having an elevation of 1861.9 feet above mean sea level; thence meandering in a counterclockwise direction around said Lake along said elevation of 1861.9 feet above mean sea level and shoreline to a point being North 9° 25' 00" West of the point of beginning; thence South 9° 25' 00" East to the point of beginning, and including all earthen structure, rip-rap, spillways, siphon pipes and any other appurtenances that are a part of Lake Tansi dam in or above the described elevation.

Being the same property acquired by Lake Tansi Village Property Owners Association, Inc., by virtue of deeds including but not limited to the following: a deed dated February 23, 1983, from Lake Tansi Village, Inc., of record at Deed Book 264, page 671, Register's Office, Cumberland County, Tennessee; and a quitclaim deed dated March 7, 1997, from Aubrey King, of record at Book D527, page 273, Register's Office, Cumberland County, Tennessee.

EXHIBIT "B"



Tenn State Plane Coordinates (NAD 83) Elevations (NAVD88), and Tenn Grid Azimuth were determined using the City of Crossville's east phone reference station at @ N588,647.937' E2,256,110.694' EL1,857.54'

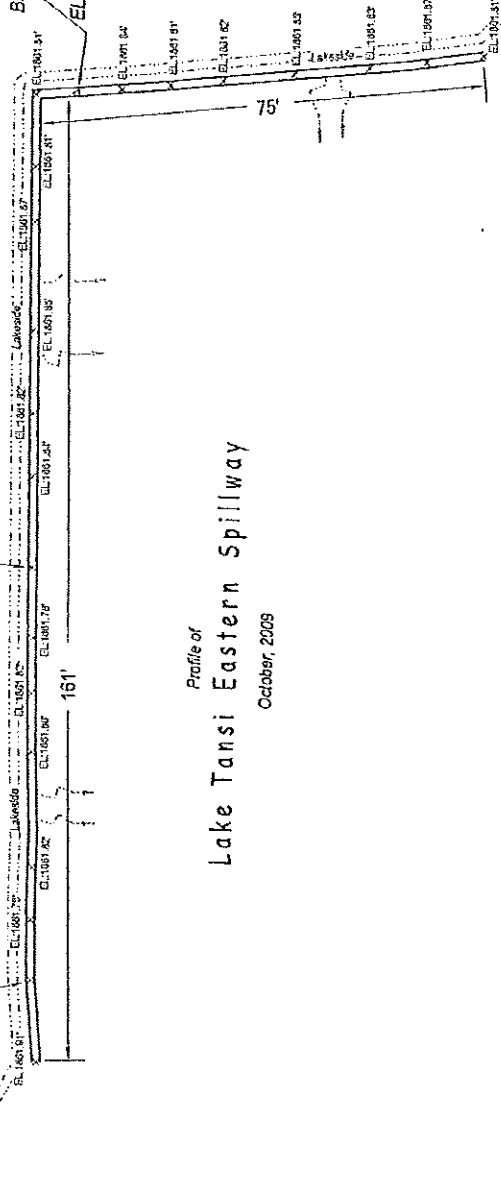
This was checked by an OPUS solution dated Sept 7, 2009 @ N558,533.538' E2,244,239.439' EL 1863.23' All distances shown are grid distances using a grid factor of 0.9998 650

National American Vertical Datum of 1988 (NAVD88) is the accepted standard for vertical control by the National Geodetic Survey (NGS)

Highest Elevation
1861.90' (NAVD88)

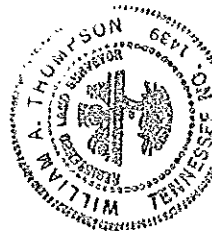
Lowest Elevation
1861.71' (NAVD88)

BM "Spill" 1/2 Rebar
N:557,477.126'
E:2,246,363.570'
EL:1861.82' (NAVD88)



Profile of
Lake Tansi Eastern Spillway

October, 2009



William A. Thompson

October 9, 2009

Surveyed by:
William A. Thompson, RLS #1439
1692 Open Range Road
Crossville, Tennessee 38555
tel 931-707-3655
cell 931-200-4852
email wats@frontier.net

EXHIBIT "C"

**Raw Water Rate for Additional Water Drawn under Emergency Conditions
And Other Applicable Provisions of the Agreement**

Fifteen Cents (\$.15) per 1,000 gallons of water, subject to adjustment as follows:

The initial rate shall be subject to annual adjustment, beginning on January 1, 2013, based on the percentage increase or decrease, if any, in the Consumer Price Index Seasonally Adjusted U.S. Average for All Items for All Urban Consumers (1982-84 = 100) published in the "Monthly Labor Review" of the Bureau of Labor Statistics of the United States Department of Labor ("CPI-U") from December 1, 2009 to December 1, 2012. Such rate, as adjusted hereby, shall be further adjusted each subsequent January 1st after 2013, by any percentage increase or increase, if any, in the CPI-U from the last annual measuring period (the year's period from December 1st through December 1st immediately preceding the effective date of such rate adjustment).

EXHIBIT "E"

RESOLUTION

Board of Directors

Lake Tansi Village Property Owners Association, Inc.

WHEREAS, the Lake Tansi Village Property Owners Association, Inc. ("LTVPOA") desires to protect the legal and other rights to the waters of all of the lakes on its property, as well as, its responsibilities relative to these waters and the association's membership; and

WHEREAS, the Board of Directors for the LTVPOA has engaged in extensive discussions and negotiations with the City of Crossville regarding the city's threatened condemnation of various water and property rights affecting Lake Tansi that are owned by the LTVPOA for the benefit of the association's members; and

WHEREAS, as a result of such discussions and negotiations, the Executive Committee and legal counsel to the LTVPOA have presented and recommended a proposed Water Harvesting Agreement that reflects significant benefits and betterments for the LTVPOA and its members as compared to the city's condemnation of the water and property interests it seeks, which agreement is subject to a few open points that remain to be negotiated with the City of Crossville as discussed by the Executive Committee and legal counsel to the association; and

WHEREAS, the Board of Directors believes thus the agreement as presented, even with the open points, is in the best interests of the association and its membership as a whole.

NOW, THEREFORE BE IT RESOLVED, that (i) the Water Harvesting Agreement substantially in the form of the agreement attached hereto as Exhibit A is hereby approved by the Board of Directors subject to the negotiation of the remaining open points as disclosed by the Executive Committee and the association's legal counsel, (ii) that the Executive Committee with the assistance of the association's legal counsel be authorized to negotiate and close the open points of the agreement presented; and (iii) that the association's president be authorized to execute and deliver the agreement substantially in the form attached, subject to its final negotiation and completion by the Executive Committee and to take any and all action necessary or convenient to effect the same.

Dated this 1st day of October, 2009.

LAKE TANSI VILLAGE
PROPERTY OWNERS ASSOCIATION, INC

BY: Patricia Steinhilber
Secretary

[Signature]
Joni Hellem, Chairman

[Signature]
Jerry Dayenpart, President

[Signature]
Ken Qualls, Vice President

[Signature]
Mike Ferry

[Signature]
Claude Coyne

[Signature]
Ed Liskover

[Signature]
Marlene Reitz

Raleigh Hawkins

Gail Boles

Michelle Williams
Notary Public
July 21, 2010

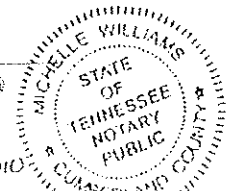


EXHIBIT "F"

RESOLUTION

- WHEREAS,** the Lake Tansi Village Property Owners Association, Inc., ("POA"), owns, controls, operates, administers an impoundment known as Lake Tansi, which is located in Lake Tansi Village in Cumberland County, Tennessee;
- WHEREAS,** the City is a municipality located in Cumberland County, Tennessee, that provides water within and outside of its municipal boundaries to approximately 16,448 customers, including residents of the Lake Tansi community, through the South Cumberland Utility District, ("South Cumberland"), which residents are located outside the City's municipal boundaries;
- WHEREAS,** the Cumberland Plateau has suffered drought conditions in the previous two years, highlighting the vulnerability of the area's raw water supply and the need to collect, draw or harvest water for the City's impoundments at Meadow Park Lake and Lake Holiday;
- WHEREAS,** the City faces an imminent need to repair the dam of its Meadow Park Lake impoundment, which repair requires the significant draw down of the pool level of Meadow Park Lake;
- WHEREAS,** drought conditions notwithstanding, the commercial, residential and industrial growth in the City's Urban Growth Boundary, and in its current potable water service regions and customer areas within Cumberland County, Tennessee, is accelerating and increasing by double digit percentages, thereby creating an exponentially greater demand annually for potable water from the City, including a greater demand in the Tansi community;
- WHEREAS,** even the POA community of Lake Tansi Village, which is served by the South Cumberland, relies entirely for its potable water needs upon that purchased from the City by South Cumberland under an existing contract with the City;
- WHEREAS,** growth and development, as well as maintenance of current potable water needs for the Lake Tansi community and other customers of the City, are largely dependent upon the supply of water by the City and the City's ability to secure additional water sources, especially during, but not limited to, times of exigent circumstances wherein water resources may not be abundant or economically accessed;

WHEREAS, harvesting water from local resources, including Lake Tansi, especially those proximately located to existing City impoundments, is advisable according to recent engineering studies to be both economically more affordable, by a wide margin, than any other studied option, (much more so than harvesting from the Tennessee River and the Caney Fork River), and will afford a significantly higher quality raw water supply;

WHEREAS, the City maintains that harvesting water from Lake Tansi will have no significant environmental impact, and this option has been determined by the City to be environmentally friendlier than harvesting water from either the Tennessee River or the Caney Fork River;

WHEREAS, the City acknowledges and agrees that such harvesting is best accomplished in cooperation with the POA in a manner that balances the City's needs for additional raw water supply to serve the area's potable water demands with the POA's desire to minimize any resulting disruptions to the water levels of Lake Tansi so as to maintain and preserve the quality of enjoyment that Lake Tansi provides the POA, its approximately 7,000 property owners, their families and guests; both parties recognizing the importance of maintaining the recreational and aesthetic attributes, and resulting economic benefits, that this water resource provides as a major tourism attraction for the Cumberland County area;

WHEREAS, the POA is willing, pursuant to the terms and conditions of the attached Agreement to permit the City to draw, collect and harvest water from Lake Tansi, and to convey the rights incidental to the same to the City in consideration of the promises and covenants made by the City to the POA contained in this Agreement; and,

WHEREAS, the relationships created under this Agreement will better enable the City to meet the potable water demands of all of its customers, not the least of which include the members of the POA and other residents of the Lake Tansi community.

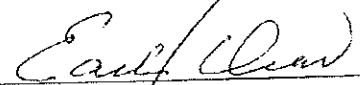
NOW, THEREFORE, for and in consideration of the premises above, **BE IT HEREBY RESOLVED** that the Water Harvesting Agreement, ("Agreement"), attached hereto and incorporated herein by reference thereto as if copied herein verbatim be ratified, accepted, approved and adopted in every respect, the public safety and welfare requiring the same, and it being in the best interest of the City of Crossville, and that the City be bound by the same, and enjoy the rights and privileges granted under the same; and,

BE IT FURTHER RESOLVED, that the Mayor of the City of Crossville be, and is hereby, authorized to execute said Water Harvesting Agreement.

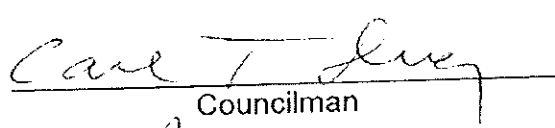
ADOPTED this 2nd day of October, 2009.



Mayor



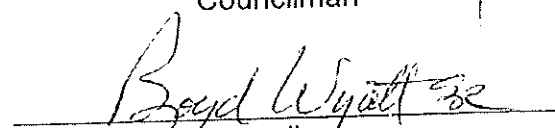
Councilman



Councilman

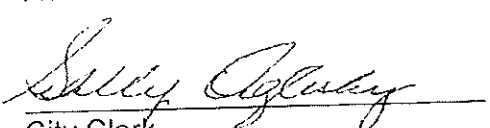


Councilman



Councilman

ATTEST:



City Clerk