
TECHNICAL MEMORANDUM 2

TO: City of Shasta Lake

FROM: Paul Reuter, P.E., President/Managing Engineer
Miles Quaife, Staff Engineer

CC: Steve Wilson, P.E., Project Manager/Senior Engineer

DATE: January 16, 2024

JOB NO.: 0110.115

SUBJECT: Raw Water Storage Tank Evaluation



As part of the Centimudi Water Storage Tank Project, the City of Shasta Lake (City) asked PACE Engineering, Inc. (PACE) to conduct a preliminary evaluation to determine the size of the future raw water (RW) storage tank located at the City's Fisherman's Point Water Treatment Plant (WTP). In addition, PACE is to prepare a preliminary site plan showing the approximate location of the new tank and site piping modifications needed to accommodate the new tank.

BACKGROUND

The City's existing 170,000-gallon RW storage tank is too small to buffer changes and/or interruptions in flow from the RW pump station (RWPS) located at the base of Shasta Dam. The City's 2016 Water Master Plan (WMP) recommended the existing RW tank be replaced with a new 1.6-million-gallon (MG) tank.

When the Centimudi Water Storage Tank is put into service, the two existing finished water (FW) tanks located on the north side of the WTP can be demolished. Both tanks have reached or exceeded their useful service lives. The new RW tank can be constructed at this location.

APPROACH

On October 19, 2023, the PACE project team met with City staff at the FW tank site to discuss expectations for this evaluation. In general, City staff expressed a desire to maximize use of the existing site and construct the largest tank that the site can accommodate. It was also confirmed during this site visit that the existing 16- and 20-inch FW pipelines leaving the north side of the site are both active. The day after the site visit, PACE surveyors conducted a cursory topographic survey of the existing FW tank site to augment the 2006 site survey conducted by PACE. The new survey was needed to incorporate the City's sludge dewatering and other facilities that did not exist in 2006.

Based on this information, PACE prepared a preliminary site plan and RW tank layout to maximize use of the FW tank site. A preliminary site plan showing an 87.5-foot-diameter 1.8 MG tank was presented to City staff for comments.

After some deliberations, it was determined an 86-foot-diameter tank was too large for the site and would not afford enough clearance to other site facilities for access with large equipment and on-site parking.

The existing FW tanks are about 13 feet lower in maximum water surface (MWS) elevation than the City's existing RW tank. To maintain similar pumping head on the RW pumps and assure that adequate head pressure exists to drive water by gravity from the RW tank to the treatment units, it is proposed the new RW tank match the MWS of the existing RW tank.

PRELIMINARY TANK SITE PIPING SUGGESTIONS

RW Tank: Based on City staff comments and PACE's opinion of the MWS for the new RW tank, we are suggesting a tank with an 82.5-foot diameter and a 40-foot height to MWS. This will produce a 1.6 MG tank that was recommended in the City's 2016 WMP.

The attached Sheet C1.0 contains a preliminary layout of a tank with these dimensions as well as key setback dimensions to existing on-site infrastructure. The new RW tank could be welded steel or concrete. A life cycle cost comparison should be conducted between the two types of construction before settling on the best material.

Site Piping Considerations: The existing site contains both in-service and abandoned pipelines reflecting the evolution of the changing uses for the two existing tanks over the years. Prior to 2006, the northernmost tank was used as an RW tank and the other an FW tank. Therefore, piping exists from the RWPS to the northernmost tank. To accommodate the proposed RW tank, we suggest the following site piping modifications, which are reflected on attached Sheet C1.0:

Configurations of valves and fittings at tie-in locations will be dictated by the need to maintain nearly continuous water service throughout construction of the new RW tank and site piping. Ideas for sequencing the tie-in effort are discussed in the next section of this memo.

1. RW Piping: The 20-inch RW pipeline enters the west side of the site and splits, traversing through two 20-inch meters. The northernmost pipeline and meter was abandoned in 2006 when the City constructed its current RW tank near the treatment units. This pipeline should be re-activated and re-configured to fill the new RW tank. The southernmost RW pipeline should remain active around the south side of the new RW tank and connect to a new RW tank outlet. This pipeline could serve as a bypass around the RW tank should it need to be taken offline.

An isolation butterfly valve (BFV) should be installed on the upstream side of the RW tank outlet tie-in, which will normally remain closed. If the City needed to bypass the new RW tank, the BFV would have to be opened manually. We do not believe that the cost and complexity of an automatic valve at this location is warranted given the anticipated infrequent use.

2. FW Piping: The existing 24-inch FW pipeline enters the site from the south conveying treated water from the treatment units to the existing FW tanks. This pipeline needs to be routed around the new RW tank and tie into the existing 16- and 20-inch pipelines located on the north side of the site. There are two alignment options for accomplishing this.

The first option is to install the new 24-inch FW pipeline between the proposed RW tank and the sludge dewatering building. A tee with valves would be cut into the existing pipeline and approximately 120 feet of new 24-inch pipe routed along the east side of proposed RW tank.

Another option is to tie into the existing 24-inch FW pipeline at the elbow located southeast of the sludge dewatering building. Approximately 160 feet of new 24-inch FW pipeline would be installed along the access road on the east side of the sludge dewatering building to the tie-in point. This potential option is shown as dashed on Sheet C1.0. There are existing pipelines along the existing access road in which the alignments are not currently well defined. Also, this access road is pretty narrow. Should the City elect to pursue this alignment, it would need to better locate these existing pipeline alignments during the design process.

At the 16- and 20-inch tie-in location, it is proposed the existing 16-inch tee be replaced with a 24-inch cross with 24-inch by 16-inch reducers cut into the existing 16-inch pipeline. A 24-inch by 20-inch reducer and a 20-inch 90-degree elbow would be used to tie into the existing 20-inch pipeline. The two existing 16-inch BFVs would be replaced with new and a new 20-inch BFV installed.

3. U.S. Bureau of Reclamation (USBR) Water Service: Currently, water service to the USBR facilities extends from the 16-inch pipeline on the north side of the site and will have to be re-established at the new 24-inch FW tie-in location. This existing pipeline “dog legs” into the proposed RW tank footprint, so it will be necessary to eliminate the “dog leg” and install about 30 feet of new pipeline to re-establish this service.

Another consideration for the USBR service is how contact time (CT) will be impacted by moving the FW tank to the Centimudi Water Storage Tank location. Currently, the City meets its disinfection requirements prior to the USBR service based on chlorine residual

leaving the WTP and CT in the existing FW tanks. By moving the FW tank to the Centimudi Water Storage Tank site, the USBR service may be served by water that has not yet met CT disinfection requirements. The same concerns exist for the restroom facility on Lake Boulevard and the Centimudi Boat Launch. These will have to be investigated during the design phase.

4. **Abandoned Pipelines:** Portions of the existing 24-inch FW piping, 20-inch RW piping, and USBR service will need to be abandoned after new tie-ins and piping are installed. These are generally delineated on Sheet C1.0. It probably will not be necessary to remove these existing pipelines, but those that will reside under the new RW tank should be filled with grout. It is possible the foundation for the new RW tank may require some depth of over excavation with compacted engineered fill, which may necessitate removing some of the existing piping.

SITE PIPING TIE-IN SEQUENCING

The RW tank and site piping improvements need to be performed with minimal interruption to water service. Sheet C1.0 contains delineation to five key piping tie-in locations. A potential approach for sequencing this work is described below:

RW Pipe Tie-In - I.D. Point 1: Since the existing RW piping is located outside the proposed work area, this tie-in will be relatively straightforward. A 4- to 8-hour shutdown will be required to cut in a 20-inch tee and two 20-inch BFVs on the existing RW pipeline, which will be positioned to tie into the outlet side of the new RW tank. The City has also requested a check valve at this location. The BFV on the branch side of the tee will be closed and the pipeline re-opened to re-establish RW flow for the duration of the work until the new RW tank is approved to be put into service.

FW Pipe Tie-Ins - I.D. Points 2, 3, 4, and 5: The FW piping tie-ins will be a bit more involved to provide nearly continuous water service. However, when the Centimudi Water Storage Tank is put into service, it can be partially filled by gravity from the two existing FW tanks. The remaining water in the FW tanks can be consumed by USBR. If the USBR demand will not be enough to drain the existing tanks in a reasonable amount of time, the City may have to take other action, such as pumping out and wasting the remaining water.

I.D. Point 2 or 5: At this point, a new 24-inch tee with two 24-inch BFVs will be cut into the existing FW pipeline. The tee and valve configuration will allow the City to quickly re-establish the FW flow to the existing tanks after making the tie-in. If the Option 2 FW pipeline alignment is used, the tie-in would be made at I.D. Point 5 and require two 24-inch BFVs.

I.D. Point 3: This point is the tie-in to the existing 16- and 20-inch FW pipelines. At this location, it is proposed the tie-in installed in 2006 be replaced with one 24-inch cross with reducers, one 24-inch BFV, and one 20-inch 90-degree elbow. Two new 16-inch BFVs will be installed on the 16-inch pipeline on each side of the cross.

After the tie-ins are completed at I.D. Points 2 or 5 and 3, the new 24-inch FW pipeline should be installed and put into service.

I.D. Point 4: This is the point at which water service is conveyed to USBR. The City has the option to utilize the majority of existing 16-inch piping back to the 10-inch meter or replace this portion of piping with a new, smaller 10-inch pipeline. For now, we show utilization of the majority of this old piping. A new 16-inch BFV will need to be installed on the pipeline from the existing FW tanks so this pipeline can be isolated during construction of the new RW tank.

PRELIMINARY PROJECT COST ESTIMATE

Two preliminary project cost estimates have been prepared for constructing the new 1.6 MG RW tank and site piping improvements. One estimate reflects a welded steel tank and the other a concrete tank with domed roof. Refer to Tables 1 and 2.

Construction costs are based on input from tank manufacturers and recently bid prices for similar work for which PACE has been involved. A 20 percent construction contingency and 30 percent soft (indirect) cost allowance has been added to the estimated construction cost. Finally, a 5 percent per year inflation allowance was added to reflect construction beginning in June 2026.

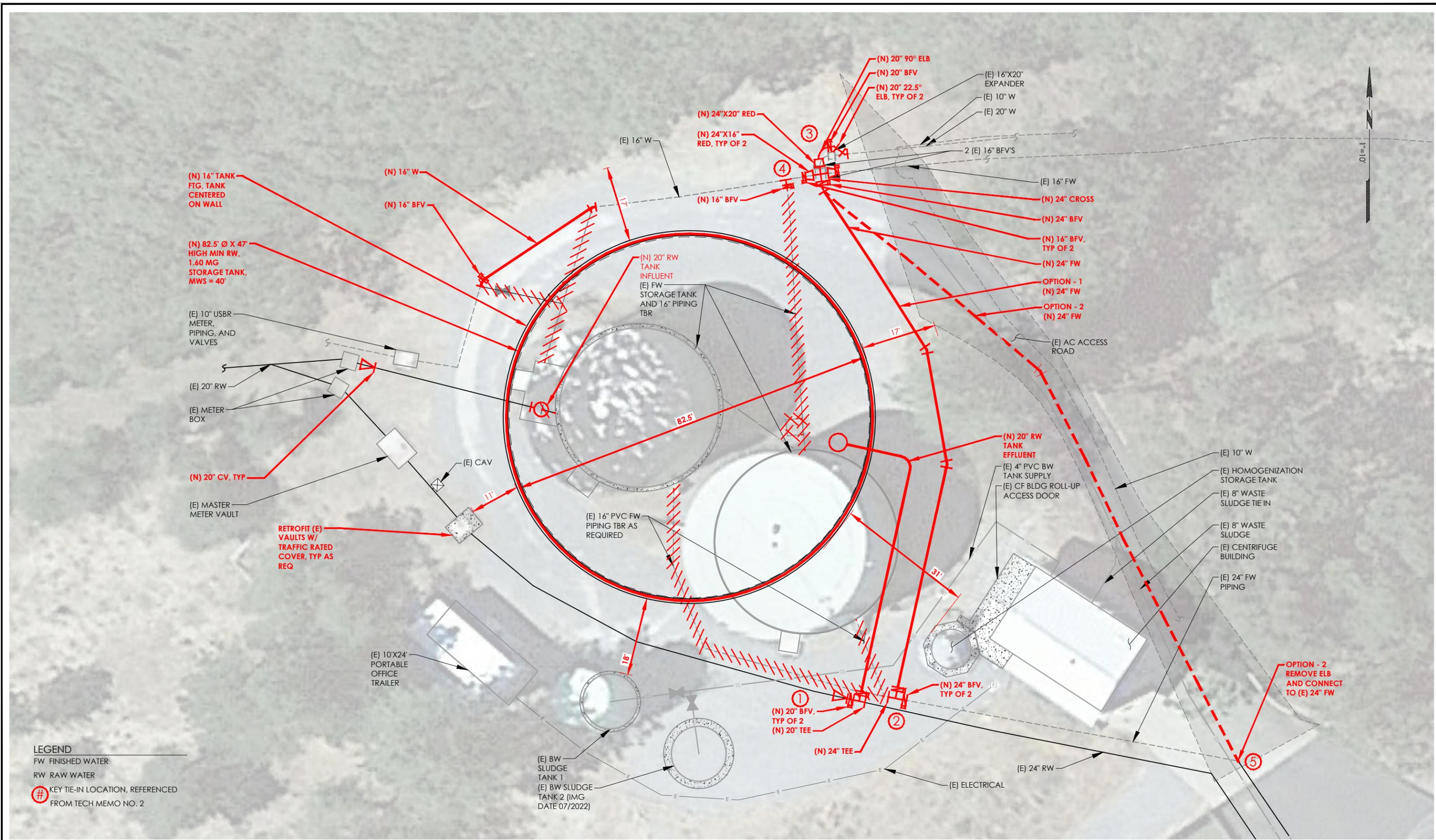
Life cycle cost analyses have not been performed to compare the steel versus concrete tank option.

TABLE 1
City of Shasta Lake
1.6 MG Raw Water Storage Tank – Steel
Project Cost Estimate – January 2024

Description	Qty	Units	Unit Cost	Contract Amounts
Tank Site and Piping Improvements				
24" Water Main w/A1 Backfill	118	LF	\$502	\$59,236
20" Water Main w/A1 Backfill	90	LF	\$320	\$28,800
16" Water Main w/A1 Backfill	35	LF	\$220	\$7,700
20" Overflow Piping w/C Backfill (footing to discharge)	60	LF	\$264	\$15,840
20" Overflow Piping (inlet to footing)	55	LF	\$264	\$14,520
20" Inlet Piping (inlet to footing)	50	LF	\$264	\$13,200
20" Outlet Piping (inlet to footing)	55	LF	\$264	\$14,520
Overflow Energy Dissipator and Duckbilled Check Valve	1	LS	\$21,600	\$21,600
24" Butterfly Valves	3	EA	\$26,756	\$80,268
20" Butterfly Valves	3	EA	\$17,800	\$53,400
20" Check Valve	2	EA	\$49,800	\$99,600
16" Butterfly Valves	4	EA	\$13,487	\$53,946
Miscellaneous Mechanical Tank Piping	1	EA	\$205,000	\$205,000
Meter Vault Retrofits w/ H-20 Lids	2	EA	\$10,000	\$20,000
Tie to Existing System	4	EA	\$10,000	\$40,000
1.6 MG Tank Improvements				
Mobilization/Demobilization	1	LS	\$50,000	\$50,000
Demolish Existing Tank/Foundation	2	LS	\$50,000	\$100,000
Overexcavate/Backfill Demolition Site	1	LS	\$75,000	\$75,000
Foundation	1	LS	\$160,000	\$160,000
Tank Erection	1,600,000	GAL	\$1.38	\$2,200,000
Electrical - Radar Transmitter	1	LS	\$7,000	\$7,000
Electrical - Intrusion Switch	1	LS	\$2,000	\$2,000
Floats	1	LS	\$1,500	\$1,500
Clearing and Grubbing	1	LS	\$10,000	\$10,000
Earthwork, Site Work, and Grading	3,600	CY	\$100	\$360,000
3" Aggregate Base	90	CY	\$150	\$13,500
Fencing	1	LS	\$44,400	\$44,400
Cleanup, Testing, Submittals, and Equipment Manuals	1	LS	\$33,300	\$33,300
Miscellaneous	1	LS	\$50,000	\$50,000
Subtotal Option 1 Tank Improvements:				\$3,834,330
Contingency Allowance @ 20%:				\$770,000
Subtotal Construction Costs (including contingency in January 2024 dollars):				\$4,600,000
Inflation to January 2026 Dollars at 5%/yr (3 years):				\$725,000
Total Construction Costs (January 2026 dollars):				\$5,325,000
Indirect Costs at 30% of Const. Cost:				\$1,597,500
TOTAL ESTIMATED PROJECT COST (January 2026 Dollars):				\$6,923,000

TABLE 2
City of Shasta Lake
1.6 MG Raw Water Storage Tank – Concrete
Project Cost Estimate – January 2024

Description	Qty	Units	Unit Cost	Contract Amounts
Tank Site and Piping Improvements				
24" Water Main w/A1 Backfill	118	LF	\$502	\$59,236
20" Water Main w/A1 Backfill	90	LF	\$320	\$28,800
16" Water Main w/A1 Backfill	35	LF	\$220	\$7,700
20" Overflow Piping w/C Backfill (footing to discharge)	60	LF	\$264	\$15,840
20" Overflow Piping (inlet to footing)	55	LF	\$264	\$14,520
20" Inlet Piping (inlet to footing)	50	LF	\$264	\$13,200
20" Outlet Piping (inlet to footing)	55	LF	\$264	\$14,520
Overflow Energy Dissipator and Duckbilled Check Valve	1	LS	\$21,600	\$21,600
24" Butterfly Valves	3	EA	\$26,756	\$80,268
20" Butterfly Valves	3	EA	\$17,800	\$53,400
20" Check Valve	2	EA	\$49,800	\$99,600
16" Butterfly Valves	4	EA	\$13,487	\$53,946
Miscellaneous Mechanical Tank Piping	1	EA	\$205,000	\$205,000
Meter Vault Retrofits w/ H-20 Lids	2	EA	\$10,000	\$20,000
Tie to Existing System	4	EA	\$10,000	\$40,000
1.6 MG Tank Improvements				
Mobilization/Demobilization	1	LS	\$50,000	\$50,000
Demolish Existing Tank/Foundation	2	LS	\$50,000	\$100,000
Overexcavate/Backfill Demolition Site Foundation	1	LS	\$75,000	\$75,000
Tank Erection (No Dye or Painting)	1,600,000	GAL	\$1.58	\$2,520,000
Electrical - Radar Transmitter	1	LS	\$7,000	\$7,000
Electrical - Intrusion Switch	1	LS	\$2,000	\$2,000
Floats	1	LS	\$1,500	\$1,500
Clearing and Grubbing	1	LS	\$10,000	\$10,000
Earthwork, Site Work, and Grading	3,600	CY	\$100	\$360,000
3" Aggregate Base	90	CY	\$150	\$13,500
Fencing	1	LS	\$44,400	\$44,400
Cleanup, Testing, Submittals, and Equipment Manuals	1	LS	\$33,300	\$33,300
Miscellaneous	1	LS	\$50,000	\$50,000
Subtotal Option 1 Tank Improvements:				\$4,154,330
Contingency Allowance @ 20%:				\$830,000
Subtotal Construction Costs (including Contingency in January 2024 dollars):				\$4,980,000
Inflation to January 2026 Dollars at 5%/yr (3 years):				\$785,000
Total Construction Costs (January 2026 dollars):				\$5,765,000
Indirect Costs at 30% of Const. Cost:				\$1,729,500
TOTAL ESTIMATED PROJECT COST (January 2026 dollars):				\$7,495,000



LEGEND
 FW FINISHED WATER
 RW RAW WATER
 # KEY TIE-IN LOCATION, REFERENCED FROM TECH MEMO NO. 2

BAR IS ONE INCH ON ORIGINAL DRAWING
 0' 1"
 IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

REVISIONS		
NO	DATE	DESCRIPTION

PACE ENGINEERING

DES	PJR	CKD	SW	JOB NO.
DRN	MAQ	DATE	1/16/2024	0110.115

SIGNED
 PRELIMINARY NOT FOR CONSTRUCTION

CITY OF SHASTA LAKE
 RAW WATER STORAGE TANK - SCHEMATIC DESIGN
 PROPOSED 1.6 MG RW STORAGE TANK

SHEET
C1.0

Plot Date: January 16, 2024 - 2:54 pm. User Name: mabale
 File Name: M:\Land Projects\010115 Continud Water Storage Tank\03 SD\WTP RW Tank\WTP RW Tank.dwg Layout: PROPOSED 1.6 MG RW STORAGE TANK