

Tomahawk Creek WWTP

Updates to Process Improvements Pre-Design Study

Wet Weather Flow Alternatives Selection

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Introduction

Technical Memorandum (TM) No. 3 – Alternatives Selection – Dry Weather Treatment presented the results of the Life Cycle Cost (LCC) evaluation for four 10-mgd and four 19-mgd dry weather treatment alternatives. The evaluation was performed on a comparative basis, focusing on those process components that differed between alternatives. In addition, the alternatives were compared with respect to Carbon Footprint, non-economic criteria, and Cost-per-Benefit score. This information was reviewed in Workshop No. 3 on May 3, 2011, and the preferred alternative for each of the 10 mgd and 19 mgd groups was identified.

Technical Memorandum No. 4 – Wet Weather Flow Evaluation and Alternatives Definition documented the criteria and assumptions that would serve as the basis for the wet weather alternatives evaluation. This TM included an analysis of the assumptions and methodologies presented in the City of Kansas City, Missouri, Overflow Control Plan (OCP) as they pertained to handling of JCW flows. It included an analysis of the design wet weather event at the Tomahawk Creek WWTP (THC) based on JCW criteria, and a reconciliation between JCW's criteria and that contained in the OCP so that an “apples-to-apples” comparison of alternatives could be made. This information was reviewed at Workshop No. 4 on July 13, 2011, and eight Wet Weather Flow alternatives were identified for further consideration: three based on 19-mgd dry weather treatment, two based on 10-mgd dry weather treatment, and three based on no dry weather treatment at THC.

The purpose of Technical Memorandum No. 5 – Wet Weather Flow Alternatives Selection, is to evaluate the wet weather alternatives identified in TM No. 4 in terms of Life Cycle Cost. The Carbon Footprint, non-economic criteria, and Cost-per-Benefit score of the alternatives will be evaluated in TM No. 6 – Combined Dry/Wet Weather Alternative Selection, in conjunction with the corresponding preferred dry weather alternatives. TM No. 6 will combine the preferred dry weather and wet weather alternatives for each dry weather

treatment capacity grouping (i.e., 19 mgd, 10 mgd, and 0 mgd) and determine the preferred overall capacity and treatment scheme.

Wet Weather Alternatives Overview

Based on the assumptions developed in TM No. 4, a series of wet weather alternatives were identified for each of the dry weather treatment capacities evaluated for THC. These alternatives have been further developed in this TM No. 5. The “Wet 19” alternatives group corresponds to 19 mgd dry weather treatment, the “Wet 10” Alternatives correspond to 10 mgd dry weather treatment, and the “Wet 0” Alternatives assume no dry weather treatment at THC. Each alternative has components to enable it to handle the expected peak hour flow, termed peak wet weather flow (PWWF), of 135 mgd. The following is an overview of the wet weather alternatives to be evaluated in this TM:

A. 19 mgd WWTP at THC

Wet 19.1:

Treat 19 mgd Dry Weather Flow (DWF) plus 19 mgd Peak Wet Weather Flow (PWWF) at THC (total of 38 mgd)

Store (then treat) 23 mgd PWWF at THC ($23 \text{ mgd} \times 0.43 \text{ mgal/mgd} = 10 \text{ mgal storage}$)

Discharge 74 mgd PWWF through Auxiliary Treatment Facility

Wet 19.2:

Treat 38 mgd at THC (19 mgd DWF and 19 mgd PWWF)

Store (then treat) 23 mgd PWWF at THC ($23 \text{ mgd} \times 0.43 \text{ mgal/mgd} = 10 \text{ mgal storage}$)

Send 74 mgd PWWF to KCMO ($74 \times 0.43 = 32 \text{ mgal storage}$ at 87th Street Pumping Station required)

Wet 19.3:

Treat 38 mgd at THC (19 mgd DWF and 19 mgd PWWF)

Store (then treat) 97 mgd PWWF at THC = $97 \times 0.43 = 42 \text{ mgal storage}$ required, 10 mgal lagoon, 32 mgal new storage at THC

B. 10 mgd WWTP at THC

Wet 10.1:

Treat 20 mgd at THC (10 mgd DWF and 10 mgd PWWF)

Send 18 mgd to KCMO (9 mgd DWF and 9 mgd PWWF, requiring 4 mgal PWWF storage at KCMO)

Store (then send to KCMO) 23 mgd PWWF at THC ($23 \text{ mgd} \times 0.43 \text{ mgal/mgd} = 10 \text{ mgal storage}$)

Discharge 74 mgd PWWF through Auxiliary Treatment Facility

Wet 10.2:

Treat 20 mgd at THC (10 mgd DWF and 10 mgd PWWF)

Send 92 mgd to KCMO consisting of 9 mgd DWF and 83 mgd PWWF (36 mgal PWWF storage at 87th Street Pumping Station)

Store (then send to KCMO) 23 mgd PWWF at THC (23 mgd X 0.43 mgal/mgd = 10 mgal storage)

C. No WWTP at THC

Wet 0.1:

Send 19 mgd DWF to KCMO (assumes no storage of DWF required)

Send 19 mgd PWWF to KCMO (8 mgal storage at 87th Street Pumping Station)

Store (then send to KCMO) 23 mgd PWWF at THC (23 mgd X 0.43 mgal/mgd = 10 mgal storage)

Discharge 74 mgd PWWF through Auxiliary Treatment Facility

Wet 0.2:

Send 97 mgd to KCMO consisting of 19 mgd DWF and 78 mgd PWWF (34 mgal PWWF storage at 87th Street Pumping Station)

Store (then send to KCMO) 38 mgd PWWF = 16 mgal storage required at THC, 10 mgal lagoon, 6 mgal new storage at THC

Wet 0.3:

Send 19 mgd DWF to KCMO (assumes no storage of DWF required)

Send 19 mgd PWWF to KCMO (8 mgal storage at 87th Street Pumping Station)

Store (then send to KCMO) 97 mgd PWWF = 42 mgal storage required at THC, 10 mgal lagoon, 32 mgal new storage at THC

Note that an alternative consisting of a 10-mgd WWTP with a large PWWF storage facility at THC was determined as not feasible as the WWTP would not have sufficient capacity to treat the stored PWWF following a storm event. Table A.1 in Appendix A presents a summary of the component sizing for each of the above alternatives. Figure A.1 shows a graphical representation of the alternatives. Working from the bottom of each stacked bar upwards, the order in which the treatment or storage component for each of the alternatives would be implemented as the flow increases is illustrated.

There is adequate space available at the existing lagoon site to modify the existing lagoon to store the volumes identified in the above alternatives as lagoon storage. The modifications required will be discussed in the following sections.

THC Storage Options

Alternatives Wet 19.3, Wet 0.2, and Wet 0.3 include the construction of additional storage for peak wet weather flows at THC. Three storage methods were evaluated:

- Above ground storage tanks.
- Shallow underground storage facility
- Deep tunnel storage

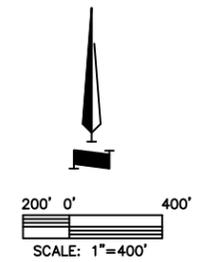
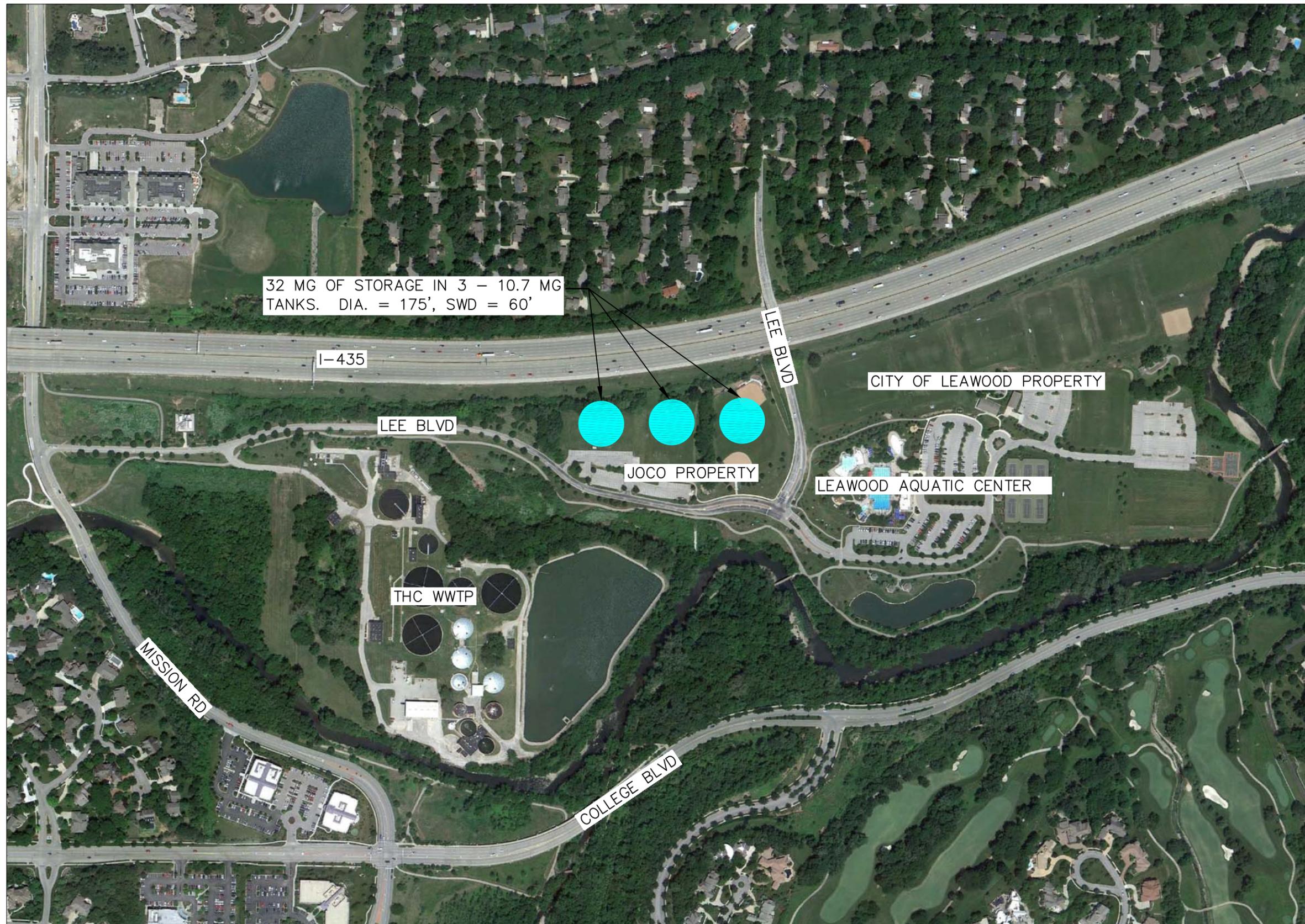
Potential storage sites near the THC WWTP were evaluated to determine their suitability for storage of the additional peak wet weather flows required for these alternatives. The soccer fields/ball diamond area north of the plant site is owned by JCW. The larger soccer field area on the east side of Lee Boulevard near the Leawood Aquatic Center is owned by the City of Leawood.

Above Ground Storage Tanks:

This option would entail storing the peak wet weather flow above ground in prestressed concrete tanks, like those manufactured by Natgun, Preload, and others. These storage tanks were originally developed for potable water and have been successfully adapted to store wastewater with the addition of thickened base slabs to handle changes in pressure due to fill and drain cycles. Domed roofs are preferred to allow an unobstructed interior space for wash down of the tank. Peak wet weather flow would be pumped into the storage tanks, and drained back into the system by gravity. Odor control would be provided onsite.

These storage tanks would potentially be sited at the soccer fields/ball diamond area north of the plant owned by JCW. Alternative Wet 0.2 requires 6 mal in additional storage at THC. This could be attained by constructing one 6 mgal tank, approximately 145 feet in diameter with a side water depth of 50 feet. Alternatives Wet 19.3 and Wet 0.3 require 32 MG in additional storage at THC. This could be attained by constructing three 10.7 mgal tanks, each approximately 175 feet in diameter with a side water depth of 60 feet. Figure 1 on the following page shows the footprint of the above ground storage tanks for this option.

This site lies within the 100 year flood plain (but outside the floodway), so additional flood mitigation may be required. Based on prior project experience, a conservative cost of \$2.00/gallon of storage (total project cost) is estimated. This results in project costs of 12,000,000 and \$64,000,000 for the alternatives requiring 6 mgal and 32 mgal of storage, respectively.



32 MG OF STORAGE IN 3 - 10.7 MG TANKS. DIA. = 175', SWD = 60'

I-435

LEE BLVD

CITY OF LEAWOOD PROPERTY

LEE BLVD

JOCO PROPERTY

LEAWOOD AQUATIC CENTER

THC WWTP

MISSION RD

COLLEGE BLVD

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JOHNSON COUNTY WASTEWATER
TOMAHAWK WASTEWATER TREATMENT PLANT
2011 PRE-DESIGN STUDY UPDATE

TM 5- WET WEATHER FLOW
ALTERNATIVES SELECTION
ABOVE GROUND STORAGE SITING EXHIBIT

PROJECT NO.
144700

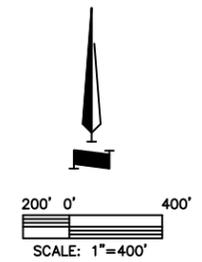
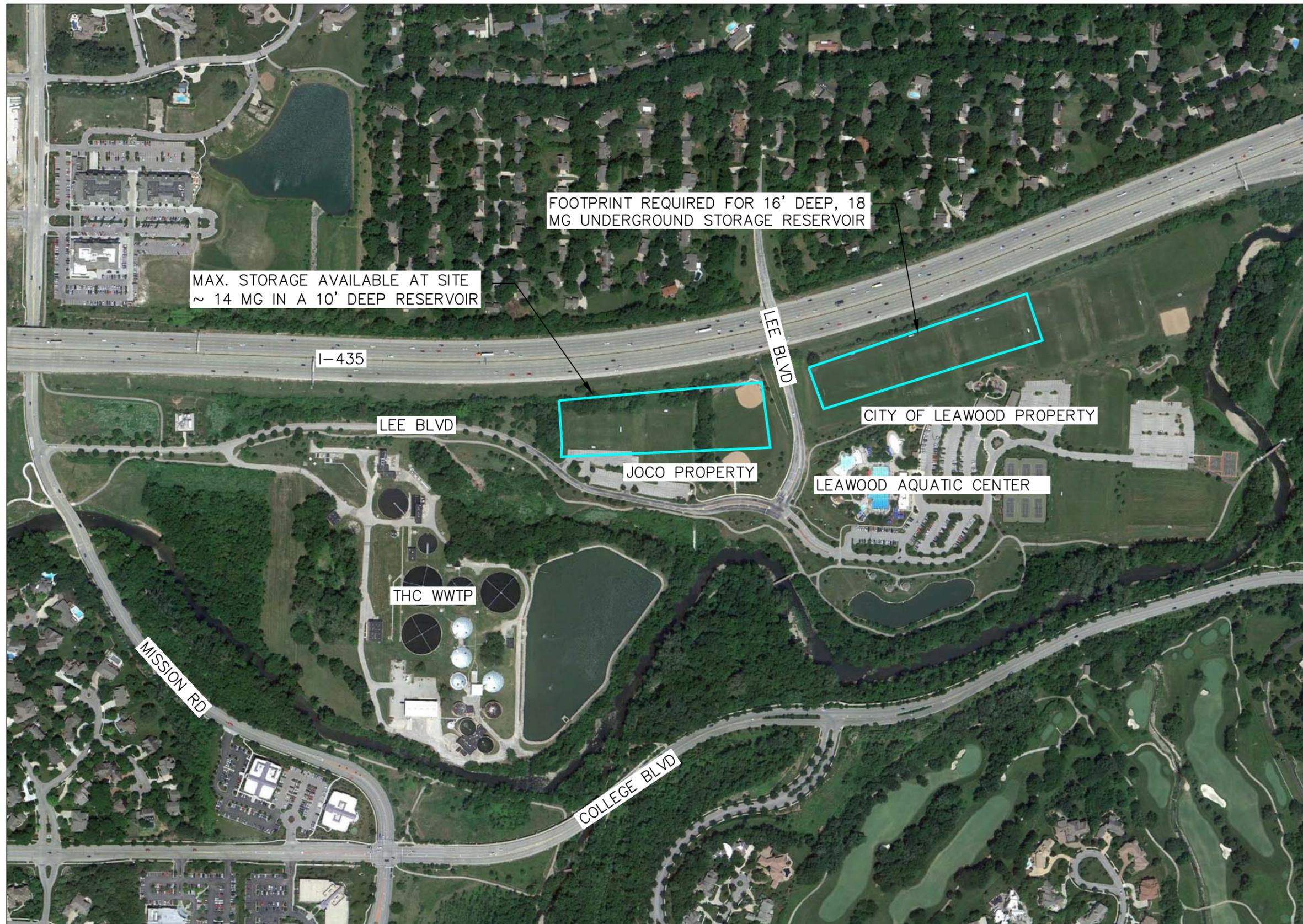
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FIG. 1

Shallow Underground Storage Facility:

This option would entail storing the peak wet weather flow below ground in a shallow underground storage structure. The storage site would be excavated to the depth of bedrock, with the base slab of the storage structure anchored into the bedrock. The structure would be a concrete reservoir with a flat, column supported roof and sloped floor slab with multiple drainage points. A flushing or wash down system would be required to clear debris after use. The top of the structure would be at or near existing grade. The existing soccer fields/baseball diamonds would be reconstructed on the roof of the facility. Odor control would be provided onsite.

Without geotechnical investigation of the potential sites to determine the elevation of bedrock, the exact storage volume available cannot be determined. Assuming the bedrock is at approximately the same elevation as the streambed of Tomahawk Creek, the 6 mgal of peak flow storage required for Alternative Wet 0.2 could likely be attained in the soccer field/ball diamond area north of the plant owned by JCW. The footprint of the 10 foot deep storage facility would be approximately 400 x 210 feet. In order to obtain the 32 mgal of peak flow storage required for alternatives Wet 19.3 and Wet 0.3, the available storage at the soccer field to the north would need to be maximized, and the larger soccer field area to the east (owned by the City of Leawood) would also need to be utilized. The available area to the north could be maximized to provide approximately 14 mgal of storage. The footprint of the 10 foot deep storage facility would be approximately 800 x 235 feet. To obtain the additional 18 mgal of storage necessary, a facility with a footprint of approximately 900 x 170 feet, with a depth of 16 feet would be required (the ground elevation at the Leawood owned site is approximately 6 feet higher than the JCW owned site). Figure 2 on the following page shows the footprint of the underground storage facility for this option.

Portions of these sites are located within the 100 year floodplain (but outside the floodway). If possible, the existing grade would not be raised in the areas within the floodplain, in order to avoid impacts that may require mitigation. For the purposes of this study, a cost of \$3.00/gallon of storage (total project cost) will be used, resulting in project costs of \$18,000,000 and \$96,000,000 for the 6 mgal and 32 mgal facilities, respectively.



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FIG. 2

Deep Tunnel Storage:

This option would entail storing the peak wet weather flow in deep tunnels. The characteristics typically expected for this type of facility would include the following:

- Generally, the longer a tunnel is, the more cost effective it is to construct. For a tunnel 2 miles in length, this results in a tunnel size of approximately 10 or 23 feet in diameter to store 6 mgal or 32 mgal, respectively.
- The tunnel would most likely need to be located completely in the bedrock, likely at a depth between 40 to 100 feet.
- The tunnel would require air shafts to allow air to enter and exit during fill and draw cycles. Depending on the location of the air shaft, the tunnel may require odor control.
- Depending on the tunnel location, a pump station may be required to divert peak wet weather flow to the storage tunnel, versus diversion by gravity. In order to be conservative, a pump station and forcemain to the tunnel were included in the cost estimates.
- Another factor impacting cost is the proximity of the spoil disposal site for the excavated material (over 160,000 cubic yards for the 32 mgal alternatives).

Refined tunnel costs cannot be determined without completion of geotechnical investigation of the tunnel site and preliminary design of the tunnel facilities. Since a number of the above factors haven't been determined, an estimate was prepared based on a range of costs encountered on other installations on projects HDR or CH2M HILL were involved in, as well as the estimates used for tunnel storage in the KCMO OCP. There is a wide variation in tunnel costs between projects, and costs can vary significantly based on the size and location of tunnel facilities. These costs ranged from a low of approximately \$2.50 per gallon (construction cost for a 77 mgal tunnel in Ohio) to a high of approximately \$7.50 per gallon (total estimated project cost in the OCP for an 8.5 mgal tunnel north of the Missouri River in KCMO). A cost of \$4.70/gallon (total project cost) will be used in this analysis, resulting in project costs of \$28,200,000 and \$150,400,000 for the 6 mgal and 32 mgal tunnels, respectively.

Site Issues and Basis of Study:

The following must also be considered:

- The above ground storage tank option would permanently remove the JCW owned soccer field/ball diamond area from use, and may also raise aesthetic issues.
- The disruption caused by the construction of the shallow underground storage facility option would put both soccer field/ball diamond areas out of use for one season. This option would also require an agreement with the City of Leawood.
- If above ground storage tanks or shallow underground storage is feasible, either would be preferable to tunnel storage because of the increased cost of tunnel storage.

For the purposes of the subsequent cost analysis, the shallow underground storage facility option will be used as the base case for the comparison of alternatives. A summary of the capital cost differences between the shallow underground storage facility, above ground storage tanks, and deep tunnel storage is included for each applicable alternative.

Reconciliation with KCMO Storage Costs:

The most recent cost information on KCMO’s website presents the cost for above ground storage tanks at the 87th Street Pump Station as follows:

Storage Cost (per Table on KCMO website as of 10/31/11):

Initial Tank (20 mgal)		\$83.2 million	(2016)
Final Tank (48 mgal)		<u>\$153.5 million</u>	(2024)
	Total	\$236.7 million	
	÷	68 million	gallons
		\$3.48/gallon	
Initial Tank	=	\$4.16/gallon	
Final Tank	=	\$3.20/gallon	

Based on a review of the KCMO OCP, it is believed that the KCMO storage costs were determined based on the following equation from the “OCP Basis of Cost Manual, Existing Conditions Costing Equations”:

$$C = 8.367V^{0.5546}$$

Where:

C = Construction Cost (\$ million)

V = Storage Volume (million gallons)

Note that this equation is for the construction cost of each individual storage tank.

JCW’s contribution to KCMO storage would be towards the final tank, estimated by KCMO to be \$3.20/gallon. This is significantly higher than the HDR/CH2MHILL estimate of \$2.00/gallon for above ground storage tanks discussed previously. The disparity in storage costs may be a result of the following:

- A more conservative cost estimating approach used by KCMO
- Specific site constraint issues at the KCMO site
- Other unknown issues

It is important that the reasons for this disparity be determined before any final decision is made. In the meantime, in order to compare the storage alternatives on an “apples to apples” basis, the \$3.00/gallon figure will be utilized in the alternatives analysis for both storage at THC and storage at KCMO, when applicable.

Alternative Evaluation

The Life Cycle Cost (LCC) analysis presented in TM No. 5 includes only those costs associated with facilities at the THC site. Inclusion of KCMO rates and charges was deferred to TM No. 6 which presents a combined dry/wet weather analysis.

Economic Analysis Protocols

Identical to the approach presented in TM No. 3, LCC analysis of the wet weather alternatives will be based on the 2011 Discount Rates presented in the President's Office of Management and Budget (OMB) Circular No. A-94 published on February 3, 2011. The real discount rate, which is a forecast of real interest rates from which the inflation premium has been removed, will be utilized in the LCC analyses as it is the most appropriate for discounting constant-dollar flows, such as required in cost-effectiveness analysis. The 2011 real discount rate is 2.1 percent for a 20 year analysis.

The planning horizon for comparison of alternatives is 20 years (2020 – 2039) with the following assumed dates based on the current long-term Capital Improvements Program (CIP):

- Design completed in 2018
- Construction conducted in 2018 and 2019 with midpoint of construction assumed to be January 2019
- Operations of upgraded facilities to start January 2020

The timing for this project is subject to change, either earlier or later depending on revisions to future CIPs and also the timing of Kansas City, MO rate increases for treatment of wastewater sent through the interceptor. A sensitivity analysis of the project timing will be evaluated in the Combined Dry/Wet Weather Alternative Selection, TM No. 6.

Cost Analysis

Retained/Modified Facilities

Wet weather facilities at THC to be retained are the lagoon and the existing wet weather pump station. These items will be retained with the following modifications:

- Lagoon – The existing lagoon berm is at an elevation of 840, 4 feet below the 100-year flood elevation. The berm will be raised to an elevation of 846, 2 feet above the 100-year flood elevation. The north, south, and west sides of the berm will be raised and extended to the new elevation of 846. The east side of the berm will be removed and relocated west, away from the stream to prevent restricting the floodway and causing an increase in the 100-year flood elevation. As discussed in TM 3, the proposed dry weather treatment facilities will encroach on the 100-year flood plain. It is anticipated that relocating the berm to the west will help offset the effects from the construction of these facilities, thus avoiding a rise in the 100-year flood elevation. The proposed berm location used in this study for cost estimating purposes is preliminary. The final location will need to be determined through a

detailed flood study. The lagoon will have an earthen berm and be sized to store 10 mgal of wet weather flow.

- Wet Weather Pump Station - The existing wet weather pump station will be retained with no modifications. The pumps and motors were installed in 1995 and are scheduled for replacement when they reach the end of their useful life in 2014. The replacement of the pumps and motors will be included in the initial project, along with any upsizing (if determined to be necessary during final design).

The cost estimates for the retained facilities for each alternative are shown in Table B.1 in Appendix B.

Capital, O&M, and Life Cycle Cost Estimates

Capital, O&M, standard allowances, and net present value cost information for the wet weather alternatives are presented in Appendix B and summarized in Table 1. The table separates the evaluation by the alternatives associated with a 19-mgd Dry Weather Flow WWTP at THC (“Wet 19” alternatives), with a 10-mgd Dry Weather Flow WWTP at THC (“Wet 10” alternatives), and with no dry weather flow WWTP at THC (“Wet 0” alternatives).

TABLE 1
Tomahawk WWTP Wet Weather Alternative Cost Summary (4)

Alternative	Total Capital Cost ¹	First Year O&M Cost ²	Net Present Value ³
Wet 19.1	\$50,720,000	\$1,070,000	\$57,850,000
Wet 19.2	\$3,110,000	\$70,000	\$3,610,000
Wet 19.3	\$118,450,000	\$390,000	\$105,980,000
Wet 10.1	\$50,720,000	\$1,070,000	\$57,850,000
Wet 10.2	\$3,110,000	\$70,000	\$3,610,000
Wet 0.1	\$50,720,000	\$1,070,000	\$57,850,000
Wet 0.2	\$31,610,000	\$310,000	\$31,130,000
Wet 0.3	\$118,450,000	\$390,000	\$105,980,000

Notes:

1. Costs presented in 2011 dollars.
2. Costs presented in 2011 dollars. First Year O&M costs are for the new facilities. O&M costs for retained or modified facilities (Wet Weather Pump Station No. 1 and Modified Lagoon Storage) are excluded, as costs for their operation are included in existing facility O&M.
3. Net Present Value includes 20 years of O&M from 2020 to 2039, and the total THC capital cost from the 2019 mid-point of construction, including non-construction costs (engineering and administration fees).
4. Only costs associated with facilities at the THC site are included. KCMO rates and charges will be added to the combined dry/wet analysis in TM 6.

Alternatives Wet 19.3, 0.2, and 0.3 include a capital cost for additional storage at THC. This cost was based on storage in a shallow underground storage facility. As discussed in the previous section, above ground storage tanks and deep tunnel storage are also options. Table 2 presents a comparison of the capital costs for the three storage options.

Table 2
Comparison of Capital Costs for Storage Options

Alternative/Storage Option	Capital Cost			Add/Deduct to Base Case
	Base Case	Above Ground	Deep Tunnel	
Wet 19.3	\$118,450,000	-	-	-
	-	\$86,450,000	-	Deduct \$32,000,000
	-	-	\$172,850,000	Add \$54,400,000
Wet 0.2	\$31,610,000	-	-	-
	-	\$25,610,000	-	Deduct \$6,000,000
	-	-	\$41,810,000	Add \$10,200,000
Wet 0.3	\$118,450,000	-	-	-
	-	\$86,450,000	-	Deduct \$32,000,000
	-	-	\$172,850,000	Add \$54,400,000

The first year O&M costs in Table 1 include general WWTP labor as well as power, electricity, maintenance and repairs for new facilities. The O&M costs are itemized by alternative in Appendix B.

Historical flow records of all flow arriving at THC from April 2008 to July 2010 were analyzed to determine what percentage of the annual volume of wastewater fell within each flow rate increment. For example, for the 19 mgd alternatives:

- The volume of wastewater during peak events that was below 38 mgd and could be directly processed at the plant
- The volume of wastewater above that limit that would be stored at the lagoon or THC storage facility
- The volume of wastewater above that limit that would be sent to the auxiliary treatment facility or KCMO

Table A.3 in Appendix A presents a summary of the wet weather flow volume distribution from the historical flow records analyzed.

This was completed in order to determine what average annual volume of wastewater flow (based on the design average annual flow of 19.1 mgd) will be treated at THC and at KCMO for each alternative. A breakdown of the average annual flow volume projected to each component and the projected total annual flow volumes treated at THC and KCMO for each alternative is presented in Table 4 on the following page. The projected annual flow volumes to KCMO will be used in conjunction with the KCMO treatment rates to determine the O&M costs for wet weather flow to KCMO.

Figure 3 Total Annual Flow Volume Projections & Treatment Locations for Wet Weather Alternatives

Alternative	Wet 19.1	Wet 19.2	Wet 19.3	Wet 10.1	Wet 10.2	Wet 0.1	Wet 0.2	Wet 0.3
Total Annual Flow at 19.1 MGD Average (mgal)	6971.5	6971.5	6971.5	6971.5	6971.5	6971.5	6971.5	6971.5
THC DWF (<19 MGD Total Flow)	5658.1 (81.2%)	5658.1 (81.2%)	5658.1 (81.2%)	3434.9 (49.3%)	3434.9 (49.3%)	-	-	-
THC WWF Direct (<38 MGD Total Flow)	1039.5 (14.9%)	1039.5 (14.9%)	1039.5 (14.9%)	828.2 (11.9%)	828.2 (11.9%)	-	-	-
PWWF to THC Lagoon - to THC for Treatment	191.0 (2.7%)	191.0 (2.7%)	191.0 (2.7%)	-	-	-	-	-
PWWF to THC Lagoon - to KCMO for Treatment	-	-	-	191.0 (2.7%)	191.0 (2.7%)	191.0 (2.7%)	191.0 (2.7%)	191.0 (2.7%)
PWWF to THC Storage - to THC for Treatment	-	-	83.0 (1.2%)	-	-	-	-	-
PWWF to THC Storage - to KCMO for Treatment	-	-	-	-	36.3 (0.5%)	-	66.9 (1%)	83.0 (1.2%)
Auxiliary Treatment Facility	83.0 (1.2%)	-	-	83.0 (1.2%)	-	83.0 (1.2%)	-	-
KCMO DWF (<19 MGD Total Flow)	-	-	-	2223.2 (31.9%)	2223.2 (31.9%)	5658.1 (81.2%)	5658.1 (81.2%)	5658.1 (81.2%)
KCMO Base WWF (<38 MGD Total Flow)	-	-	-	211.9 (3.0%)	211.9 (3.0%)	1039.5 (14.9%)	1039.5 (14.9%)	1039.5 (14.9%)
KCMO PWWF	-	83.0 (1.2%)	-	-	46.7 (0.7%)	-	16.0 (0.2%)	-
Total DWF Volume Treated at THC	5658.1 (81.2%)	5658.1 (81.2%)	5658.1 (81.2%)	3434.9 (49.3%)	3434.9 (49.3%)	-	-	-
Total WWF Volume Treated at THC	1230.5 (17.6%)	1230.5 (17.6%)	1313.4 (18.8%)	828.2 (11.9%)	828.2 (11.9%)	-	-	-
Total Flow Volume Treated at THC	6888.6 (98.8%)	6888.6 (98.8%)	6971.5 (100%)	4263.1 (61.1%)	4263.1 (61.1%)	-	-	-
Total DWF Volume Treated at KCMO	-	-	-	2223.2 (31.9%)	2223.2 (31.9%)	5658.1 (81.2%)	5658.1 (81.2%)	5658.1 (81.2%)
Total WWF Volume Treated at KCMO	-	83.0 (1.2%)	-	402.9 (5.8%)	485.9 (7.0%)	1230.5 (17.6%)	1313.4 (18.8%)	1313.4 (18.8%)
Total Flow Volume Treated at KCMO	-	83.0 (1.2%)	-	2626.1 (37.7%)	2709.1 (38.9%)	6888.6 (98.8%)	6971.5 (100%)	6971.5 (100%)

Notes:

DWF = Dry Weather Flow

WWF = Wet Weather Flow

PWWF = Peak Wet Weather Flow

Appendix A
**Flow Volume Determination for Operation
and Maintenance Costs**

Table A.1 Wet Weather Alternatives Component Sizing Matrix

<u>Component Sizing</u>	<u>Wet 19.1</u>	<u>Wet 19.2</u>	<u>Wet 19.3</u>	<u>Wet 10.1</u>	<u>Wet 10.2</u>	<u>Wet 0.1</u>	<u>Wet 0.2</u>	<u>Wet 0.3</u>
Ex. Wet Weather PS #1 (mgd)	23	23	23	23	23	23	23	23
Wet Weather PS #2 (mgd)	74	0	74	74	0	74	15	74
Lagoon (mgal)	10	10	10	10	10	10	10	10
Auxiliary Treatment Facility (mgd)	74	-	-	74	-	74	-	-
THC Storage (mgal)	-	-	32	-	-	-	6	32
Storage Return PS (mgd)	-	-	19	-	-	-	6	19
KCMO Storage (mgal)	-	32	-	4	36	8	34	8

Figure A.1
Wet Weather Flow Treatment/Storage Alternatives

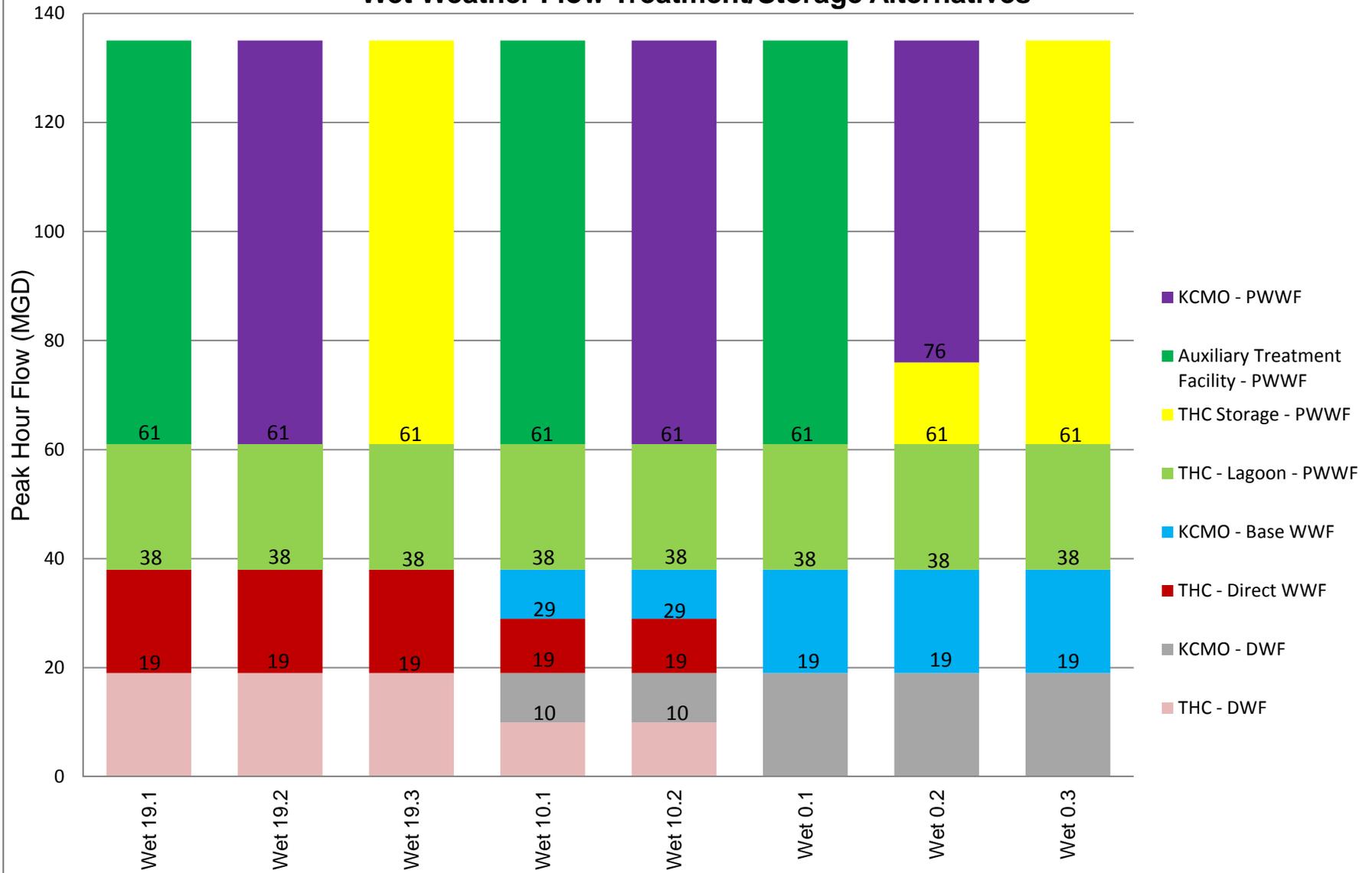


Table A.2 Total Annual Flow Volume Projections & Treatment Locations for Wet Weather Alternatives

Alternative	Wet 19.1	Wet 19.2	Wet 19.3	Wet 10.1	Wet 10.2	Wet 0.1	Wet 0.2	Wet 0.3
Total Annual Flow at 19.1 MGD Average (mgal)	6971.5	6971.5	6971.5	6971.5	6971.5	6971.5	6971.5	6971.5
THC DWF (<19 MGD Total Flow)	5658.1 (81.2%)	5658.1 (81.2%)	5658.1 (81.2%)	3434.9 (49.3%)	3434.9 (49.3%)	-	-	-
THC WWF Direct (<38 MGD Total Flow)	1039.5 (14.9%)	1039.5 (14.9%)	1039.5 (14.9%)	828.2 (11.9%)	828.2 (11.9%)	-	-	-
PWWF to THC Lagoon - to THC for Treatment	191.0 (2.7%)	191.0 (2.7%)	191.0 (2.7%)	-	-	-	-	-
PWWF to THC Lagoon - to KCMO for Treatment	-	-	-	191.0 (2.7%)	191.0 (2.7%)	191.0 (2.7%)	191.0 (2.7%)	191.0 (2.7%)
PWWF to THC Storage - to THC for Treatment	-	-	83.0 (1.2%)	-	-	-	-	-
PWWF to THC Storage - to KCMO for Treatment	-	-	-	-	36.3 (0.5%)	-	66.9 (1%)	83.0 (1.2%)
Auxiliary Treatment Facility	83.0 (1.2%)	-	-	83.0 (1.2%)	-	83.0 (1.2%)	-	-
KCMO DWF (<19 MGD Total Flow)	-	-	-	2223.2 (31.9%)	2223.2 (31.9%)	5658.1 (81.2%)	5658.1 (81.2%)	5658.1 (81.2%)
KCMO Base WWF (<38 MGD Total Flow)	-	-	-	211.9 (3.0%)	211.9 (3.0%)	1039.5 (14.9%)	1039.5 (14.9%)	1039.5 (14.9%)
KCMO PWWF	-	83.0 (1.2%)	-	-	46.7 (0.7%)	-	16.0 (0.2%)	-
Total DWF Volume Treated at THC	5658.1 (81.2%)	5658.1 (81.2%)	5658.1 (81.2%)	3434.9 (49.3%)	3434.9 (49.3%)	-	-	-
Total WWF Volume Treated at THC	1230.5 (17.6%)	1230.5 (17.6%)	1313.4 (18.8%)	828.2 (11.9%)	828.2 (11.9%)	-	-	-
Total Flow Volume Treated at THC	6888.6 (98.8%)	6888.6 (98.8%)	6971.5 (100%)	4263.1 (61.1%)	4263.1 (61.1%)	-	-	-
Total DWF Volume Treated at KCMO	-	-	-	2223.2 (31.9%)	2223.2 (31.9%)	5658.1 (81.2%)	5658.1 (81.2%)	5658.1 (81.2%)
Total WWF Volume Treated at KCMO	-	83.0 (1.2%)	-	402.9 (5.8%)	485.9 (7.0%)	1230.5 (17.6%)	1313.4 (18.8%)	1313.4 (18.8%)
Total Flow Volume Treated at KCMO	-	83.0 (1.2%)	-	2626.1 (37.7%)	2709.1 (38.9%)	6888.6 (98.8%)	6971.5 (100%)	6971.5 (100%)

Notes:

Color coding corresponds to Figure A.1, Wet Weather Flow Treatment/Storage Alternatives

DWF = Dry Weather Flow

WWF = Wet Weather Flow

PWWF = Peak Wet Weather Flow

Table A.3 April 2008-July 2010 Wet Weather Flow Distribution Summary

Year	Total Flow Volume (MG)	Total Volume Below 10 MGD (MG)	Total Volume Above 10 MGD (MG)	Total Volume between 10-19 MGD (MG)	Total Volume Below 19 MGD (MG)	Total Volume Above 19 MGD (MG)	Total Volume between 19-38 MGD (MG)	Total Volume between 19-29 MGD (MG)	Total Volume Above 29 MGD (MG)	Total Volume between 29-38 MGD (MG)	Total Volume Above 38 MGD (MG)	Total Volume between 38-61 MGD (MG)	Total Volume Above 61 MGD (MG)	Total Volume between 61-73 MGD (MG)	Total Volume Above 73 MGD (MG)	Total Volume between 73-93 MGD (MG)	Total Volume Above 93 MGD (MG)
28 Month Total	16,440.8	8,099.8	8,341.1	5,243.0	13,342.7	3,098.1	2,452.1	1,952.6	1,145.6	499.6	646.0	449.9	196.1	85.9	110.2	73.0	37.3
Monthly Average	587.2	289.3	297.9	187.2	476.5	110.6	87.6	69.7	40.9	17.8	23.1	16.1	7.0	3.1	3.9	2.6	1.3
Annual Avg.	7,046.1	3,471.3	3,574.8	2,247.0	5,718.3	1,327.8	1,050.9	836.8	491.0	214.1	276.9	192.8	84.1	36.8	47.2	31.3	16.0
% of Annual Flow	100.00%	49.27%	50.73%	31.89%	81.16%	18.84%	14.91%	11.88%	6.97%	3.04%	3.93%	2.74%	1.19%	0.52%	0.67%	0.44%	0.23%

Appendix B
CPES Output, Cost Estimates for CPES
Bullet Items, and Economic Analysis Results

Alternative Wet 19.1

CH2M HILL Parametric Cost Estimating System (CPES)

FACILITIES DESIGN & CONSTRUCTION COST MODULE

Project Name:	<u>Tomahawk WWTF - 2011 Update</u>
Project Number:	<u>382059.04</u>
Project Manager:	<u>Dale Gabel</u>
Estimator:	<u>E. Johnson</u>
Project Description:	<u>Wet Weather Alternative 19.1</u>
Project Location (City):	<u>Kansas City</u>
Project Location (State):	<u>KANSAS</u>
Project Location (Country):	<u>USA</u>
Construction Start (Month):	<u>Jan</u>
Construction Start (Year):	<u>2018</u>
Construction Duration (months):	<u>24</u>
Mid-Point of Construction:	<u>Jan/2019</u>

SCOPE OF PROJECT	Year 0 COST
Liquid Chemical: Ferric	\$535,481
Wet Weather Pump Station #2	\$3,741,727
WW Actiflo: Auxillary Treatment Facility	\$9,411,918
Oxidant Contactor: Chlor_Dechlor	\$1,503,340
Liquid Chemical: Bisulfite	\$259,238
Liquid Chemical: Defoaming	\$257,109
Liquid Chemical: Hypochlor	\$893,459
Screening for Wet Weather Pump Station #2	\$1,376,267
Ex. Wet Weather Pump Station #1	\$150,000
<hr/>	
SUBTOTAL - PROJECT COST	\$18,128,539
<hr/>	
ADDITIONAL PROJECT COSTS:	
Demolition	0% \$0
Overall Sitework	10% \$1,812,854
Plant Computer System	9% \$1,540,926
Yard Electrical	6% \$1,051,456
Yard Piping	10% \$1,812,854
THC Lagoon Storage (10 MG)	\$1,385,000
UD #2 Default Description	\$0
<hr/>	
SUBTOTAL with Additional Project Costs	\$25,731,629
<hr/>	
CONTRACTOR MARKUPS:	
Overhead	10% \$2,574,000
<i>Subtotal</i>	<i>\$28,305,629</i>
Profit	5% \$1,416,000
<i>Subtotal</i>	<i>\$29,721,629</i>
Mob/Bonds/Insurance	5% \$1,487,000
<i>Subtotal</i>	<i>\$31,208,629</i>
Contingency	30% \$9,363,000
<hr/>	
SUBTOTAL with Markups	\$40,572,000
<hr/>	
TOTAL - CONSTRUCTION COST	\$40,572,000
<hr/>	
NON-CONSTRUCTION COSTS:	
Engineering/Admin	25% \$10,143,000
<hr/>	
SUBTOTAL - Non-Construction Costs	\$50,715,000
<hr/>	
TOTAL - CAPITAL COST	\$50,715,000

**CPES Additional Project Cost
Alternative Wet 19.1 - Wet Weather Storage/Pumping
WWTP Percentage Allowance Calculator**

1.) Overall Sitework

Suggested percentage range for "Rehab" Project: 5 to 10%
Suggested percentage range for "Greenfield" Project: 12 to 20%

Rehab or Greenfield Project?	Rehab
Complexity of Tie-In's to Existing Plant?	Medium
Rock Excavation?	Yes
Groundwater?	Yes
Overall Sitework	10.0

2.) Plant Computer System

Suggested percentage range: 7 to 10%

Level of Sophistication?	Average
Plant Computer System	8.5

3.) Yard Electrical

Suggested percentage range for Plant with Available Primary Power: 5 to 8%
Suggested percentage range for Plant without Available Primary Power: 10 to 25%

Is Primary Power Available to the Site?	Yes
Connected HP Size?	Average
Size of Secondary Distribution Voltage System?	Small
Yard Electrical	5.8

4.) Yard Piping

Suggested percentage range: 10 to 30%

What is the Relative Size of the Plant?	Small
Above Ground Piping?	No
Construction Cost per GPD	No
Annual O & M Cost per 1,000 Gallons	10.0

JCW Tomahawk WWTP Pre-Design Study

Table B.1. - CPES Bullet Items

Status	Scope	Year	Cost (2011 \$'s)
<u>Alternative Wet 19.1</u>			
1	Common <u>Ex. Wet Weather Pump Station #1*</u> Storm Pumps 5-8 & Motors	Replace	2020 150,000
2	Varies	Wet Weather Pump Station #2	CPES
3	Varies	<u>10 MG Lagoon Storage*</u>	2020
		Sludge Removal	230,000
		Lagoon Liner and Underdrain	170,000
		Berm Removal & Grading	85,000
		Import Fill/Raise Berm	575,000
		RipRap	305,000
		Vegetation/Restoration	15,000
		Seeding	<u>5,000</u>
		Total	1,385,000
4	Varies	PEFTF	2020 CPES
5	Varies	THC Storage	-
6	Varies	Storage Return Pump Station	2020 CPES

* Does not include contractor markups, contingency, or engineering

CH2M HILL Parametric Cost Estimating System (CPES) FACILITIES LIFE CYCLE COST ANALYSIS

Project Name:	<u>Tomahawk WWTF - 2011 Update</u>
Project Number:	<u>382059.04</u>
Project Manager:	<u>Dale Gabel</u>
Estimator:	<u>E. Johnson</u>
Project Description:	<u>Wet Weather Alternative 19.1</u>
Project Location (City):	<u>Kansas City</u>
Project Location (State):	<u>KANSAS</u>
Project Location (Country):	<u>USA</u>
Construction Start (Month):	<u>Jan</u>
Construction Start (Year):	<u>2018</u>
Construction Duration (months):	<u>24</u>
Mid-Point of Construction:	<u>Jan/2019</u>

<i>SCOPE OF PROJECT</i>	<i>Year 0 Construction Cost</i>	<i>Annual O&M Cost (Escalated)</i>
Liquid Chemical: Ferric	\$1,054,769	\$79,843
Wet Weather Pump Station #2	\$7,370,311	\$34,838
WW Actiflo: Auxillary Treatment Facility	\$18,539,237	\$432,768
Oxidant Contactor: Chlor_Dechlor	\$2,961,221	\$716
Liquid Chemical: Bisulfite	\$510,637	\$11,056
Liquid Chemical: Defoaming	\$506,443	\$13,460
Liquid Chemical: Hypochlor	\$1,759,901	\$30,653
Screening for Wet Weather Pump Station #2	\$2,710,918	\$32,687
Ex. Wet Weather Pump Station #1	\$295,465	\$0

Additional Project Costs:

<i>Biosolids Disposal</i>	\$0	\$0
<i>Standard Items</i>	\$12,248,157	\$374,858
<i>User Defined Items (Lagoon Storage at THC)</i>	\$2,728,121	\$0

Plant O & M Labor (based on wage, influent BOD, and solids handling)		\$59,905
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TOTAL - Life Cycle Analysis	\$50,685,180	\$1,070,784
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JCW Tomahawk WWTP - Predesign Study Update Wet Weather Cost Analysis

Alternative 19.1

Project Element	Year Incurred or Initiated	Present Cost (2011 Dollars)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Capital Costs @ THC																							
Wet Weather	2019	\$50,720,000	\$58,500,755																				
O&M Costs @ THC																							
Wet Weather	2020	\$1,070,000		\$1,256,359	\$1,278,974	\$1,301,995	\$1,325,431	\$1,349,289	\$1,373,576	\$1,398,300	\$1,423,470	\$1,449,092	\$1,475,176	\$1,501,729	\$1,528,760	\$1,556,278	\$1,584,291	\$1,612,808	\$1,641,839	\$1,671,392	\$1,701,477	\$1,732,103	\$1,763,281

Wet Weather NPV Summary

Wet Weather Capital Cost	\$43,076,171
Wet Weather O&M @ THC	\$14,769,511
Total NPV at THC, Wet Weather	\$57,845,682

Economic Analysis Criteria:

Nominal Discount Rate	3.90%
Net Discount Rate	2.10%
Inflation	1.80%

Alternative Wet 19.2

C H2M HILL **P** arametric Cost **E** stimating **S** ystem (CPES) **FACILITIES DESIGN & CONSTRUCTION COST MODULE**

Project Name:	<u>Tomahawk WWTF - 2011 Update</u>
Project Number:	<u>382059.04</u>
Project Manager:	<u>Dale Gabel</u>
Estimator:	<u>E. Johnson</u>
Project Description:	<u>Wet Weather Alternative 19.2</u>
Project Location (City):	<u>Kansas City</u>
Project Location (State):	<u>KANSAS</u>
Project Location (Country):	<u>USA</u>
Construction Start (Month):	<u>Jan</u>
Construction Start (Year):	<u>2018</u>
Construction Duration (months):	<u>24</u>
Mid-Point of Construction:	<u>Jan/2019</u>

SCOPE OF PROJECT	Year 0 COST
Flow to KCMO	\$0
Ex. Wet Weather Pump Station #1	\$150,000

SUBTOTAL - PROJECT COST **\$150,000**

ADDITIONAL PROJECT COSTS:

Demolition	0%	\$0
Overall Sitework	8%	\$12,000
Plant Computer System	9%	\$13,000
Yard Electrical	6%	\$9,000
Yard Piping	5%	\$8,000
THC Lagoon Storage (10 MG)		\$1,385,000
UD #2		\$0

SUBTOTAL with Additional Project Costs **\$1,577,000**

CONTRACTOR MARKUPS:

Overhead	10%	\$158,000
<i>Subtotal</i>		\$1,735,000
Profit	5%	\$87,000
<i>Subtotal</i>		\$1,822,000
Mob/Bonds/Insurance	5%	\$92,000
<i>Subtotal</i>		\$1,914,000
Contingency	30%	\$575,000

SUBTOTAL with Markups **\$2,489,000**

TOTAL - CONSTRUCTION COST **\$2,489,000**

NON-CONSTRUCTION COSTS:

Engineering/Admin	25%	\$622,000
SUBTOTAL - Non-Construction Costs		\$3,111,000

TOTAL - CAPITAL COST **\$3,111,000**

**CPES Additional Project Cost
Alternative Wet 19.2 - Wet Weather Storage/Pumping
WWTP Percentage Allowance Calculator**

1.) Overall Sitework

Suggested percentage range for "Rehab" Project: 5 to 10%
Suggested percentage range for "Greenfield" Project: 12 to 20%

Rehab or Greenfield Project?	Rehab
Complexity of Tie-In's to Existing Plant?	Low
Rock Excavation?	Yes
Groundwater?	Yes
Overall Sitework	8.0

2.) Plant Computer System

Suggested percentage range: 7 to 10%

Level of Sophistication?	Average
Plant Computer System	8.5

3.) Yard Electrical

Suggested percentage range for Plant with Available Primary Power: 5 to 8%
Suggested percentage range for Plant without Available Primary Power: 10 to 25%

Is Primary Power Available to the Site?	Yes
Connected HP Size?	Average
Size of Secondary Distribution Voltage System?	Small
Yard Electrical	5.8

4.) Yard Piping

Suggested percentage range: 10 to 30%

What is the Relative Size of the Plant?	Small
Above Ground Piping?	No
Construction Cost per GPD	No
Annual O & M Cost per 1,000 Gallons	5.0

JCW Tomahawk WWTP Pre-Design Study

Table B.1. - CPES Bullet Items

Status	Scope	Year	Cost (2011 \$'s)
<u>Alternative Wet 19.2</u>			
1 Common	<u>Ex. Wet Weather Pump Station #1*</u> Storm Pumps 5-8 & Motors	Replace	2020 150,000
2 Varies	Wet Weather Pump Station #2		-
3 Varies	<u>10 MG Lagoon Storage*</u> Sludge Removal Lagoon Liner and Underdrain Berm Removal & Grading Import Fill/Raise Berm RipRap Vegetation/Restoration Seeding		2020 230,000 170,000 85,000 575,000 305,000 15,000 <u>5,000</u>
	Total		1,385,000
4 Varies	PEFTF		-
5 Varies	THC Storage		-
6 Varies	Storage Return Pump Station		-

* Does not include contractor markups, contingency, or engineering

CH2M HILL Parametric Cost Estimating System (CPES) FACILITIES LIFE CYCLE COST ANALYSIS

Project Name:	<u>Tomahawk WWTF - 2011 Update</u>
Project Number:	<u>382059.04</u>
Project Manager:	<u>Dale Gabel</u>
Estimator:	<u>E. Johnson</u>
Project Description:	<u>Wet Weather Alternative 19.2</u>
Project Location (City):	<u>Kansas City</u>
Project Location (State):	<u>KANSAS</u>
Project Location (Country):	<u>USA</u>
Construction Start (Month):	<u>Jan</u>
Construction Start (Year):	<u>2018</u>
Construction Duration (months):	<u>24</u>
Mid-Point of Construction:	<u>Jan/2019</u>

<i>SCOPE OF PROJECT</i>	<i>Year 0 Construction Cost</i>	<i>Annual O&M Cost (Escalated)</i>
Ex. Wet Weather Pump Station #1	\$295,465	\$0

Additional Project Costs:

<i>Biosolids Disposal</i>	\$0	\$0
<i>Standard Items</i>	\$82,770	\$2,464
<i>User Defined Items (Lagoon Storage at THC)</i>	\$2,729,445	\$0

<i>Plant O & M Labor</i> (based on wage, influent BOD, and solids handling)		\$59,905
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<i>TOTAL - Life Cycle Analysis</i>	\$3,107,681	\$62,369
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JCW Tomahawk WWTP - Predesign Study Update Wet Weather Cost Analysis

Alternative 19.2

Project Element	Year Incurred or Initiated	Present Cost (2011 Dollars)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Capital Costs @ THC																							
Wet Weather	2019	\$3,110,000	\$3,587,093																				
O&M Costs @ THC																							
Wet Weather	2020	\$70,000		\$82,192	\$83,671	\$85,177	\$86,710	\$88,271	\$89,860	\$91,478	\$93,124	\$94,800	\$96,507	\$98,244	\$100,012	\$101,813	\$103,645	\$105,511	\$107,410	\$109,343	\$111,312	\$113,315	\$115,355

Wet Weather NPV Summary

Wet Weather Capital Cost	\$2,641,303
Wet Weather O&M @ THC	\$966,230
Total NPV at THC, Wet Weather	\$3,607,533

Economic Analysis Criteria:

Nominal Discount Rate	3.90%
Net Discount Rate	2.10%
Inflation	1.80%

Alternative Wet 19.3

C H2M HILL **P**arametric Cost **E**stimating **S**ystem (CPES) **FACILITIES DESIGN & CONSTRUCTION COST MODULE**

Project Name:	<u>Tomahawk WWTF - 2011 Update</u>
Project Number:	<u>382059.04</u>
Project Manager:	<u>Dale Gabel</u>
Estimator:	<u>E. Johnson</u>
Project Description:	<u>Wet Weather Alternative 19.3</u>
Project Location (City):	<u>Kansas City</u>
Project Location (State):	<u>KANSAS</u>
Project Location (Country):	<u>USA</u>
Construction Start (Month):	<u>Jan</u>
Construction Start (Year):	<u>2018</u>
Construction Duration (months):	<u>24</u>
Mid-Point of Construction:	<u>Jan/2019</u>

SCOPE OF PROJECT	Year 0 COST
Wet Weather Pump Station #2	\$3,741,727
Screening for Wet Weather Pump Station #2	\$1,376,267
Ex. Wet Weather Pump Station #1	\$150,000
Storage Return Pump Station	\$1,566,427
<hr/>	
SUBTOTAL - PROJECT COST	\$6,834,421

ADDITIONAL PROJECT COSTS:		
Demolition	0%	\$0
Overall Sitework	15%	\$1,025,164
Plant Computer System	9%	\$580,926
Yard Electrical	6%	\$396,397
Yard Piping	10%	\$683,443
THC Lagoon Storage (10 MG)		\$1,385,000
THC Added Storage (32 MG) ¹		\$49,195,000
<hr/>		
SUBTOTAL with Additional Project Costs		\$60,100,351

CONTRACTOR MARKUPS:		
Overhead	10%	\$6,011,000
<i>Subtotal</i>		<i>\$66,111,351</i>
Profit	5%	\$3,306,000
<i>Subtotal</i>		<i>\$69,417,351</i>
Mob/Bonds/Insurance	5%	\$3,471,000
<i>Subtotal</i>		<i>\$72,888,351</i>
Contingency	30%	\$21,867,000
<hr/>		
SUBTOTAL with Markups		\$94,756,000

TOTAL - CONSTRUCTION COST	\$94,756,000
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NON-CONSTRUCTION COSTS:		
Engineering/Admin	25%	\$23,689,000
<hr/>		
SUBTOTAL - Non-Construction Costs		\$118,445,000

TOTAL - CAPITAL COST	\$118,445,000
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¹ cost includes forcemain to storage and return forcemain from storage. See Appendix B, Table B.1, for details of cost basis.

**CPES Additional Project Cost
Alternative Wet 19.3 - Wet Weather Storage/Pumping
WWTP Percentage Allowance Calculator**

1.) Overall Sitework

Suggested percentage range for "Rehab" Project: 5 to 10%
Suggested percentage range for "Greenfield" Project: 12 to 20%

Rehab or Greenfield Project?	Greenfield
Size of Site?	Medium
Rock Excavation?	Yes
Groundwater?	Yes
Overall Sitework	15.0

2.) Plant Computer System

Suggested percentage range: 7 to 10%

Level of Sophistication?	Average
Plant Computer System	8.5

3.) Yard Electrical

Suggested percentage range for Plant with Available Primary Power: 5 to 8%
Suggested percentage range for Plant without Available Primary Power: 10 to 25%

Is Primary Power Available to the Site?	Yes
Connected HP Size?	Average
Size of Secondary Distribution Voltage System?	Small
Yard Electrical	5.8

4.) Yard Piping

Suggested percentage range: 10 to 30%

What is the Relative Size of the Plant?	Small
Above Ground Piping?	No
Construction Cost per GPD	No
Annual O & M Cost per 1,000 Gallons	10.0

JCW Tomahawk WWTP Pre-Design Study

Table B.1. - CPES Bullet Items

Status	Scope	Year	Cost (2011 \$'s)
<u>Alternative Wet 19.3</u>			
1	Common	<u>Ex. Wet Weather Pump Station #1*</u>	
	Storm Pumps 5-8 & Motors	Replace	2020 150,000
2	Varies	Wet Weather Pump Station #2 CPES	
3	Varies	<u>10 MG Lagoon Storage*</u> 2020	
	Sludge Removal		230,000
	Lagoon Liner and Underdrain		170,000
	Berm Removal & Grading		85,000
	Import Fill/Raise Berm		575,000
	RipRap		305,000
	Vegetation/Restoration		15,000
	Seeding		<u>5,000</u>
	Total		1,385,000
4	Varies	PEFTF -	
5	Varies	<u>32 MG Shallow Underground Storage</u> 2020	
	Underground Storage Facility**		48,700,000
	Forcemain to Storage		290,000
	Return Forcemain		<u>205,000</u>
	Total		49,195,000
6	Varies	Storage Return Pump Station 2020 CPES	

* Does not include contractor markups, contingency, or engineering

** \$1.52/gallon = \$48,700,000 without contractor markups, contingency, or engineering/admin

\$2.40/gallon = \$76,800,000 with contractor markups and contingency

\$3.00/gallon = \$96,000,000 with contractor markups, contingency, and engineering/admin

CH2M HILL Parametric Cost Estimating System (CPES) FACILITIES LIFE CYCLE COST ANALYSIS

Project Name:	<u>Tomahawk WWTF - 2011 Update</u>
Project Number:	<u>382059.04</u>
Project Manager:	<u>Dale Gabel</u>
Estimator:	<u>E. Johnson</u>
Project Description:	<u>Wet Weather Alternative 19.3</u>
Project Location (City):	<u>Kansas City</u>
Project Location (State):	<u>KANSAS</u>
Project Location (Country):	<u>USA</u>
Construction Start (Month):	<u>Jan</u>
Construction Start (Year):	<u>2018</u>
Construction Duration (months):	<u>24</u>
Mid-Point of Construction:	<u>Jan/2019</u>

<i>SCOPE OF PROJECT</i>	Year 0 Construction Cost	Annual O&M Cost (Escalated)
Wet Weather Pump Station #2	\$7,370,311	\$34,838
Screening for Wet Weather Pump Station #2	\$2,710,918	\$32,687
Ex. Wet Weather Pump Station #1	\$295,465	\$0
Storage Return Pump Station	\$3,085,488	\$17,376

Additional Project Costs:

<i>Biosolids Disposal</i>	\$0	\$0
<i>Standard Items</i>	\$5,290,643	\$141,321
<i>User Defined Items (Total Storage at THC)</i>	\$99,630,555	\$100,000

<i>Plant O & M Labor</i> (based on wage, influent BOD, and solids handling)	\$59,905
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TOTAL - Life Cycle Analysis	\$118,383,380	\$386,127
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JCW Tomahawk WWTP - Predesign Study Update Wet Weather Cost Analysis

Alternative 19.3

Project Element	Year Incurred or Initiated	Present Cost (2011 Dollars)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Capital Costs @ THC																							
Wet Weather	2019	\$118,450,000	\$136,620,946																				
O&M Costs @ THC																							
Wet Weather	2020	\$390,000		\$457,925	\$466,168	\$474,559	\$483,101	\$491,797	\$500,649	\$509,661	\$518,835	\$528,174	\$537,681	\$547,359	\$557,212	\$567,241	\$577,452	\$587,846	\$598,427	\$609,199	\$620,164	\$631,327	\$642,691

Wet Weather NPV Summary

Wet Weather Capital Cost	\$100,598,825
Wet Weather O&M @ THC	\$5,383,280
Total NPV at THC, Wet Weather	\$105,982,105

Economic Analysis Criteria:

Nominal Discount Rate	3.90%
Net Discount Rate	2.10%
Inflation	1.80%

Alternative Wet 10.1

CH2M HILL Parametric Cost Estimating System (CPES)

FACILITIES DESIGN & CONSTRUCTION COST MODULE

Project Name:	<u>Tomahawk WWTF - 2011 Update</u>
Project Number:	<u>382059.04</u>
Project Manager:	<u>Dale Gabel</u>
Estimator:	<u>E. Johnson</u>
Project Description:	<u>Wet Weather Alternative 10.1</u>
Project Location (City):	<u>Kansas City</u>
Project Location (State):	<u>KANSAS</u>
Project Location (Country):	<u>USA</u>
Construction Start (Month):	<u>Jan</u>
Construction Start (Year):	<u>2018</u>
Construction Duration (months):	<u>24</u>
Mid-Point of Construction:	<u>Jan/2019</u>

SCOPE OF PROJECT	COST
Liquid Chemical: Ferric	\$535,481
Wet Weather Pump Station #2	\$3,741,727
WW Actiflo: Auxillary Treatment Facility	\$9,411,918
Oxidant Contactor: Chlor_Dechlor	\$1,503,340
Liquid Chemical: Bisulfite	\$259,238
Liquid Chemical: Defoaming	\$257,109
Liquid Chemical: Hypochlor	\$893,459
Screening for Wet Weather Pump Station #2	\$1,376,267
Ex. Wet Weather Pump Station #1	\$150,000
Flow to KCMO	\$0
<u>SUBTOTAL - PROJECT COST</u>	<u>\$18,128,539</u>
ADDITIONAL PROJECT COSTS:	
Demolition	0% \$0
Overall Sitework	10% \$1,812,854
Plant Computer System	9% \$1,540,926
Yard Electrical	6% \$1,051,456
Yard Piping	10% \$1,812,854
THC Lagoon Storage (10 MG)	\$1,385,000
UD #2 Default Description	
<u>SUBTOTAL with Additional Project Costs</u>	<u>\$25,731,629</u>
CONTRACTOR MARKUPS:	
Overhead	10% \$2,574,000
<i>Subtotal</i>	<i>\$28,305,629</i>
Profit	5% \$1,416,000
<i>Subtotal</i>	<i>\$29,721,629</i>
Mob/Bonds/Insurance	5% \$1,487,000
<i>Subtotal</i>	<i>\$31,208,629</i>
Contingency	30% \$9,363,000
<u>SUBTOTAL with Markups</u>	<u>\$40,572,000</u>
<u>TOTAL - CONSTRUCTION COST</u>	<u>\$40,572,000</u>
NON-CONSTRUCTION COSTS:	
Engineering/Admin	25% \$10,143,000
<u>SUBTOTAL - Non-Construction Costs</u>	<u>\$50,715,000</u>
<u>TOTAL - CAPITAL COST</u>	<u>\$50,715,000</u>

**CPES Additional Project Cost
Alternative Wet 10.1 - Wet Weather Storage/Pumping
WWTP Percentage Allowance Calculator**

1.) Overall Sitework

Suggested percentage range for "Rehab" Project: **5 to 10%**
Suggested percentage range for "Greenfield" Project: **12 to 20%**

Rehab or Greenfield Project?	Rehab
Complexity of Tie-In's to Existing Plant?	Medium
Rock Excavation?	Yes
Groundwater?	Yes
Overall Sitework	10.0

2.) Plant Computer System

Suggested percentage range: **7 to 10%**

Level of Sophistication?	Average
Plant Computer System	8.5

3.) Yard Electrical

Suggested percentage range for Plant with Available Primary Power: **5 to 8%**
Suggested percentage range for Plant without Available Primary Power: **10 to 25%**

Is Primary Power Available to the Site?	Yes
Connected HP Size?	Average
Size of Secondary Distribution Voltage System?	Small
Yard Electrical	5.8

4.) Yard Piping

Suggested percentage range: **10 to 30%**

What is the Relative Size of the Plant?	Small
Above Ground Piping?	No
Construction Cost per GPD	No
Annual O & M Cost per 1,000 Gallons	10.0

JCW Tomahawk WWTP Pre-Design Study

Table B.1. - CPES Bullet Items

Status	Scope	Year	Cost (2011 \$'s)
<u>Alternative Wet 10.1</u>			
1	Common <u>Ex. Wet Weather Pump Station #1*</u> Storm Pumps 5-8 & Motors	Replace	2020 150,000
2	Varies	Wet Weather Pump Station #2	CPES
3	Varies	<u>10 MG Lagoon Storage*</u>	2020
		Sludge Removal	230,000
		Lagoon Liner and Underdrain	170,000
		Berm Removal & Grading	85,000
		Import Fill/Raise Berm	575,000
		RipRap	305,000
		Vegetation/Restoration	15,000
		Seeding	<u>5,000</u>
		Total	1,385,000
4	Varies	PEFTF	2020 CPES
5	Varies	THC Storage	-
6	Varies	Storage Return Pump Station	-

* Does not include contractor markups, contingency, or engineering

CH2M HILL Parametric Cost Estimating System (CPES) FACILITIES LIFE CYCLE COST ANALYSIS

Project Name:	<u>Tomahawk WWTF - 2011 Update</u>
Project Number:	<u>382059.04</u>
Project Manager:	<u>Dale Gabel</u>
Estimator:	<u>E. Johnson</u>
Project Description:	<u>Wet Weather Alternative 10.1</u>
Project Location (City):	<u>Kansas City</u>
Project Location (State):	<u>KANSAS</u>
Project Location (Country):	<u>USA</u>
Construction Start (Month):	<u>Jan</u>
Construction Start (Year):	<u>2018</u>
Construction Duration (months):	<u>24</u>
Mid-Point of Construction:	<u>Jan/2019</u>

<i>SCOPE OF PROJECT</i>	<i>Year 0 Construction Cost</i>	<i>Annual O&M Cost (Escalated)</i>
Liquid Chemical: Ferric	\$1,054,769	\$79,843
Wet Weather Pump Station #2	\$7,370,311	\$34,922
WW Actiflo: Auxillary Treatment Facility	\$18,539,237	\$432,823
Oxidant Contactor: Chlor_Dechlor	\$2,961,221	\$716
Liquid Chemical: Bisulfite	\$510,637	\$11,056
Liquid Chemical: Defoaming	\$506,443	\$13,460
Liquid Chemical: Hypochlor	\$1,759,901	\$30,653
Screening for Wet Weather Pump Station #2	\$2,710,918	\$32,690
Ex. Wet Weather Pump Station #1	\$295,465	\$0

Additional Project Costs:

<i>Biosolids Disposal</i>	\$0	\$0
<i>Standard Items</i>	\$12,248,157	\$374,858
<i>User Defined Items (Lagoon Storage at THC)</i>	\$2,728,121	\$0

Plant O & M Labor (based on wage, influent BOD, and solids handling)	\$59,905
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TOTAL - Life Cycle Analysis	\$50,685,180	\$1,070,926
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JCW Tomahawk WWTP - Predesign Study Update Wet Weather Cost Analysis

Alternative 10.1

Project Element	Year Incurred or Initiated	Present Cost (2011 Dollars)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Capital Costs @ THC																							
Wet Weather	2019	\$50,720,000	\$58,500,755																				
O&M Costs @ THC																							
Wet Weather	2020	\$1,070,000		\$1,256,359	\$1,278,974	\$1,301,995	\$1,325,431	\$1,349,289	\$1,373,576	\$1,398,300	\$1,423,470	\$1,449,092	\$1,475,176	\$1,501,729	\$1,528,760	\$1,556,278	\$1,584,291	\$1,612,808	\$1,641,839	\$1,671,392	\$1,701,477	\$1,732,103	\$1,763,281

Wet Weather NPV Summary

Wet Weather Capital Cost	\$43,076,171
Wet Weather O&M @ THC	\$14,769,511
Total NPV at THC, Wet Weather	\$57,845,682

Economic Analysis Criteria:

Nominal Discount Rate	3.90%
Net Discount Rate	2.10%
Inflation	1.80%

Alternative Wet 10.2

CH2M HILL Parametric Cost Estimating System (CPES) FACILITIES DESIGN & CONSTRUCTION COST MODULE

Project Name:	<u>Tomahawk WWTF - 2011 Update</u>
Project Number:	<u>382059.04</u>
Project Manager:	<u>Dale Gabel</u>
Estimator:	<u>E. Johnson</u>
Project Description:	<u>Wet Weather Alternative 10.2</u>
Project Location (City):	<u>Kansas City</u>
Project Location (State):	<u>KANSAS</u>
Project Location (Country):	<u>USA</u>
Construction Start (Month):	<u>Jan</u>
Construction Start (Year):	<u>2018</u>
Construction Duration (months):	<u>24</u>
Mid-Point of Construction:	<u>Jan/2019</u>

SCOPE OF PROJECT	COST
Wet Weather Pump Station #2	\$0
Screening for Wet Weather Pump Station #2	\$0
Ex. Wet Weather Pump Station #1	\$150,000
Flow to KCMO	\$0
Storage Return Pump Station	\$0

SUBTOTAL - PROJECT COST	\$150,000
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ADDITIONAL PROJECT COSTS:		
Demolition	0%	\$0
Overall Sitework	8%	\$12,000
Plant Computer System	9%	\$13,000
Yard Electrical	6%	\$9,000
Yard Piping	5%	\$8,000
THC Lagoon Storage (10 MG)		\$1,385,000

SUBTOTAL with Additional Project Costs	\$1,577,000
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CONTRACTOR MARKUPS:		
Overhead	10%	\$158,000
<i>Subtotal</i>		\$1,735,000
Profit	5%	\$87,000
<i>Subtotal</i>		\$1,822,000
Mob/Bonds/Insurance	5%	\$92,000
<i>Subtotal</i>		\$1,914,000
Contingency	30%	\$575,000
SUBTOTAL with Markups		\$2,489,000

TOTAL - CONSTRUCTION COST	\$2,489,000
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NON-CONSTRUCTION COSTS:		
Engineering/Admin	25%	\$622,000
SUBTOTAL - Non-Construction Costs		\$3,111,000

TOTAL - CAPITAL COST	\$3,111,000
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**CPES Additional Project Cost
Alternative Wet 10.2 - Wet Weather Storage/Pumping
WWTP Percentage Allowance Calculator**

1.) Overall Sitework

Suggested percentage range for "Rehab" Project: 5 to 10%
Suggested percentage range for "Greenfield" Project: 12 to 20%

Rehab or Greenfield Project?	Rehab
Complexity of Tie-In's to Existing Plant?	Low
Rock Excavation?	Yes
Groundwater?	Yes
Overall Sitework	8.0

2.) Plant Computer System

Suggested percentage range: 7 to 10%

Level of Sophistication?	Average
Plant Computer System	8.5

3.) Yard Electrical

Suggested percentage range for Plant with Available Primary Power: 5 to 8%
Suggested percentage range for Plant without Available Primary Power: 10 to 25%

Is Primary Power Available to the Site?	Yes
Connected HP Size?	Average
Size of Secondary Distribution Voltage System?	Small
Yard Electrical	5.8

4.) Yard Piping

Suggested percentage range: 10 to 30%

What is the Relative Size of the Plant?	Small
Above Ground Piping?	No
Construction Cost per GPD	No
Annual O & M Cost per 1,000 Gallons	5.0

JCW Tomahawk WWTP Pre-Design Study

Table B.1. - CPES Bullet Items

Status	Scope	Year	Cost (2011 \$'s)
<u>Alternative Wet 10.2</u>			
1	Common	<u>Ex. Wet Weather Pump Station #1*</u>	
	Storm Pumps 5-8 & Motors	Replace	2020 150,000
2	Varies	Wet Weather Pump Station #2	2020 CPES
3	Varies	<u>10 MG Lagoon Storage*</u>	
	Sludge Removal		230,000
	Lagoon Liner and Underdrain		170,000
	Berm Removal & Grading		85,000
	Import Fill/Raise Berm		575,000
	RipRap		305,000
	Vegetation/Restoration		15,000
	Seeding		<u>5,000</u>
		Total	1,385,000
4	Varies	PEFTF	-
5	Varies	THC Storage	Lagoon
6	Varies	Storage Return Pump Station	2020 CPES

* Does not include contractor markups, contingency, or engineering

CH2M HILL Parametric Cost Estimating System (CPES) FACILITIES LIFE CYCLE COST ANALYSIS

Project Name:	<u>Tomahawk WWTF - 2011 Update</u>
Project Number:	<u>382059.04</u>
Project Manager:	<u>Dale Gabel</u>
Estimator:	<u>E. Johnson</u>
Project Description:	<u>Wet Weather Alternative 10.2</u>
Project Location (City):	<u>Kansas City</u>
Project Location (State):	<u>KANSAS</u>
Project Location (Country):	<u>USA</u>
Construction Start (Month):	<u>Jan</u>
Construction Start (Year):	<u>2018</u>
Construction Duration (months):	<u>24</u>
Mid-Point of Construction:	<u>Jan/2019</u>

SCOPE OF PROJECT	Year 0 Construction Cost	Annual O&M Cost (Escalated)
Wet Weather Pump Station #2	\$0	\$0
Screening for Wet Weather Pump Station #2	\$0	\$0
Ex. Wet Weather Pump Station #1	\$295,465	\$0
Storage Return Pump Station	\$0	\$0

Additional Project Costs:		
Biosolids Disposal	\$0	\$0
Standard Items	\$82,770	\$2,464
User Defined Items (Lagoon Storage at THC)	\$2,729,445	\$0

Plant O & M Labor (based on wage, influent BOD, and solids handling)	\$59,905
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TOTAL - Life Cycle Analysis	\$3,107,681	\$62,369
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JCW Tomahawk WWTP - Predesign Study Update Wet Weather Cost Analysis

Alternative 10.2

Project Element	Year Incurred or Initiated	Present Cost (2011 Dollars)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Capital Costs @ THC																							
Wet Weather	2019	\$3,110,000	\$3,587,093																				
O&M Costs @ THC																							
Wet Weather	2020	\$70,000		\$82,192	\$83,671	\$85,177	\$86,710	\$88,271	\$89,860	\$91,478	\$93,124	\$94,800	\$96,507	\$98,244	\$100,012	\$101,813	\$103,645	\$105,511	\$107,410	\$109,343	\$111,312	\$113,315	\$115,355

Wet Weather NPV Summary

Wet Weather Capital Cost	\$2,641,303
Wet Weather O&M @ THC	\$966,230
Total NPV at THC, Wet Weather	\$3,607,533

Economic Analysis Criteria:

Nominal Discount Rate	3.90%
Net Discount Rate	2.10%
Inflation	1.80%

Alternative Wet 0.1

CH2M HILL Parametric Cost Estimating System (CPES)

FACILITIES DESIGN & CONSTRUCTION COST MODULE

Project Name:	<u>Tomahawk WWTF - 2011 Update</u>
Project Number:	<u>382059.04</u>
Project Manager:	<u>Dale Gabel</u>
Estimator:	<u>E. Johnson</u>
Project Description:	<u>Wet Weather Alternative 0.1</u>
Project Location (City):	<u>Kansas City</u>
Project Location (State):	<u>KANSAS</u>
Project Location (Country):	<u>USA</u>
Construction Start (Month):	<u>Jan</u>
Construction Start (Year):	<u>2018</u>
Construction Duration (months):	<u>24</u>
Mid-Point of Construction:	<u>Jan/2019</u>

SCOPE OF PROJECT	COST
Liquid Chemical: Ferric	\$535,481
Wet Weather Pump Station #2	\$3,741,727
Flow to KCMO	\$0
WW Actiflo: Auxillary Treatment Facility	\$9,411,918
Oxidant Contactor: Chlor_Dechlor	\$1,503,340
Liquid Chemical: Bisulfite	\$259,238
Liquid Chemical: Defoaming	\$257,109
Liquid Chemical: Hypochlor	\$893,459
Screening for Wet Weather Pump Station #2	\$1,376,267
Ex. Wet Weather Pump Station #1	\$150,000
<u>SUBTOTAL - PROJECT COST</u>	<u>\$18,128,539</u>
ADDITIONAL PROJECT COSTS:	
Demolition	0% \$0
Overall Sitework	10% \$1,812,854
Plant Computer System	9% \$1,540,926
Yard Electrical	6% \$1,051,456
Yard Piping	10% \$1,812,854
THC Lagoon Storage (10 MG)	\$1,385,000
UD #2 Default Description	
<u>SUBTOTAL with Additional Project Costs</u>	<u>\$25,731,629</u>
CONTRACTOR MARKUPS:	
Overhead	10% \$2,574,000
Subtotal	\$28,305,629
Profit	5% \$1,416,000
Subtotal	\$29,721,629
Mob/Bonds/Insurance	5% \$1,487,000
Subtotal	\$31,208,629
Contingency	30% \$9,363,000
<u>SUBTOTAL with Markups</u>	<u>\$40,572,000</u>
<u>TOTAL - CONSTRUCTION COST</u>	<u>\$40,572,000</u>
NON-CONSTRUCTION COSTS:	
Engineering/Admin	25% \$10,143,000
<u>SUBTOTAL - Non-Construction Costs</u>	<u>\$50,715,000</u>
<u>TOTAL - CAPITAL COST</u>	<u>\$50,715,000</u>

**CPES Additional Project Cost
Alternative Wet 0.1 - Wet Weather Storage/Pumping
WWTP Percentage Allowance Calculator**

1.) Overall Sitework

Suggested percentage range for "Rehab" Project: 5 to 10%
Suggested percentage range for "Greenfield" Project: 12 to 20%

Rehab or Greenfield Project?	Rehab
Complexity of Tie-In's to Existing Plant?	Medium
Rock Excavation?	Yes
Groundwater?	Yes
Overall Sitework	10.0

2.) Plant Computer System

Suggested percentage range: 7 to 10%

Level of Sophistication?	Average
Plant Computer System	8.5

3.) Yard Electrical

Suggested percentage range for Plant with Available Primary Power: 5 to 8%
Suggested percentage range for Plant without Available Primary Power: 10 to 25%

Is Primary Power Available to the Site?	Yes
Connected HP Size?	Average
Size of Secondary Distribution Voltage System?	Small
Yard Electrical	5.8

4.) Yard Piping

Suggested percentage range: 10 to 30%

What is the Relative Size of the Plant?	Medium
Above Ground Piping?	No
Construction Cost per GPD	No
Annual O & M Cost per 1,000 Gallons	10.0

JCW Tomahawk WWTP Pre-Design Study

Table B.1. - CPES Bullet Items

Status	Scope	Year	Cost (2011 \$'s)
<u>Alternative Wet 0.1</u>			
1	Common	<u>Ex. Wet Weather Pump Station #1*</u>	
	Storm Pumps 5-8 & Motors	Replace	2020 150,000
2	Varies	Wet Weather Pump Station #2 CPES	
3	Varies	<u>10 MG Lagoon Storage*</u> 2020	
	Sludge Removal		230,000
	Lagoon Liner and Underdrain		170,000
	Berm Removal & Grading		85,000
	Import Fill/Raise Berm		575,000
	RipRap		305,000
	Vegetation/Restoration		15,000
	Seeding		<u>5,000</u>
	Total		1,385,000
4	Varies	PEFTF	2020 CPES
5	Varies	THC Storage -	
6	Varies	Storage Return Pump Station -	

* Does not include contractor markups, contingency, or engineering

CH2M HILL Parametric Cost Estimating System (CPES)

FACILITIES LIFE CYCLE COST ANALYSIS

Project Name:	Tomahawk WWTF - 2011 Update
Project Number:	382059.04
Project Manager:	Dale Gabel
Estimator:	E. Johnson
Project Description:	Wet Weather Alternative 0.1
Project Location (City):	Kansas City
Project Location (State):	KANSAS
Project Location (Country):	USA
Construction Start (Month):	Jan
Construction Start (Year):	2018
Construction Duration (months):	24
Mid-Point of Construction:	Jan/2019

SCOPE OF PROJECT	Year 0 Construction Cost	Annual O&M Cost (Escalated)
Liquid Chemical: Ferric	\$1,054,769	\$79,845
Wet Weather Pump Station #2	\$7,370,311	\$35,314
WW Actiflo: Auxillary Treatment Facility	\$18,539,237	\$433,079
Oxidant Contactor: Chlor_Dechlor	\$2,961,221	\$716
Liquid Chemical: Bisulfite	\$510,637	\$11,058
Liquid Chemical: Defoaming	\$506,443	\$13,462
Liquid Chemical: Hypochlor	\$1,759,901	\$30,655
Screening for Wet Weather Pump Station #2	\$2,710,918	\$32,701
Ex. Wet Weather Pump Station #1	\$295,465	\$0

Additional Project Costs:

Biosolids Disposal	\$0	\$0
Standard Items	\$12,248,157	\$374,858
User Defined Items (Lagoon Storage at THC)	\$2,728,121	\$0

Plant O & M Labor (based on wage, influent BOD, and solids handling)		\$59,905
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TOTAL - Life Cycle Analysis (Construction only)	\$50,685,180	\$1,071,593
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JCW Tomahawk WWTP - Predesign Study Update Wet Weather Cost Analysis

Alternative 0.1

Project Element	Year Incurred or Initiated	Present Cost (2011 Dollars)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Capital Costs @ THC																							
Wet Weather	2019	\$50,720,000	\$58,500,755																				
O&M Costs @ THC																							
Wet Weather	2020	\$1,070,000		\$1,256,359	\$1,278,974	\$1,301,995	\$1,325,431	\$1,349,289	\$1,373,576	\$1,398,300	\$1,423,470	\$1,449,092	\$1,475,176	\$1,501,729	\$1,528,760	\$1,556,278	\$1,584,291	\$1,612,808	\$1,641,839	\$1,671,392	\$1,701,477	\$1,732,103	\$1,763,281

Wet Weather NPV Summary

Wet Weather Capital Cost	\$43,076,171
Wet Weather O&M @ THC	\$14,769,511
Total NPV at THC, Wet Weather	\$57,845,682

Economic Analysis Criteria:

Nominal Discount Rate	3.90%
Net Discount Rate	2.10%
Inflation	1.80%

Alternative Wet 0.2

C H2M HILL **P** arametric Cost **E** stimating **S** ystem (CPES) **FACILITIES DESIGN & CONSTRUCTION COST MODULE**

Project Name:	<u>Tomahawk WWTF - 2011 Update</u>
Project Number:	<u>382059.04</u>
Project Manager:	<u>Dale Gabel</u>
Estimator:	<u>E. Johnson</u>
Project Description:	<u>Wet Weather Alternative 0.2</u>
Project Location (City):	<u>Kansas City</u>
Project Location (State):	<u>KANSAS</u>
Project Location (Country):	<u>USA</u>
Construction Start (Month):	<u>Jan</u>
Construction Start (Year):	<u>2018</u>
Construction Duration (months):	<u>24</u>
Mid-Point of Construction:	<u>Jan/2019</u>

SCOPE OF PROJECT	COST
Wet Weather Pump Station #2	\$1,814,071
Flow to KCMO	\$0
Ex. Wet Weather Pump Station #1	\$150,000
Screening for Wet Weather Pump Station #2	\$945,029
Storage Return Pump Station	\$1,098,582
<hr/>	
SUBTOTAL - PROJECT COST	\$4,007,682
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ADDITIONAL PROJECT COSTS:	
Demolition	0% \$0
Overall Sitework	8% \$320,615
Plant Computer System	9% \$340,653
Yard Electrical	6% \$232,446
Yard Piping	5% \$200,385
THC Lagoon Storage (10 MG)	\$1,385,000
THC Added Storage (6 MG) ¹	\$9,549,000
<hr/>	
SUBTOTAL with Additional Project Costs	\$16,035,781
<hr/>	
CONTRACTOR MARKUPS:	
Overhead	10% \$1,604,000
<i>Subtotal</i>	\$17,639,781
Profit	5% \$882,000
<i>Subtotal</i>	\$18,521,781
Mob/Bonds/Insurance	5% \$927,000
<i>Subtotal</i>	\$19,448,781
Contingency	30% \$5,835,000
<hr/>	
SUBTOTAL with Markups	\$25,284,000
<hr/>	
TOTAL - CONSTRUCTION COST	\$25,284,000
<hr/>	
NON-CONSTRUCTION COSTS:	
Engineering/Admin	25% \$6,321,000
<hr/>	
SUBTOTAL - Non-Construction Costs	\$31,605,000
<hr/>	
TOTAL - CAPITAL COST	\$31,605,000

¹ cost includes forcemain to storage and return forcemain from storage. See Appendix B, Table B.1, for details of cost basis.

**CPES Additional Project Cost
Alternative Wet 0.2 - Wet Weather Storage/Pumping
WWTP Percentage Allowance Calculator**

1.) Overall Sitework

Suggested percentage range for "Rehab" Project: **5 to 10%**
Suggested percentage range for "Greenfield" Project: **12 to 20%**

Rehab or Greenfield Project?	Rehab
Complexity of Tie-In's to Existing Plant?	Low
Rock Excavation?	Yes
Groundwater?	Yes
Overall Sitework	8.0

2.) Plant Computer System

Suggested percentage range: **7 to 10%**

Level of Sophistication?	Average
Plant Computer System	8.5

3.) Yard Electrical

Suggested percentage range for Plant with Available Primary Power: **5 to 8%**
Suggested percentage range for Plant without Available Primary Power: **10 to 25%**

Is Primary Power Available to the Site?	Yes
Connected HP Size?	Average
Size of Secondary Distribution Voltage System?	Small
Yard Electrical	5.8

4.) Yard Piping

Suggested percentage range: **10 to 30%**

What is the Relative Size of the Plant?	Small
Above Ground Piping?	No
Construction Cost per GPD	No
Annual O & M Cost per 1,000 Gallons	5.0

JCW Tomahawk WWTP Pre-Design Study

Table B.1. - CPES Bullet Items

Status	Scope	Year	Cost (2011 \$'s)
<u>Alternative Wet 0.2</u>			
1	Common	<u>Ex. Wet Weather Pump Station #1*</u>	
	Storm Pumps 5-8 & Motors	Replace	2020 150,000
2	Varies	Wet Weather Pump Station #2	2020 CPES
3	Varies	<u>10 MG Lagoon Storage*</u>	
	Sludge Removal		230,000
	Lagoon Liner and Underdrain		170,000
	Berm Removal & Grading		85,000
	Import Fill/Raise Berm		575,000
	RipRap		305,000
	Vegetation/Restoration		15,000
	Seeding		<u>5,000</u>
	Total		1,385,000
4	Varies	PEFTF	-
5	Varies	<u>6 MG Shallow Underground Storage</u>	
	Underground Storage Facility**	2020	9,134,000
	Forcemain to Storage		230,000
	Return Forcemain		<u>185,000</u>
	Total		9,549,000
6	Varies	Storage Return Pump Station	2020 CPES

* Does not include contractor markups, contingency, or engineering

** \$1.52/gallon = \$9,134,000 without contractor markups, contingency, or engineering/admin
 \$2.40/gallon = \$14,400,000 with contractor markups and contingency
 \$3.00/gallon = \$18,000,000 with contractor markups, contingency, and engineering/admin

CH2M HILL Parametric Cost Estimating System (CPES) FACILITIES LIFE CYCLE COST ANALYSIS

Project Name:	<u>Tomahawk WWTF - 2011 Update</u>
Project Number:	<u>382059.04</u>
Project Manager:	<u>Dale Gabel</u>
Estimator:	<u>E. Johnson</u>
Project Description:	<u>Wet Weather Alternative 0.2</u>
Project Location (City):	<u>Kansas City</u>
Project Location (State):	<u>KANSAS</u>
Project Location (Country):	<u>USA</u>
Construction Start (Month):	<u>Jan</u>
Construction Start (Year):	<u>2018</u>
Construction Duration (months):	<u>24</u>
Mid-Point of Construction:	<u>Jan/2019</u>

<i>SCOPE OF PROJECT</i>	<i>Year 0 Construction Cost</i>	<i>Annual O&M Cost (Escalated)</i>
Wet Weather Pump Station #2	\$3,573,287	\$28,787
Screening for Wet Weather Pump Station #2	\$1,861,481	\$22,807
Ex. Wet Weather Pump Station #1	\$295,465	\$0
Storage Return Pump Station	\$2,163,944	\$17,312
Additional Project Costs:		
<i>Biosolids Disposal</i>	\$0	\$0
<i>Standard Items</i>	\$2,747,030	\$83,897
<i>User Defined Items (Total Storage at THC)</i>	\$21,547,839	\$100,000
Plant O & M Labor (based on wage, influent BOD, and solids handling)		\$59,905
TOTAL - Life Cycle Analysis (Construction only)	\$32,189,046	\$312,708

JCW Tomahawk WWTP - Predesign Study Update Wet Weather Cost Analysis

Alternative 0.2

Project Element	Year Incurred or Initiated	Present Cost (2011 Dollars)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Capital Costs @ THC																							
Wet Weather	2019	\$31,610,000	\$36,459,165																				
O&M Costs @ THC																							
Wet Weather	2020	\$310,000		\$363,992	\$370,544	\$377,214	\$384,003	\$390,915	\$397,952	\$405,115	\$412,407	\$419,830	\$427,387	\$435,080	\$442,912	\$450,884	\$459,000	\$467,262	\$475,673	\$484,235	\$492,951	\$501,824	\$510,857

Wet Weather NPV Summary

Wet Weather Capital Cost	\$26,846,170
Wet Weather O&M @ THC	\$4,279,017
Total NPV at THC, Wet Weather	\$31,125,188

Economic Analysis Criteria:

Nominal Discount Rate	3.90%
Net Discount Rate	2.10%
Inflation	1.80%

Alternative Wet 0.3

C H2M HILL **P** arametric Cost **E** stimating **S** ystem (CPES) **FACILITIES DESIGN & CONSTRUCTION COST MODULE**

Project Name:	<u>Tomahawk WWTF - 2011 Update</u>
Project Number:	<u>382059.04</u>
Project Manager:	<u>Dale Gabel</u>
Estimator:	<u>E. Johnson</u>
Project Description:	<u>Wet Weather Alternative 0.3</u>
Project Location (City):	<u>Kansas City</u>
Project Location (State):	<u>KANSAS</u>
Project Location (Country):	<u>USA</u>
Construction Start (Month):	<u>Jan</u>
Construction Start (Year):	<u>2018</u>
Construction Duration (months):	<u>24</u>
Mid-Point of Construction:	<u>Jan/2019</u>

SCOPE OF PROJECT	COST
Wet Weather Pump Station #2	\$3,741,727
Flow to KCMO	\$0
Ex. Wet Weather Pump Station #1	\$150,000
Screening for Wet Weather Pump Station #2	\$1,376,267
Storage Return Pump Station	\$1,566,427
<hr/>	
SUBTOTAL - PROJECT COST	\$6,834,421
ADDITIONAL PROJECT COSTS:	
Demolition	0% \$0
Overall Sitework	15% \$1,025,164
Plant Computer System	9% \$580,926
Yard Electrical	6% \$396,397
Yard Piping	10% \$683,443
THC Lagoon Storage (10 MG)	\$1,385,000
THC Added Storage (32 MG) ¹	\$49,195,000
<hr/>	
SUBTOTAL with Additional Project Costs	\$60,100,351
CONTRACTOR MARKUPS:	
Overhead	10% \$6,011,000
Subtotal	\$66,111,351
Profit	5% \$3,306,000
Subtotal	\$69,417,351
Mob/Bonds/Insurance	5% \$3,471,000
Subtotal	\$72,888,351
Contingency	30% \$21,867,000
<hr/>	
SUBTOTAL with Markups	\$94,756,000
<hr/>	
TOTAL - CONSTRUCTION COST	\$94,756,000
NON-CONSTRUCTION COSTS:	
Engineering/Admin	25% \$23,689,000
<hr/>	
SUBTOTAL - Non-Construction Costs	\$118,445,000
<hr/>	
TOTAL - CAPITAL COST	\$118,445,000

¹ cost includes forcemain to storage and return forcemain from storage. See Appendix B, Table B.1, for details of cost basis.

**CPES Additional Project Cost
Alternative Wet 0.3 - Wet Weather Storage/Pumping
WWTP Percentage Allowance Calculator**

1.) Overall Sitework

Suggested percentage range for "Rehab" Project: 5 to 10%
Suggested percentage range for "Greenfield" Project: 12 to 20%

Rehab or Greenfield Project?	Greenfield
Size of Site?	Medium
Rock Excavation?	Yes
Groundwater?	Yes
Overall Sitework	15.0

2.) Plant Computer System

Suggested percentage range: 7 to 10%

Level of Sophistication?	Average
Plant Computer System	8.5

3.) Yard Electrical

Suggested percentage range for Plant with Available Primary Power: 5 to 8%
Suggested percentage range for Plant without Available Primary Power: 10 to 25%

Is Primary Power Available to the Site?	Yes
Connected HP Size?	Average
Size of Secondary Distribution Voltage System?	Small
Yard Electrical	5.8

4.) Yard Piping

Suggested percentage range: 10 to 30%

What is the Relative Size of the Plant?	Small
Above Ground Piping?	No
Construction Cost per GPD	No
Annual O & M Cost per 1,000 Gallons	10.0

JCW Tomahawk WWTP Pre-Design Study

Table B.1. - CPES Bullet Items

Status	Scope	Year	Cost (2011 \$'s)
<u>Alternative Wet 0.3</u>			
1	Common <u>Ex. Wet Weather Pump Station #1*</u> Storm Pumps 5-8 & Motors	Replace	2020 150,000
2	Varies Wet Weather Pump Station #2		2020 CPES
3	Varies <u>10 MG Lagoon Storage*</u> Sludge Removal Lagoon Liner and Underdrain Berm Removal & Grading Import Fill/Raise Berm RipRap Vegetation/Restoration Seeding		2020 230,000 170,000 85,000 575,000 305,000 15,000 <u>5,000</u>
		Total	1,385,000
4	Varies PEFTF		-
5	Varies <u>32 MG Shallow Underground Storage</u> Underground Storage Facility** Forcemain to Storage Return Forcemain		2020 48,700,000 290,000 <u>205,000</u>
		Total	49,195,000
6	Varies Storage Return Pump Station		2020 CPES

* Does not include contractor markups, contingency, or engineering

** \$1.52/gallon = \$48,700,000 without contractor markups, contingency, or engineering/admin

\$2.40/gallon = \$76,800,000 with contractor markups and contingency

\$3.00/gallon = \$96,000,000 with contractor markups, contingency, and engineering/admin

CH2M HILL Parametric Cost Estimating System (CPES) FACILITIES LIFE CYCLE COST ANALYSIS

Project Name:	<u>Tomahawk WWTF - 2011 Update</u>
Project Number:	<u>382059.04</u>
Project Manager:	<u>Dale Gabel</u>
Estimator:	<u>E. Johnson</u>
Project Description:	<u>Wet Weather Alternative 0.3</u>
Project Location (City):	<u>Kansas City</u>
Project Location (State):	<u>KANSAS</u>
Project Location (Country):	<u>USA</u>
Construction Start (Month):	<u>Jan</u>
Construction Start (Year):	<u>2018</u>
Construction Duration (months):	<u>24</u>
Mid-Point of Construction:	<u>Jan/2019</u>

<i>SCOPE OF PROJECT</i>	<i>Year 0 Construction Cost</i>	<i>Annual O&M Cost (Escalated)</i>
Wet Weather Pump Station #2	\$7,370,311	\$35,314
Screening for Wet Weather Pump Station #2	\$2,710,918	\$32,701
Ex. Wet Weather Pump Station #1	\$295,465	\$0
Storage Return Pump Station	\$3,085,488	\$17,494
Additional Project Costs:		
<i>Biosolids Disposal</i>	\$0	\$0
<i>Standard Items</i>	\$5,290,643	\$141,321
<i>User Defined Items (Total Storage at THC)</i>	\$99,630,555	\$100,000
Plant O & M Labor (based on wage, influent BOD, and solids handling)		\$59,905
TOTAL - Life Cycle Analysis (Construction only)	\$118,383,380	\$386,735

JCW Tomahawk WWTP - Predesign Study Update Wet Weather Cost Analysis

Alternative 0.3

Project Element	Year Incurred or Initiated	Present Cost (2011 Dollars)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Capital Costs @ THC																							
Wet Weather	2019	\$118,450,000	\$136,620,946																				
O&M Costs @ THC																							
Wet Weather	2020	\$390,000		\$457,925	\$466,168	\$474,559	\$483,101	\$491,797	\$500,649	\$509,661	\$518,835	\$528,174	\$537,681	\$547,359	\$557,212	\$567,241	\$577,452	\$587,846	\$598,427	\$609,199	\$620,164	\$631,327	\$642,691

Wet Weather NPV Summary

Wet Weather Capital Cost	\$100,598,825
Wet Weather O&M @ THC	\$5,383,280
Total NPV at THC, Wet Weather	\$105,982,105

Economic Analysis Criteria:

Nominal Discount Rate	3.90%
Net Discount Rate	2.10%
Inflation	1.80%