Engineering Feasibility Study

for

CoP/CTUIR Joint Water Project

Prepared for:

CITY OF PENDLETON

Department of Public Works

and the

CONFEDERATED TRIBES
OF THE
UMATILLA INDIAN RESERVATION

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City of Pendleton
and the
Confederated Tribes of the Umatilla Indian Reservation

CoP/CTUIR Joint Water Project

EXECUTIVE SUMMARY

This Engineering Feasibility Study, prepared by W&H Pacific, Inc., serves to provide information and aid in decision making for the City of Pendleton and the Confederated Tribes of the Umatilla Indian Reservation for development of CoP/CTUIR Joint Water Project improvements. A number of alternatives for Joint Water Project improvements consisting of a water treatment plant, water conveyance systems, and water storage impounds were evaluated within this Study. The fundamental conclusion of this Study is that the City and Tribes may mutually benefit from the development of a Joint Water Project. CoP/CTUIR Joint Water Project development will provide a reliable source of raw domestic water to the City of Pendleton to augment its existing groundwater well sources. The Confederated Tribes of the Umatilla Indian Reservation will benefit with a source of irrigation water, and a future means to obtained treated water from the City as area growth potential governs.

The CoP/CTUIR Joint Water Project – Engineering Feasibility Study identified and investigated nine separate and unique water treatment plant/conveyance system siting alternatives, and examined three different water storage impound sites. A detailed water quality study for the impound storage of Umatilla River water is also presented within this Study.

This Study concludes that in order to satisfy the mutual objectives of the City and Tribe, the most apparent feasible Joint Water Project alternative involves the construction of a Umatilla River water intake structure at the east side of Pendleton, siting a water treatment plant at Lower Goad Road in Pendleton (identified within this Study as Alternative No. 1), and if required, the development of a water storage impound at West Patawa. The City of Pendleton is currently assessing the viability of employing artificial storage and recovery (ASR) as a solution to long-term domestic water needs. If planned pilot studies prove ASR to be feasible, the City may not need earthen dam water storage impound. New raw and domestic (treated) water pipelines would be constructed to integrate the various water system improvement conveyance requirements. The existing CoP gravity pipeline can be commissioned and employed for delivering treated water into the City's South Hill water system, and /or for delivering irrigation water to the Tribe's resort area. The estimated cost of Alternative No. 1, water treatment plant/conveyance system improvement, is $11,864,000 (this cost includes the conveyance pipeline systems to the West Patawa Impound, and the booster pump station at the Impound). The estimated cost of the West Patawa 4,000 acre-feet water storage impound is $8,617,800. The combined (inclusive) cost of these Joint Water Project improvements is $20,481,800.

The Summary of Cost – WTP/Conveyance Systems for Alternative No. 1 (Appendix III) includes the major infrastructure components, including the large diameter conveyance pipeline to the site of the West Patawa Impound (excludes the actual cost of the Impound) to develop the most apparent mutually suitable joint water system project. If the City seeks and develops ASR, and implements a "stand alone" water system which would not require the West Patawa Impound for raw water storage, Alternative No. 9, with a budgeted cost of $9,147,600 would serve the needs of the City.

The City and Tribe may choose not to initially own all components of the water system jointly. The Tribe does not need treated domestic water in the foreseeable future, and may choose not to participate in ownership of the water treatment plant until they need domestic water. Likewise, the City may wish to delay a decision on storage until its artificial storage and recovery pilot project is completed. If the City does not participate in the reservoir, the Tribe may elect to build a small "irrigation only" reservoir at the Nagel Property site. Regardless of the decisions on the above components, joint ownership of the intake structure, pump station, and raw water pipeline components is in the best interest of both the City and Tribe.

The water quality study prepared by Dr. Peter Nelson concludes that no major water quality limitations will exist if adequate storage depth is provided. Issues related to water temperature and algal growth should be limited to late summer and fall.

From this study W&H Pacific concludes that raw water can be withdrawn from a properly designed and operated 4,000 acre foot water storage impound for two to three months, commencing in June, treated, and used for domestic purposes. Water stored in the upper water surface level of the impound can be withdrawn for irrigation purposes, and water stored in the deeper zone of the impound reserved for domestic use.

The assistance of the members of the Joint Water Project committee, including Jerry Odman, P.E., City of Pendleton Public Works Director; and Bob Patterson, P.E., Public Works Director, and J.D. Williams, Managing Attorney, Confederated Tribes of the Umatilla Indian Reservation, was greatly appreciated in the preparation of this Study.

1.0 INTRODUCTION

The goal of this Engineering Feasibility Study is to evaluate additional alternatives to determine the most practical and economical means to provide a reliable augmenting supply of water for the City of Pendleton (CoP) and the Confederated Tribes of the Umatilla Indian Reservation (CTUIR). Subsequent to the CoP/CTUIR Regional Water System Feasibility Study, dated August, 1996, the City and Tribe explored the suitability of several additional smaller water storage impoundment sites, referenced to within as: West Patawa, East Patawa, Nagle Property Impounds. Additional water treatment plant sites were also identified, referenced to within as: Lower Goad Road, Upper Goad Road, West Patawa, Nagle Property and CTUIR. Refer to Appendix I for Siting Considerations Map, and to Appendix II for Schematic Diagrams of Joint Water Project Alternatives.

Continued regional growth will require additional treated and untreated water, a resource that is in short supply, as a result of over appropriation and growing demand throughout the Umatilla Basin for domestic, irrigation, and fisheries purposes. It is proposed to appropriate surface water from the Umatilla River for the purpose of augmenting the current ground water supplies utilized by the CoP/CTUIR. Water would be withdrawn from the Umatilla River during winter high-flow periods, stored off-stream, and subsequently used as domestic and irrigation water for year-round use, including satisfying the summer peak demand periods. There exist a number of alternatives to impound a suitable quantity of water, provide treated water for domestic consumption, and convey untreated water for irrigation purposes with mutual benefit to the City of Pendleton and the Confederated Tribes. The purpose of this study is to aid in identifying the water system improvement alternatives which best align with the objectives of the City of Pendleton and the Confederated Tribes of the Umatilla Indian Reservation.

2.0 PROJECT OBJECTIVES

The objective of this feasibility study is to identify the most desirable alternative for implementing the CoP/CTUIR Joint Water Project with an emphasis mutually placed on the specific goals of the City of Pendleton and the Confederated Tribes of the Umatilla Indian Reservation. Cost and logistical considerations, ownership and CoP/CTUIR individual needs and preferences will drive the selection of the most appropriate water system alternative. Other than identifying fundamental Joint Water Project siting locations and capital cost comparisons for various improvements, no effort was made to determine property or easement acquisition requirements, water rights interest, approval requirements of the regulatory agencies, environmental concerns, listed or endangered species, or to the presence of political situations.

2.1 Objective Statement of the City of Pendleton (CoP)

The City of Pendleton has an immediate need to further develop an economical and reliable potable water supply to reduce its historic demand on diminishing groundwater supplies and provide for future growth. In addition, the CoP needs to provide treatment for Thorn Hollow Area Springs or any other surface water if it is to be used for domestic purposes. The accomplishment of this goal will lessen the City's reliance on groundwater supplies by utilizing the winter runoff surface water from the Umatilla River.

The CoP desires to investigate the potential use of Aquifer Storage and Recharge (ASR) as a part of the long-term water solution. All of the components of this feasibility study are intended to support ASR if it is deemed feasible and if the CoP elects to choose that option.

2.2 Objective Statement of the Confederated Tribes of the Umatilla Indian Reservation (CTUIR)

The Confederated Tribes of the Umatilla Indian Reservation desires irrigation water primarily near the resort area and Wildhorse Golf Course. The Tribe is also concerned with meeting the future need for potable water for municipal and economic development purposes. The implementation of a Joint Water Project would initiate the Tribe's recovery of the Winex Spring lands (Thorn Hollow Area Springs), currently serving as a source of water supply for the City of Pendleton, and could provide for additional flows in the Umatilla River, especially during the summer months. Ownership of the Wenix Springs land is a high priority for the Tribe.

3.0 WATER SYSTEM STUDY

3.1 Description of Alternatives

At the directive of the City of Pendleton and Confederated Tribes of the Umatilla Indian Reservation a number of alternatives were considered in evaluating potential Joint Water Project improvements. Schematic diagrams were prepared for each alternative to aid in the evaluation process, and illustrate the major infrastructure components necessary in the development of the CoP/CTUIR Joint Water Project.

The following Joint Water Project alternative schematics were prepared and are contained in Appendix II of this study:

Alternative 1
Schematic 1 – Intake: CoP, WTP: Lower Goad Road, Impound: West Patawa

Alternative 2
Schematic 2 – Intake: CoP, WTP: Lower Goad Road, Impound: East Patawa

Alternative 3
Schematic 3 – Intake: CoP, WTP: Lower Goad Road, Impound: Nagle Property

Alternative 4
Schematic 4 – Intake: CoP, WTP: Upper Goad Road, Impound: West Patawa

Alternative 5
Schematic 5 – Intake: CoP, WTP: Upper Goad Road, Impound: East Patawa

Alternative 6
Schematic 6 – Intake: CoP, WTP: Upper Goad Road, Impound: Nagle Property

Alternative 7
Schematic 7 – Intake: CTUIR, WTP: West Patawa, Impound: West Patawa

Alternative 8
Schematic 8 – Intake: CTUIR, WTP: Nagle Property, Impound: Nagle Property

Alternative 9 (CoP "stand alone" Water System, no water supplied to CTUIR)
Schematic 9 – Intake: CoP, WTP: Lower Goad Road, Impound: none (use ASR)

Alternative 10 (CTUIR "stand alone" Water System, no water supplied to CoP)
Schematic 10 – Intake: CTUIR, WTP: Mission, Impound: Nagle Property

3.2 Scope of W&H Pacific's Engineering Feasibility Study

W&H Pacific was provided with a City of Pendleton/Confederated Tribes of the Umatilla Indian Reservation Intergovernmental Agreement – Consultant's Scope of Work (Attachment A) which outlined specific guidelines to satisfy in the preparation of the CoP/CTUIR Joint Water Project - Engineering Feasibility Study. The Scope of Work for the engineering study generally contains the following tasks: Basic Parameters, Impoundments, and Treatment Plant. A copy of the CoP/CTUIR Intergovernmental Agreement – Consultant's Scope of Work (Attachment A) is included in Appendix IX of this Study.

There existed an interest by the water committee participants of the CoP/CTUIR Joint Water Project to be provided with an initial verification of several specific tasks stated in the Intergovernmental Agreement - Scope of Work provided to W&H Pacific, Inc. (the Consultant), and identified within the Scope as task items: 11, 19, 20, 21, and 22. These specific task items were provided with replies prepared by W&H Pacific for the draft review of this document in the Verification of a Portion of the Study as follows (the remaining Intergovernmental Agreement – Scope of Work tasks are addressed in Section 3.4 of this Study):

3.3 Verification of Portion of the Study (Scope of Work items: 11, 19, 20, 21, and 22)

Item 11. Address the limits to water quantity and rate of pumping imposed by a 30 inch, 36 inch, and 42 inch diameter pipeline in order to fill the impounds and calculate the reasonable maximum rate of flow through the above referenced pipe sizes.

Data supporting this scope item is contained in Appendix VI of this study. In summary, it is recommended to construct a 42-inch diameter pipeline from the intake/booster pump station site to the proposed water treatment plant (WTP). From the WTP it is recommended to construct a 36-inch diameter pipeline to the impoundment location. If this pipeline is situated at the downstream side of the impound, the 36-inch pipeline may be jointly used to convey water to the impound from the Umatilla River during peak runoff periods, and from the impound to the WTP during periods of impound withdrawal.

A two directional flow application of the 36-inch pipeline will require a booster pump station and valved piping network at the site of the impoundment.

A 42-inch diameter pipeline from the intake to the water treatment plant, and 36-inch from the water treatment plant to the impound will allow an adequate quantity of raw water to be concurrently conveyed to the water treatment plant to satisfied system demands, and for conveyance to fill the impoundment within a 60 day time period. This pipeline diameter will also allow WTP expansion to 10 MGD if required for future growth.

For the CoP/CTUIR Joint Water Project improvements proposed, the data contained in Appendix VI presents pumping/flow hydraulic information for various pipe size -vs- water flow rate potentials.

Table 1 summarizes the anticipated impound fill time (in days) for various pumping rates (in cubic feet per second, cfs):

Table 1: Fill Time for Water Storage Impound

Storage Impound Capacity	Days to Fill Water Storage Impound Pumping rate in cubic feet per second (cfs)						
Acre Feet (Ac-Ft)	**20 cfs**	**25 cfs**	**30 cfs**	**35 cfs**	**40 cfs**	**45 cfs**	**50 cfs**
500	13	10	8	7	6	6	5
1,000	25	20	17	14	13	11	10
1,500	38	30	25	22	19	17	15
2,000	50	40	34	29	25	22	20
2,500	63	50	42	36	32	28	25
3,000	76	61	50	43	38	34	30
3,500	88	71	59	50	44	39	35
4,000	101	81	67	58	50	45	40

As indicated and supported by the hydraulic data contained in Appendix VI, water flow rate within a conveyance infrastructure system is a function of pipeline diameter. The following provides a brief summary of the pipeline diameter with associated effect to flow rate(plus the time in days to fill a 4,000 Ac-Ft impound):

Pipeline Dia.	Flow Rate	Days to fill 4,000 Ac-Ft Impound
30-inch	20 CFS	101 days
36-inch	32 CFS	60 days
42-inch	50 CFS	40 days

The above noted pipeline diameters will also adequately convey 5.0 MGD (7.7 CFS), ((10.0 MGD (15 CFS) future)), concurrently to the WTP to satisfy water system demands while filling the impound from the Umatilla River intake. The intake booster pump station horsepower requirements will need to be investigated to ensure proper system operating parameters are addressed and designed for.

Supported by the data above and in Appendix VI, the time required to fill the storage impound is a function of the pumping rate of the hydraulic systems and the storage capacity of the impound. Assuming that a 90-day window exists to withdraw water from the Umatilla River and fill the storage impound, a 30-inch diameter pipeline would be adequate. A longer fill time would allow the existing 30-inch CoP gravity line to be used in the delivery of raw water to and from the impound location. A short impound fill time (60 days) would mandate a 36-inch diameter pipeline be employed from the intake to the impound. The utilization of the existing line would result in cost savings of varying magnitude for each Joint Water Project alternative under consideration. (Potential cost savings utilizing the existing CoP gravity line from intake to impound for raw water conveyance have been excluded from cost analysis at this time in order to maintain comparative consistency within the evaluation of each unique alternative). It is noted that the existing CoP gravity line from the South Hill Reservoirs area to and along the sites of the proposed West Patawa Impound and East Patawa Impound is in good condition. This section of the CoP gravity line was reconstructed during the development of Interstate 84. There are several portions of the existing gravity line (sections of 18" and 22" diameter pipe) which may need to be upgraded with larger diameter pipelines if water storage impound fill time becomes of concern.

Item 19. Verify the calculated costs of the joint treatment plant, intake and delivery systems. See attached "Site Proposal" calculations and maps. Determine if any advantages to siting treatment plant in vicinity of intake.

(A copy of the "Site Proposal" calculations and maps from the CoP/CRUIR's preliminary Joint Water Project evaluation as provided to W&H Pacific, Inc., is included in Appendix VIII).

The capital cost of the various CoP/CTUIR Joint Water Project improvements alternatives are indicated in the summary contained in Appendix III and summarized in Table 2 following this section. Because many common costs are associated with each of the various Joint Project alternatives (water treatment plant, intake structure/booster pump station, metering facilities), the construction cost of the necessary piping networks and pumping requirements were the primary influence in the cost evaluation of one alternative versus another.

Many factors other than initial capital cost need to be considered prior to making any decision. It is the Consultant's intent to provide adequate information within this feasibility study, to help lead the joint water committee to the best overall decision for the

location of the water treatment plant and impound that meets the individual objectives of the City and the Tribe.

The three apparent lowest Joint Water Project cost alternatives are Alternatives 1, 4, and 8, however, not all project costs (including land acquisition, power and control systems, operations personnel, etc.) have been included and fully evaluated in the CoP/CTUIR Joint Water Project – Engineering Feasibility Study. However a 20% contingency has been included in the Summary of Cost of the water system improvements considered in this report.

In addition to initial capital costs, there will exist a host of tangible and intangible factors to consider in the selection and implementation of improvements for the CoP/CTUIR Joint Water Project, which will be further developed in the final report. Appendix III.A contains a summary of water project improvements schematics and cost estimates, and provides an abbreviated list of advantages/disadvantages of each alternative under consideration.

There exist several advantages in siting the major Joint Water Project infrastructure components together, such as locating the intake structure, booster pump station, and WTP together. It is always beneficial to consolidate major system components that require large electrical power demand. Locating large power demand facilities adjacent to existing distribution lines will result in cost savings. A common delivery point for three-phase power to service several facilities, such as the WTP and booster pump station, would be desirable. It would better facilitate water system operation and maintenance efforts and response time to site major infrastructure components within the same vicinity, particularly adjacent to existing municipal systems. An additional benefit may also exist with interfacing the operation of the water improvement facilities into the City of Pendleton's supervisory control and data acquisition system (SCADA).

With the current Joint Water Project data made available to, and evaluated by W&H Pacific, Inc., and based on our understanding of Project objectives, it is the recommendation of the Consultant to develop Alternative No. 1 (intake and WTP at Lower Goad Road, impound at West Patawa). This alternative presents the highest degree of merit based on siting considerations (common site development for the intake structure and WTP), availability of three phase power (along Mission Highway), access to existing water system infrastructure (near City of Pendleton utilities and lends well to the implementation of the CoP to CTUIR intertie), general access to the site (existing roadways), and for water system operation and maintenance requirements (within established municipal system).

Selection of Alternative No. 1 (intake: CoP, WTP: Lower Goad Road, impound: West Patawa (note: West Patawa Impound may not be needed if the City of Pendleton seeks and develops ASR solution)) was arrived at being mindful of Project capital cost, with selection further supplemented and supported by other considerations which included the following:

(1) The Lower Goad Road site for the WTP lends itself well to the future build-out of the treatment plant (10MGD). This alternative consolidates the major mechanical systems (intake booster pump station and WTP) of the Project and provides a single delivery point for three phase power, and one remote telemetry unit (RTU) location for the City's SCADA system for control and monitoring purposes. In addition, only one site needs to be acquired.

(2) Alternative No. 1 provides the shortest and most direct alignment for the development of the CoP to CTUIR intertie. However, at this time the merits of providing an intertie to Mission is of question as current understanding is that the Tribe's immediate interest is a supply of raw water for irrigation use. With a new raw water supply, existing wells (plus the possibility of adding the City's Well No. 7) should be sufficient for the Tribe's domestic water needs for a long time in the future.

(3) With support of the Water Quality Study (Appendix V), and with consideration to water storage impound development cost, the potential use of the West Patawa impound appears to be the most logical selection for Umatilla River water storage. The configuration of the West Patawa drainage will provide ample storage potential to, and in excess of, 4,000 Ac-Ft. This impound location offers the shortest intake to impound pipeline route alignment (with the intake location at CoP), and allows use of the existing CoP gravity line for raw irrigation water conveyance to the Tribe's resort area.

(4) The practical merits of using the Nagle Property impound (Alternative No. 8) are diminished by the available land area and topography. The 80 acre Nagle Property parcel identified for the impound site is constrained and would not allow development of a large storage impound (to 4,000 Ac-Ft.) without occupying adjacent parcels. The 80-acre Nagle Property could suitably serve as a smaller impound site, up to approximately 2,000 Ac-Ft. The flat topography creates a shallow impoundment that will produce warmer water and likely will compromise water quality. A water quality assessment is included in this Study. The Nagle impound site appears to be best suited or limited to storing irrigation water.

(5) The City has indicated a desire to expand the WTP to produce 10 MGD or more of treated water. With this requirement, the existing CoP gravity line would not have sufficient capacity and would need to be replaced or expanded. With the WTP at the Nagle Property site (Alternative No.8), and the potential employment of a Patawa site for future impound expansion requirements, additional large diameter conveyance pipeline would be necessary. A 10 MGD WTP expansion would require a pipeline to be constructed to the City for treated water conveyance, and a pipeline to be constructed from the impound (Patawa site) to the WTP for raw

water conveyance. These facts would raise the cost of Alternative No. 8 above Alternatives 1 or 4.

Table 2 summarizes the cost of the Joint Water System water treatment plant and conveyance systems considered in this Study:

Table 2: Summary of Water System Alternatives
(note: cost of water storage impound excluded, See Table 4)

WTP/Conveyance Systems	Cost
Alternative No. 1 Intake: CoP, WTP (5.0 MGD): Lower Goad Road, Impound: West Patawa	**$11,864,000**
Alternative No. 2 Intake: CoP, WTP (5.0 MGD): Lower Goad Road, Impound: East Patawa	**$12,952,100**
Alternative No. 3 Intake: CoP, WTP (5.0 MGD): Lower Goad Road, Impound: Nagle Property	**$13,462,400**
Alternative No. 4 Intake: CoP, WTP (5.0 MGD): Upper Goad Road, Impound: West Patawa	**$11,548,700**
Alternative No. 5 Intake: CoP, WTP (5.0 MGD): Upper Goad Road, Impound: East Patawa	**$12,663,800**
Alternative No. 6 Intake: CoP, WTP (5.0 MGD): Upper Goad Road, Impound: Nagle Property	**$13,147,100**
Alternative No. 7 Intake: CTUIR, WTP (5.0 MGD): West Patawa, Impound: West Patawa	**$13,280,600**
Alternative No. 8 Intake: CTUIR, WTP (5.0 MGD): Nagle Property, Impound: Nagle Property	**$11,149,000**
Alternative No. 9 Intake: CoP, WTP (5.0 MGD): Lower Goad Road, Impound: None (use ASR)	**$9,147,600**
Alternative No. 10 Intake: CTUIR, WTP (0.5 MGD): Mission, Impound: Nagle Property	**$4,061,400**

Item 20. Address the assumptions underlying the "Site Proposal" calculations and maps, verifying and providing comments.

The assumptions underlying the "Site Proposal" (Appendix VIII) prepared by the City and Tribe for initial project conceptual development outline, consisting of various water system improvement considerations, appear to align with the objectives of the

CoP/CTUIR Joint Water Project and provide for the sought after mutual degree of Project benefit to the City and Tribe. The assumptions support the City of Pendleton's need for large volumes of treated water. The Tribe's needs for current irrigation water are supported, and provide for a source of treated water for future development demands. W&H Pacific generally concurs with the assumptions of the "Site Proposals" prepared and provided for preliminary CoP/CTUIR Joint Water project alternative assessment prepared by the committee.

The material and assumptions prepared and employed by W&H Pacific, contained in this study, aided in the arrival of independent conclusions by the Consultant with regard to the selection of a Joint Water Project alternative based on the understood objective and associated initial capital cost consideration. Site selection of the major water system infrastructure components (intake, WTP, impound) significantly impact Joint Water Project cost. The results within independently indicate and support impoundment storage capacity requirements, pipeline sizing, and water flow rates for the proper function of Joint Water Project system hydraulics.

The development of the Joint Water Project storage impound site has the potential to be a major cost consideration and influence in alternative selection. The 80 acre Nagle Property site initially considered for water storage impoundment appears not to be of adequate size for large storage capacity (greater than 2,000 Ac-Ft.) without additional land acquisition to the north, or by utilizing Tribal owned property on the south side of Interstate 84. Storage sites may be developed and/or expanded as long-term needs dictate. The West Patawa impound may be initially constructed for 2,000 Ac-Ft. and further developed as demand occurs, or the East Patawa impound may be constructed to couple and augment the initial storage provided in the West Patawa impound. This type of storage development option would lend to the siting of the WTP at the Goad Road location.

Preliminary cost comparisons of the alternatives were made with reference to the capital cost of major infrastructure components, including the cost of required treated and untreated conveyance pipeline interconnecting the intake structure, WTP and impound, with a Summary of Cost contained in Appendix III (items excluded from the preliminary cost comparison are noted in the summary). The primary varying cost associated with alternative implementation is the length of pipeline required to connect one water system infrastructure component to another. These improvements result in substantial project costs and serve to support the merits of one alternative versus another. An area of concern is the employment of the existing CoP gravity line in the Joint Water Project. The unknown overall integrity and suitability of the existing CoP gravity line may result in the need to provide parallel piping and/or upgrade line sections. There may exist additional underlining items, such as validity or cost of easements, which will require additional careful consideration, evaluation, and assessment.

Item 21. Comment briefly on the location of the treatment plant in relationship to potential future use of McKay Reservoir water and future development of an artificial storage and recovery project.

The technical merits of using McKay Reservoir flows to serve the CoP/CTUIR water demands and requirements exist and do not present a formable challenge to implement. Water quality of McKay Reservoir water was not studied, however, and its suitability for domestic water should be evaluated prior to pursuing this option further. The political challenges and efforts of using McKay Reservoir waters are paramount and pose the greater degree of difficulty. Currently the water stored in McKay Reservoir is restricted to agricultural and fisheries uses, and is not available for domestic appropriation.

Utilization of McKay Reservoir water for domestic purposes, and potentially for an artificial storage and recovery project, would involve the construction of an intake, pipeline, and booster pump station to convey McKay Reservoir water to the location of the WTP. A pipeline from McKay Reservoir would need to cross several major drainages in its alignment to the South Hill area in the City of Pendlton. The proximity of the proposed water treatment sites currently under consideration in relationship to the McKay Reservoir would require a sizable pipeline network and substantial capital cost. However, this type of cost would be greatly offset if it eliminated the need to construct a new impound for Umatilla River water storage.

Of the ten alternatives presented in this report, Upper Goad Road (Alternative No. 4) and Lower Goad Road (Alternative No. 1) appear to be the best location for the water treatment plant (WTP). Extending a pipeline southerly from the McKay Reservoir along Goad Road to a WTP would be the most direct route and likely would result in the lowest cost for easements.

Another option which would eliminate a booster pump station and pipeline altogether, would be to convey the water from McKay Reservoir via McKay Creek to a location within the City of Pendleton, where a second WTP would be constructed. Although this option has merits and potential cost savings, it would require the construction, operation and maintenance of a second WTP.

The analysis of a pipeline versus the McKay Creek option is beyond the scope of this study. Furthermore, the decision would not be needed for many years, so we would not recommend any effort be spent on this topic until the certainty of, and the need for, McKay water is solidified.

The City remains positive about the potential of using Artificial Storage and Recovery (ASR) as a future solution to its long-term domestic water needs. ASR requires that water injected into underground aquifers meet drinking water standards prior to injection, which means treatment.

If ASR is pursued, the City must have a source of water and construct a treatment plant. All components that are the subject of this study support ASR if it is deemed feasible.

The inclusion of McKay Reservoir in the ASR discussion merely adds a potential second water source other than the Umatilla River, but it is not a necessity if ASR is pursued.

The development of ASR would require the distribution of treated water from the WTP to the location of the injection well(s). The siting of the Joint Water Project WTP at the Lower Goad Road location will benefit the City in the development and implementation of ASR. At the Lower Goad Road location treated water may readily be transported into the City's existing water system network and ultimately to injection well location(s). The ASR pilot study, which the City is to commence with, will explore the merits of ASR, and serve to identify feasible locations for ASR injection, and guide the City in further evaluating the cost and merits of employing this type of water management.

Item 22. Comment on advantages and disadvantages of a treated intertie along Mission Highway between the City and Tribe's water systems.

An intertie pipeline between the City of Pendleton and the Confederated Tribes of the Umatilla Indian Reservation water system would benefit the Tribe by providing an adequate supply of domestic water from a reliable municipal system for current backup or augmenting purposes, and for future expansion as growth occurs. The intertie from the water treatment plant would also provide the City with another point of delivery into their distribution system in the valley floor area. From a common point branch location along Mission Highway to the west the intertie would serve the City of Pendleton. From the common point location to the east the intertie would serve the Confederated Tribe.

The Tribe would benefit by creating additional water system revenue by serving a number of potential customers on the reservation area west of Mission, which currently rely on individual wells for domestic and irrigation water. Connection of these accounts to the Tribe's municipal system would reduce the number of individual water wells withdrawing from the declining water table(s) and reduce the draw-down interference problems being experienced in several of the current housing developments between the City of Pendleton and Mission.

A CoP/CTUIR intertie could also be used for conveyance of potable water to the City of Pendleton from the CTUIR system for emergency purposes. The intertie would also enhance fire protection supply flow within the City's and Tribe's existing distribution systems.

No apparent disadvantages exist with a CoP/CTUIR intertie with the exception of the capital cost associated with construction of the pipeline network, estimated to cost $396,200. The intertie would benefit both entities with the cost proportioned between the City of Pendleton and the Confederated Tribe. The Tribe's cost could be significantly less than the cost of developing their own WTP facility, or seeking additional groundwater supplies. The intertie could be constructed within the Mission Highway right-of-way corridor.

The key questions to be answered by both the CoP and the CTUIR are: (1) Is additional domestic water currently needed by the CTUIR?, and if not, when would it be needed by the CTUIR?; (2) Is the cost versus benefit good for both entities, including the cost of water usage to the CTUIR?

Based on our knowledge of the Tribe's domestic water needs, it would be a long time in the future before additional domestic water is needed, especially if a joint water project provides irrigation water for the Tribe's needs. Further, if the Tribe acquires the City's Well No. 7, the need for more domestic water would be delayed even further into the future.

3.4 Address Scope of Work Tasks

The remaining tasks contained in the Intergovernmental Agreement – Consultant's Scope of Work, which were not addressed in Section 3.3 (Verification of Portion of the Study), are listed and addressed in sequential order in Subsections 3.4.1, 3.4.2, and 3.4.3 as follows:

3.4.1 Basic Parameters (Scope of Work Tasks 1 – 10)

Note: Scope of Work Task item numbers: 1, 2, 3, 4, 5, 8, 9, and 10 acknowledged, no response required.

Item 6. The impoundment sites are a) West Patawa, b) East Patawa, and c) Nagle.

a. The West Patawa Site shall be analyzed to provide a useable storage of impoundment water at 1) 1,000 acre-feet, and 2) a maximum size for the site based on existing topography.

b. The East Patawa Site shall be analyzed to provide a useable storage of impoundment water at 1) 1,000 acre-feet, and 2) a maximum size for the site based on existing topography.

c. The Nagle Site shall be analyzed to provide a useable storage of impoundment water at 1) 500 acre-feet, 2) 1,000 acre-feet, and 3) 4,000 acre-feet.

The various size and storage configurations for the proposed Joint Water Project impounds have been evaluated, preliminarily illustrated, and are contained in Appendix IV of this Study. Table 3 summarizes several water storage volume potentials for each Joint Water Project impound under consideration:

Table 3: Impound Water Storage Volume Potential

West Patawa Impound		
Water Depth	**Contour Elevation**	**Water Storage, Ac-Ft**
62	1330	1,207
72	1340	1,739
82	1350	2,421
92	1360	3,351
102	1370	4,520
East Patawa Impound		
Water Depth	**Contour Elevation**	**Water Storage, Ac-Ft**
50	1350	602
60	1360	1,079
70	1370	1,774
80	1380	2,769
90	1390	4,018
Nagle Property Impound		
Water Depth	**Contour Elevation**	**Water Storage, Ac-Ft**
25.7 (1,200' sq. bottom)	1359.7	1,000
45.4 (1,200' sq. bottom)	1379.4	2,000 *
76.0 (1,200' sq. bottom)	1410.0	4,000 *
19.9 (1,400' sq. bottom)	1365.9	1,000
36.4 (1,400' sq. bottom)	1382.4	2,000 *
63.3 (1,400' sq. bottom)	1409.3	4,000 *

* Construction of a 2,000 or 4,000 acre-foot impound on the 80-acre Nagle Property would not be feasible due to land area constraints. The Nagle Property is best suited for a smaller impound with storage capacity limited to 1,000 to 1,500 acre-feet.

Item 7. Water quality issues to be investigated for the impoundment sites should include, but not be limited to, temperature, algae growth, turbidity, total organic carbon, siltation, and evaporation in relation to the depth of the site.

W&H Pacific, Inc. employed the services of Dr. Peter Nelson, Oregon State University, to assess and analyze water quality issues related to the storage impoundment of Umatilla River water. A copy of Dr. Nelson's Water Quality Study for the CoP/CTUIR Joint Water Project is contained in Appendix V.

Dr. Nelson's Water Quality Study concludes that no major water quality limitations will exist for the proposed water storage impounds if adequate water storage depth and

overturn are provided. Shallow domestic water storage impounds may promote detrimental temperature and stratification profiles during warm summer storage periods. Taste and odor problems may be of concern late in the summer as alga degradation product concentrate in the deoxygenated lower layer (hypolimnion) of the impound prior to overturn in late September or October. However the lack of anaerobic conditions will make this problem less severe. Estimated impound evaporation loss is predicted to be 55 inches per year (greatest losses in July and August).

Dr. Nelson states that the major water quality concern will be algal growth due to relatively high levels of nutrients (nitrogen and phosphorus) in the Umatilla River water. However, the algal production is not predicted to be high enough to cause severe oxygen depletion and anaerobic conditions of the impounds under consideration for the CoP/CTUIR Joint Water Project. Other water quality issues which need to be considered in the development of a water storage impound are addressed in the Study.

3.4.2 Impoundments (Scope of Work Tasks 11 – 17)

Note: Scope of Work Tasks item number 11 included in Section 3.3 (Verification of Portion of the Study).

Item 12. Determine the relationship of stored Umatilla River water quality related to the depth of the impoundment and associated water surface area. The Consultant shall make recommendation on the depth and surface area of such an impoundment relative to water quality for a municipal water supply.

Dr. Nelson's Water Quality Study, Temperature and Stratification, concludes that summer water storage periods (June through August) in the impounds may create a hypolimnion (poor thermal mixing and deoxygenated lower layer) which will extend to a depth of 20-feet to 40-feet. Thus, water quality can vary greatly in the impound from top to bottom during summer storage periods. Maximum surface water temperature is predicted to be approximately 72 °F in August, with the stratified bottom layer remaining near 50 °F, depending on drawdown characteristics of the reservoir.

In order to preserve water quality of the stored water within the impound for as long a storage period as possible, it may be advisable to consider developing several impound valved control outlets staged at different water storage elevations. Staged outlets, upper and lower level of the impound, could allow water to be used for irrigation supply to be withdrawn for the top of the impound (warmer water temperature zone). Impound stored water to be used for domestic water supply treatment could be withdrawn from the bottom of the impound (lower water temperature zone). Consideration may also be given to introducing groundwater into the storage impound, commingling groundwater with impound water at the point of treatment, and/or water aeration of the stored impound water, during summer periods in order to provide a means to enhance water quality. There will exist various operating parameters and protocols that may benefit water quality which will require further study during the Joint Water Project design phase.

The Effects of Reservoir Depth and Surface Area on Water Quality portion of the Study states that, in general, impound water quality will depend primarily on the water quality of the inflow water from the Umatilla River. Inflow water turbidity nutrient concentrations, and oxygen demand (BOD, COD) are of greatest concern. Secondary effects are caused by changes in water quality during storage within the impounds. These include the effects of algal growth, which are related to nutrient levels, and oxygen depletion, which are related to inflow oxygen demand and bacterial respiration of alga cells. Changes in impound maximum depth and surface area will have very little influence on these effects.

Dr. Nelson concludes that effects on water quality with changes in impound maximum depth are expected to be minimal, and all proposed impound locations considered for the CoP/CTUIR Joint Water Project are suitable in terms of acceptable water quality for a municipal water supply if adequate depth is considered. A copy of Dr. Nelson's Water Quality Study is contained in Appendix V.

Item 13. Estimate the costs of construction, maintenance and operation of the selected impoundment sites, including costs of delivery system to and from the gravity line. Address costs issues involving dam regulations for both construction and maintenance.

Impound Construction Cost

For the Joint Water Project storage impound it is proposed to employ an earthfill dam utilizing native and natural material that require a minimum of processing insofar as possible. If adequate site geology exist, the foundation structural requirements for an earthfill dam are less stringent than for other types (concrete or rockfill). A rolled-fill classified earthfill dam for water storage impound would used site impervious soil material for the construction of a compacted embankment to serve as the impound containment dam. Available, and referenced geotechnical and geologic information, of the subject water storage impound sites indicate that conditions appear to be satisfactory for earthfill dam construction. The embankment dam would require riprap facing and a spillway structure. Developed basalt quarries near Hermiston could supply riprap and any necessary rockfill. Also, several small basalt quarry sites are located within approximately 10 miles of the proposed subject impound locations. The base of the impound will require a bentonite amended silt soil overlain with six inches of protective soil covering.

The cost of earthfill water storage impound dams considered for the CoP/CTUIR Joint Water Project are included in the Summary of Cost – Water Storage Impound contained in Appendix III.A. The estimated operation and maintenance costs for the impounds are also included in the Summary. The conveyance systems costs for the Joint Water Project alternatives under consideration consisting of WTP, pipelines, booster pump stations and related appurtenances are included in the Summary of Cost – WTP/Conveyance contained in Appendix III.B, and Tabulated Summary of Cost in Appendix III.C. Table 4

summarizes the cost of the Joint Water System water storage impounds considered in this Study:

Table 4: Summary of Water Storage Impound Cost

Water Storage Impound	Cost
West Patawa	
1,000 acre-feet	$2,958,100
2,000 acre-feet	$6,661,900
4,000 acre-feet	$8,617,800
East Patawa	
1,000 acre-feet	$3,049,100
2,000 acre-feet	$5,411,000
4,000 acre-feet	$11,758,500
Nagle Property	
500 acre-feet (850' x 850' impound footprint)	$3,137,300
1,000 acre-feet (850' x 850' impound footprint)	$5,607,100
1,000 acre-feet (1,200' x 1,200' impound footprint)	$5,006,200
2,000 acre-feet (1,200' x 1,200' impound footprint)	$9,440,000
3,000 acre-feet (1,200' x 1,200' impound footprint)	$13,718,000
4,000 acre-feet (1,200' x 1,200' impound footprint)	$18,694,700

Dam Regulation

The cost issues associated with dam regulations for both construction and maintenance will be primarily governed by the specific requirements of the State of Oregon Water Resources Department (WRD). The Oregon Administrative Rules (OAR) of the Water Resources Department, specifically Chapter 690 Division 3: Timelines For Processing Applications-Guidelines, and Chapter 690 Division 20: Appropriation And Use of Surface Water – Dams, are intended as a guide to develop permit requirements and establish acceptable standards for construction of dam structures. The WRD Director retains the authority to administer and enforce the OAR. The Rules are not intended to restrict the application of sound engineering design principles in the development of projects such as the water storage impound for the CoP/CTUIR Joint Water Project.

Division 20: Appropriation and Use of Surface Water – Dams, provides the general agency requirements which apply to construction of dams. The earthfill dam water storage impounds under consideration for the CoP/CTUIR Joint Water Project would be classified under OAR Article 690-020-0035 Dams Over the Statutory Limits. The Oregon Department of Water Resources provides a checklist entitled Safety of Dams that provide the minimum requirements for examination and approval of plans and specifications for dam and reservoir construction greater than, or equal to, 10 feet height

and 9.2 acre-feet storage (ORS 540.400). A copy of the OAR Division 3: Timelines For Processing Applications-Guidelines, Division 20: Appropriation And Use of Surface Water – Dams, and the WRD Safety of Dams Checklist is included in Appendix VII.

The cost of work related to addressing WRD regulated issues and requirements involve the preparation of certified engineering design plans and specifications of the proposed water storage impound structure in accordance with OAR Chapter 690, Divisions 3 and 20, and in adherence with the WRD Checklist. Safety in the operation and maintenance of the water storage impoundment must be of extreme priority and is to be in adherence to appropriate Water Resources Department of the Oregon Administrative Rules. General responsibility for the impound structure will lie with the municipality, or a special board or commission endowed with administrative powers, (the Owner).

The WRD will require an Operations and Maintenance (O&M) Manual be prepared by the Owner as a condition of impound approval and permit issuance. The WRD Director will require the Owner of the impound to keep records of, and to report on, maintenance, operation, staffing and engineering and geologic investigations. The WRD will issue rules and regulations as necessary to secure maintenance and operation, and will require staffing, and engineering and geologic investigations, which will safeguard life and property.

The Director may make inspections of the water storage impound at State expense for the purpose of verifying its safety and integrity. Any necessary safety related work shall be performed at the Owner's expense. The Director has the authority and may immediately employ any remedial means necessary to protect life and property downstream of the impound. The cost and expense of any necessary remedial work shall be recoverable by the State from the Owner. OAR Division 20 provides enforcement procedures (690-020-0039) for any hydraulic structure found to be in violation of the terms and conditions of the permit or certificate.

The estimated cost of the engineering (including preparation of an O&M Manual), and satisfying regulatory permitting and approval requirements for development and implementation of the Joint Water Project water storage impound has been included in the Summary of Cost – Impound in Appendix III.B, and in the Tabulated Summary of Cost in Appendix III.C.

Item 14. Estimate the costs of providing treated water to the Tribe and the City under each impound scenario.

The cost of providing treated water to the CoP and the CTUIR has been estimated within this Study, and is summarized in Table 2 and Table 4, and included in the Summary of Cost – WTP/Conveyance Systems, Appendix III.A.

Item 15. Estimate the costs of providing raw water to the Tribe's golf course under each impound scenario.

The CTUIR seeks 0.5 MGD (350 GPM) of raw water at the site of the Tribe's golf course pond for resort area irrigation purposes. It is proposed to convert and employ the existing CoP gravity line which currently conveys domestic water from Well No. 7 and the upland water springs to a low pressure conduit in order to convey raw water from the Joint Water Project impound to the Tribe's golf course pond. The existing CoP gravity line passes within approximately 200 feet of the golf course irrigation pond. A short lateral line (10" pipe) would need to be constructed between the converted existing gravity line (future low-pressure conduit) and the pond. A booster pump station at the impound site which is needed to deliver raw water to the CoP WTP would also be equipped with a jockey pump to serve the irrigation flow requirements of the Tribe's resort by filling the golf course pond. A float control valve assembly at the golf course pond would serve to replenish and maintain the water surface level in the pond and introduce raw water into the pond (from the impound booster pump station) as Tribal irrigation system demand consumes stored water.

Cost basis consideration for the conversion and employment of the existing CoP gravity line to provide raw irrigation water to the CTUIR golf course pond is common to Alternatives No. 1 through 8. The cost to implement this system would include pipeline construction, and jockey pump and float control structure installation. The estimated cost for these improvements is $34,000 (including minor upgrade if necessary to the existing CoP gravity line for conversion to pressure conduit).

The cost for delivering raw water to the Tribe's golf course with consideration to Alternative No. 10 is included in the Summary of Cost in Appendix III.A, and was been estimated to be $60,000 (pipeline and level control float valve assembly). Alternative No. 10 is the Tribe's "stand only" alternative for treated and raw water system improvements. This alternative would not benefit by utilizing the existing CoP gravity line, and would result in a higher cost to provide a raw water irrigation supply to the Tribe's golf course pond.

Item 16. Determine ability to expand, if necessary, the capacity of the facility to meet long-term needs of the City and the Tribes, including costs of later expansion by increasing the height of the dam or berm.

The employment of an earthfill dam for the Joint Water Project impound would lend to increasing the height of the embankment for additional water storage capacity needs in the future. With initial appropriate design considerations, altering an earthen structure is technically possible and feasible, and does not present formable challenge and excessive cost implications. The cost of water storage impound expansion will be a function of the dam embankment height increase, crest length and width. Slope stability analyses will determine the appropriate upstream and downstream slopes (assumptions for an earthfill

dam embankment for the West and East Patawa Impound are a 3:1 upstream slope, and a 2:1 downstream slope).

Increased water storage capacity could readily be accomplished by adding low permeability material to the downstream embankment slope and providing riprap to the upstream slope (water surface side). The embankment soil interface surfaces would need to be adequately prepared and benched to receive addition slope earthfill. The cutoff trench constructed for the original embankment (at the interface of the dam embankment and foundation) should be substantially sized to provide for future impound expansion. The spillway on the downstream slope of the impound would require reconstruction due to embankment alterations. It should be noted, however, that the cost of reservoir expansion at a later date would be substantially greater than constructing the reservoir to the larger size initially.

Consideration of future water storage expansion would further support and warrant the selection of the West Patawa drainage as the most feasible impound site. The configuration and geometry of the West Patawa drainage basin would offer the most available storage net gain for the less amount of vertical embankment increase (in comparison to the East Patawa and Nagle Property Impound sites). A ten-foot high dam embankment increase of the West Patawa Impound would result in an approximate additional 1,400 acre-feet of water storage (from elevation 1370 to elevation 1380).

Water storage impound expansion would require plans, drawings, and specifications of the proposed work to be submitted to the State of Oregon Water Resources Department for review and approval.

Item 17. Verify the maximum storage capacity that is economically available from all impound sites.

The water storage size/capacity configurations of the proposed Joint Water Storage impounds are indicated on the diagrams contained in Appendix IV. The cost of the various impound configurations are contained in the Summary of Cost in Appendix III.B and in the Tabulated Summary of Cost in Appendix III.C. In summary, the following present the maximum impound storage capacity that appears to be the most economical based on the preliminary information studied and considered:

<u>West Patawa Impound</u>

The geometry of the West Patawa Impound is well suited to provide water storage to 4,000 acre-feet by the construction of an earthfilled embankment dam across the offstream drainage sub-basin tributary to Patawa Creek. Natural basin topography and geometry provide adequate large volume water storage with ample freeboard without the need to extensively alter the basin landscape. Additional storage, to approximately 5,200

acre-feet, may be obtained in the West Patawa Impound by the construction of a 10-foot high berm around the perimeter of the impound (with 5-feet of freebroad).

East Patawa Impound

The geometry of the East Patawa Impound is well suited to provide water storage to approximately 2,500 acre-feet by the construction of an earthfilled embankment across the offstream drainage sub-basin tributary to Patawa Creek. Natural basin topography and geometry provide adequate medium volume water storage with ample freeboard without the need to extensively alter the basin landscape. Additional storage, in the range of 3,500 acre-feet, may be obtained in the East Patawa Impound by the construction of a 10-foot high berm around the perimeter of the impound (with 5-feet of freeboard).

Nagle Property Impound

The proposed Nagle Property Impound is situated in relatively level agricultural land with topography and geometry limited to provide shallow water storage to approximately 1,000 acre-feet. The Nagle Property Impound does not benefit by the presence of drainage basin topography and geometry, and will not accommodate deeper water storage depths and resulting water quality advantages. The water storage volume obtained by the Nagle Property Impound must be gained by excavation of the entire site using the excavated material to create earthfilled embankments around the impound perimeter (above existing grade). Interstate 80 bisects the Nagle Property and makes the employment of a large storage impound impractical. The 80 acre Nagle Property currently under consideration is best suited for a smaller impound with storage capacity limited to 1,000 to 1,500 acre-feet.

3.4.2 Treatment Plant (Scope of Work Tasks 18 – 23)

Note: Scope of Work Tasks item numbers: 19, 20, 21, 22 included in Section 3.3 (Verification of Portion of the Study).

Item 18. Estimate the cost of a treatment plant, intake and delivery system, including the most economical intake location, located near the Mission Market, sized to deliver 0.5 mgd of treated water to the Tribes only and 1,000 acre-feet of raw water to the Nagle impound site.

The Tribe's "stand alone" option for water system improvements is identified as Alternative No. 10 and is illustrated as Schematic No. 10 in Appendix II. The estimated cost for Alternative No. 10 is included in the Summary of Cost – WTP/Conveyance Systems in Appendix III. The cost of the Tribe's "stand alone" system is estimated within this Engineering Feasibility Study to be $4,061,400.

Item 23. Prepare three schematic diagrams showing the impoundment site, treatment plant site, intake site, pipelines including the intertie where appropriate, for each of the following:

a) a schematic showing both intake sites, all three treatment plant sites, and all three impound sites and the delivery systems, including the intertie;

b) a schematic showing the intake/treatment plant at the most economical location and all three impound sites with delivery systems, including the intertie; and

c) a schematic showing the intake/treatment plant at Mission for a tribal system only, with delivery to the Nagel impound site from the Mission intake site, but with no intertie.

Schematics diagrams for all the various alternatives presented above have been prepared and evaluated within this CoP/CTUIR Joint Water Project Engineering Feasibility Study and are contained in Appendix II.

4.0 CONCLUSION

The City of Pendleton and the Confederated Tribes of the Umatilla Indian Reservation are unified in their concerns regarding the region's water resources, and recognize the need, and have displayed the willingness, to carefully accommodate increasing population and economic development. The area's groundwater supply is rapidly diminishing while the need for domestic and irrigation water supply is growing. Water committee members of the CoP and the CTUIR recognize that implementing a long-term solution to satisfy the area's growing water supply demand is paramount.

The CoP/CTUIR Joint Water Project – Engineering Feasibility Study presents solutions to common interests and concerns for consideration by the water committee members of the City of Pendleton and the Confederated Tribes of the Umatilla Indian Reservation. The intend of the Joint Water Project is to created a joint partnership to meet the specific objectives of the City and Tribe. Project development will provide for the long-term domestic water needs of the City. The Tribe will obtain a source of irrigation water and a means to obtain domestic water as future demands dictate. Project development will minimize withdrawals from the rapidly dwindling aquifer under the City, and will allow the return of the City's spring sites to the Tribe.

After consideration of strictly the initial capital cost of the various CoP/CTUIR Joint Water Project alternatives it is W&H Pacific's opinion that several suitable alternatives may exist in meeting the objectives of the Project. The initial capital cost of the alternatives considered need to be incorporated not only with siting logistics and O&M considerations, but also with the cost of impound construction (including land acquisition cost).

CoP/CTUIR Joint Water Project alternative Nos. 1 through 8 provide the large volumes of treated water required by the City of Pendleton, and provide for augmenting domestic and

irrigation water to the Confederated Tribe. Alternative No. 9 is a "stand alone" domestic water system exclusively for the City of Pendleton. Alternative No. 10 is a "stand alone" domestic water system exclusively for the Confederated Tribe.

The goal of the alternative selected will be to provide the required treated water for the City of Pendleton for present and future demands, and facilitate ASR implementation. The needs of the Confederated Tribes of the Umatilla Indian Reservation for a supply of irrigation and domestic water for their current and future needs must be provided for.

We do not believe that the selection of an alternative should be based on cost alone. With consideration of the magnitude of the capital cost for the development of the CoP/CTUIR Joint Water Project, the variance among the three apparent most feasible alternatives as presented within *(Item 19- Alternatives No. 1, 4, and 8)* for joint project consideration are very modest and should not serve as the primary driver in the decision making matrix. The development of a Joint Water Project storage impound will require careful attention in order to assure adequate storage volume is provided, and water quality issues are evaluated. The Water Quality Study prepared for the CoP/CTUIR Joint Water Project – Engineering Feasibility Study concludes that the impound sites considered for the storage of Umatilla River water are generally suitable in terms of acceptable water quality for a municipal water supply.

In conclusion, based on the material studied and presented within this Engineering Feasibility Study, it is the recommendation of W&H Pacific, Inc., that the development of Alternative No. 1 will best serve the mutual objectives of the City of Pendleton and the Confederated Tribe of the Umatilla Indian Reservation. The development of the West Patawa Impound, if required, offers the greatest water storage capacity and water quality benefit for cost base consideration, and fits well with the overall water system development objectives of Alternative No. 1. If pilot studies and trials successfully support the City of Pendleton's development of artificial storage and recovery (ASR), an earthen dam water storage impound may only potentially benefit the Tribe's need for raw irrigation water supply. If the City of Pendleton develops their own water system improvements, the infrastructure components as included in Alternatives No. 10, consisting of the Umatilla River intake at the City of Pendleton, the WTP at Lower Goad Road, and tie lines to the existing CoP gravity line which feeds into the South Hill Reservoirs, and the Valley Floor system would be required (the large diameter conveyance pipeline to the West Patawa Impound, which is indicated in Alternative No. 1, would not be required for a City of Pendleton "stand alone" system development, if ASR is employed).

Subsequent to initiating and implementing actions on the recommendations made within this CoP/CTUIR Joint Water Project – Engineering Feasibility Study, the Consultant desires to work with the CoP/CTUIR professional staff and joint water committee, and further solidify the merits of the recommendation(s).

APPENDIX I WATER SYSTEM IMPROVEMENTS - SITING CONSIDERATIONS

CoP INTAKE

CTUIR INTAKE

LOWER GOAD ROAD WTP
Mile 58

CTUIR WTP

UPPER GOAD ROAD WTP

EXISTING CoP GRAVITY LINE

WTP

NAGLE PROPERTY IMPOUND

WTP

RESORT AREA GOLF COURSE WEST LAKE

TO WATER SPRINGS & WELL No. 7

WEST PATAWA IMPOUND

EAST PATAWA IMPOUND

CITY OF PENDLETON

CONFEDERATED TRIBES OF THE UMATILLA INDIAN RESERVATION

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CoP/CTUIR JOINT WATER PROJECT
LOCATION MAP OF
WATER SYSTEM IMPROVEMENTS
SITING CONSIDERATIONS
PENDLETON OREGON

SCALE: N.T.S.
PROJECT NO. 06.1365.0001
FILE NAME: UMITIL1.DWG

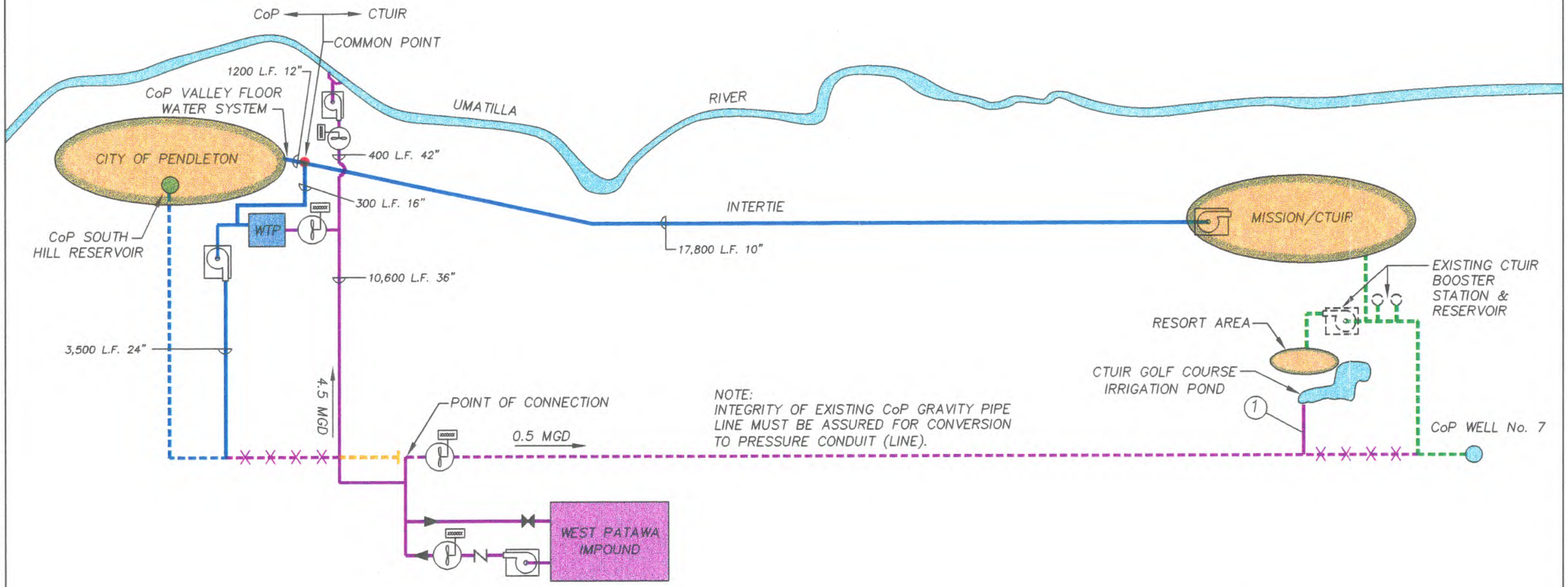
DESIGNED BY: DLU
DRAWN BY: kk
CHECKED BY: ____
APPROVED BY: ____

SHEET 1

LAST EDIT: 4/1/99
PLOT DATE:

APPENDIX II SCHEMATIC DIAGRAMS OF WATER SYSTEM IMPROVEMENTS

Schematic 1 (Alternate 1) – Intake: CoP, WTP: Lower Goad Road, Impound: West Patawa
Schematic 2 (Alternate 2) – Intake: CoP, WTP: Lower Goad Road, Impound: East Patawa
Schematic 3 (Alternate 3) – Intake: CoP, WTP: Lower Goad Road, Impound: Nagle Property
Schematic 4 (Alternate 4) – Intake: CoP, WTP: Upper Goad Road, Impound: West Patawa
Schematic 5 (Alternate 5) – Intake: CoP, WTP: Upper Goad Road, Impound: East Patawa
Schematic 6 (Alternate 6) – Intake: CoP, WTP: Upper Goad Road, Impound: Nagle Property
Schematic 7 (Alternate 7) – Intake: CTUIR, WTP: West Patawa, Impound: West Patawa
Schematic 8 (Alternate 8) – Intake: CTUIR, WTP: Nagle Property, Impound: Nagle Property
Schematic 9 (Alternate 9) – Intake: CoP, WTP: Lower Goad Road, Impound: None (use ASR)
(CoP "stand alone" Water System, no water supplied to CTUIR)
Schematic 10 (Alternate 10) – Intake: CTUIR, WTP: Mission, Impound: Nagle Property
(CTUIR "stand alone" Water System, no water supplied to CoP)



LEGEND

- PROPOSED TREATED (POTABLE) WATER
- TREATED (POTABLE) WATER CONVEYED INTO CoP SOUTH HILL RESERVOIR(S) VIA EXISTING GRAVITY LINE
- PROPOSED RAW WATER LINE
- EXISTING CoP GRAVITY LINE USED AS A PRESSURE LINE FOR RAW WATER DELIVERY TO CTUIR IRRIGATION
- ABANDON PORTION OF EXISTING CoP GRAVITY LINE
- EXISTING CTUIR WATER SYSTEM NETWORK
- EXISTING CoP GRAVITY LINE TO PROVIDE FUTURE PARALLEL LINE TO IMPOUND
- PROPOSED INTAKE STRUCTURE
- FLOW METERING FACILITY
- BOOSTER PUMP
- WTP — WATER TREATMENT PLANT
- (1) — RAW WATER TIE TO CTUIR GOLF COURSE
- ISOLATION VALVE (NO DURING IMPOUND FILL OPERATION) (NC DURING IMPOUND WITHDRAWAL)
- N — CHECK VALVE

ALTERNATIVE No.1

SITING – WATER PROJECT IMPROVEMENTS

INTAKE: CoP
WTP: LOWER GOAD ROAD
IMPOUND: WEST PATAWA

SEE APPENDIX III, SUMMARY SHEET 1 FOR COST INFORMATION

CITY OF PENDLETON

CONFEDERATED TRIBES OF THE UMATILLA INDIAN RESERVATION

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CoP/CTUIR JOINT WATER PROJECT
IMPOUND/TREATMENT PLANT IMPROVEMENTS
SCHEMATIC DIAGRAM -
ALTERNATIVE No. 1

CoP/CTUIR — OREGON

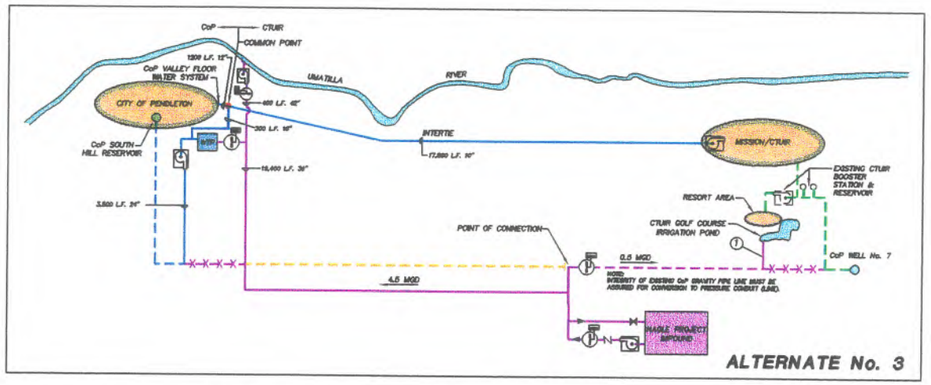
SCALE: N.T.S.
PROJECT NO. 06.1365.0001
FILE NAME: UMITIL3.DWG

DESIGNED BY: DLU
DRAWN BY: kk
CHECKED BY:
APPROVED BY:

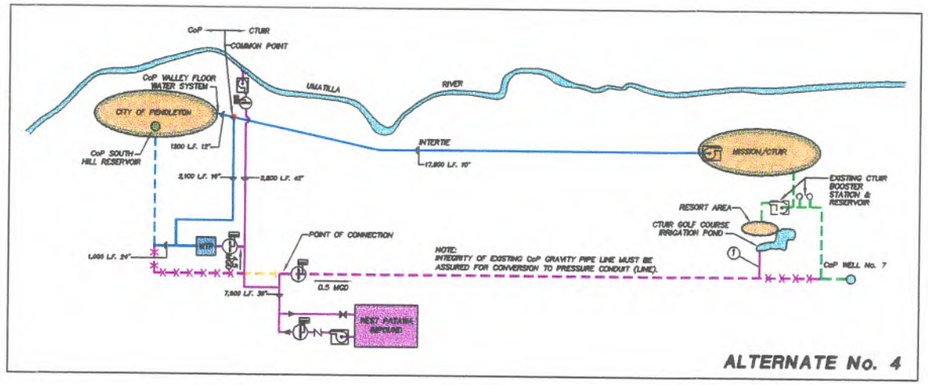
SHEET
SCHEMATIC No. 1

LAST EDIT: 4/20/99
PLOT DATE:

SECTION, TOWNSHIP, RANGE:



ALTERNATE No. 3



ALTERNATE No. 4

ALTERNATIVE No. 3 - SUMMARY OF COST

INTAKE: CoP, WTP: LOWER GOAD ROAD, IMPOUND: NAGLE PROPERTY

WATER TREATMENT PLANT (WTP), 5.0 MGD		$5,250,000
INTAKE MANIFOLD		$250,000
PIPELINES	L.F.	
42" W/ APPURTENANCES	400	$64,000
36" W/ APPURTENANCES	19,400	$2,522,000
24" W/ APPURTENANCES	3,500	$245,000
16" W/ APPURTENANCES	300	$11,400
12" W/ APPURTENANCES	1,200	$28,800
10" W/ APPURTENANCES	17,800	$356,000
BOOSTER PUMP STATIONS (BPS)		
INTAKE BPS, 50 CFS		$790,000
IMPOUND BPS, 15 CFS		$220,000
SOUTH HILL ZONE BPS, 10 CFS		$160,000
MISSION INTERTIE BPS, 1 CFS		$75,000
SUBTOTAL		$9,972,200
ADMINISTRATION/ENGINEERING (15%)		$1,495,800
CONTINGENCY (20%)		$1,994,400
TOTAL		**$13,462,400**

COSTS NOT INCLUDED IN BUDGETARY ESTIMATE:

- SITE GRADING/DEVELOPMENT
- THREE PHASE POWER SERVICE
- CONTROL/MOITORING SYSTEM (SCADA)
- OPERATION & MAINTENANCE (O&M) EXPENSE
- IRRIGATION CONNECTION TO CTUIR GOLF COURSE
- IMPOUND
- FLOW METERING FACILITIES
- LAND ACQUISITION
- SITE DEWATERING
- UPGRADING EXISTING CoP GRAVITY LINE

ADVANTAGES:

- CONSOLIDATES INTAKE BOOSTER PUMP STATION & WTP.
- IMPOUND PROPERTY UNDER CTUIR OWNERSHIP.
- AVAILABILITY OF THREE PHASE POWER.
- UTILIZE EXISTING CoP GRAVITY PIPELINE.
- SUITABLE SITE FOR ASR (NEAR EXISTING WATER SYSTEM INFRASTRUCTURE).

DISADVANTAGES:

- BOOSTER PUMP STATION REQUIRED FOR SOUTH HILL ZONE.
- LONG LENGTH OF RAW WATER SUPPLY LINE.
- RELIANCE ON INTEGRITY OF EXISTING CoP GRAVITY PIPELINE FOR TREATED WATER CONVEYANCE.
- RELIANCE ON INTEGRITY OF EXISTING CoP GRAVITY FOR USE AS A PRESSURE CONDUIT
- POTENTIAL LACK OF LARGE STORAGE VOLUMES IN NAGLE PROPERTY IMPOUND

ALTERNATIVE No. 4 - SUMMARY OF COST

INTAKE: CoP, WTP: UPPER GOAD ROAD, IMPOUND: WEST PATAWA

WATER TREATMENT PLANT (WTP), 5.0 MGD		$5,250,000
INTAKE MANIFOLD		$250,000
PIPELINES	L.F.	
42" W/ APPURTENANCES	2,800	$448,000
36" W/ APPURTENANCES	7,900	$1,027,000
24" W/ APPURTENANCES	1,000	$70,000
16" W/ APPURTENANCES	2,100	$79,800
12" W/ APPURTENANCES	1,200	$28,800
10" W/ APPURTENANCES	17,800	$356,000
BOOSTER PUMP STATIONS (BPS)		
INTAKE BPS, 50 CFS		$750,000
IMPOUND BPS, 15 CFS		$220,000
MISSION INTERTIE BPS, 1 CFS		$75,000
SUBTOTAL		$8,554,600
ADMINISTRATION/ENGINEERING (15%)		$1,283,200
CONTINGENCY (20%)		$1,710,900
TOTAL		**$11,548,700**

COSTS NOT INCLUDED IN BUDGETARY ESTIMATE:

- SITE GRADING/DEVELOPMENT
- THREE PHASE POWER SERVICE
- CONTROL/MOITORING SYSTEM (SCADA)
- OPERATION & MAINTENANCE (O&M) EXPENSE
- IRRIGATION CONNECTION TO CTUIR GOLF COURSE
- IMPOUND
- FLOW METERING FACILITIES
- LAND ACQUISITION
- SITE DEWATERING
- UPGRADING EXISTING CoP GRAVITY LINE

ADVANTAGES:

- AVAILABILITY OF THREE PHASE POWER.
- UTILIZE EXISTING CoP GRAVITY PIPELINE.
- TREATED WATER TO SOUTH HILL SYSTEM FROM WTP WITHOUT NEED OF ADDITIONAL BOOSTER PUMP.
- SUITABLE SITE FOR ASR
- WEST PATAWA IMPOUND OFFERS LARGE STORAGE POTENTIAL

DISADVANTAGES:

- POTENTIAL PROPERTY ACQUISITION COST.
- RELIANCE ON INTEGRITY OF EXISTING CoP GRAVITY PIPELINE FOR TREATED WATER CONVEYANCE.
- SEPARATE THREE PHASE POWER SERVICE TO EACH MAJOR INFRASTRUCTURE COMPONENT.
- RELIANCE ON INTEGRITY OF EXISTING CoP GRAVITY FOR USE AS A PRESSURE CONDUIT

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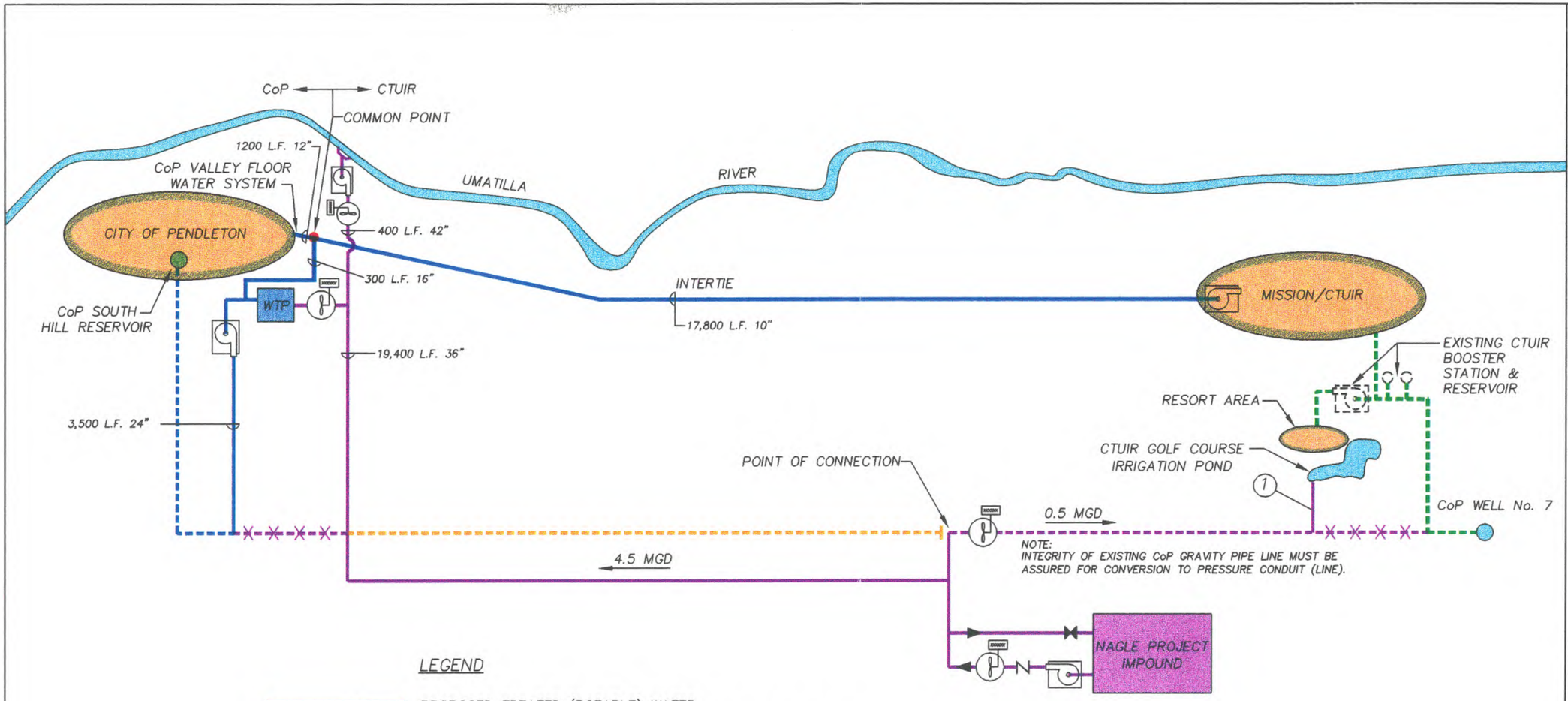
CoP/CTUIR JOINT WATER PROJECT
SUMMARY OF COST
WTP/CONVEYANCE SYSTEMS
CoP/CTUIR OREGON

DESIGNED BY: DLU
DRAWN BY: kk
CHECKED BY:
APPROVED BY:

SCALE: N.T.S.
PROJECT NO. 06.1365.0001
FILE NAME: UMTLSUM2.DWG
PLOT DATE:
LAST EDIT: 5/13/99

SHEET
SUMMARY 2

SECTION, TOWNSHIP, RANGE:



LEGEND

- PROPOSED TREATED (POTABLE) WATER
- TREATED (POTABLE) WATER CONVEYED INTO CoP SOUTH HILL RESERVOIR(S) VIA EXISTING GRAVITY LINE
- PROPOSED RAW WATER LINE
- EXISTING CoP GRAVITY LINE USED AS A PRESSURE LINE FOR RAW WATER DELIVERY TO CTUIR IRRIGATION
- ABANDON PORTION OF EXISTING CoP GRAVITY LINE
- EXISTING CTUIR WATER SYSTEM NETWORK
- EXISTING CoP GRAVITY LINE TO PROVIDE FUTURE PARALLEL LINE TO IMPOUND
- PROPOSED INTAKE STRUCTURE
- FLOW METERING FACILITY
- BOOSTER PUMP
- WTP — WATER TREATMENT PLANT
- (1) — RAW WATER TIE TO CTUIR GOLF COURSE
- ISOLATION VALVE (NO DURING IMPOUND FILL OPERATION) (NC DURING IMPOUND WITHDRAWAL)
- CHECK VALVE

ALTERNATIVE No.3

SITING – WATER PROJECT IMPROVEMENTS

INTAKE: CoP
WTP: LOWER GOAD ROAD
IMPOUND: NAGLE PROJECT

SEE APPENDIX III, SUMMARY SHEET 2 FOR COST INFORMATION

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CoP/CTUIR JOINT WATER PROJECT
IMPOUND/TREATMENT PLANT IMPROVEMENTS
SCHEMATIC DIAGRAM - ALTERNATIVE No. 3
OREGON

CoP/CTUIR | SCALE: N.T.S. | PROJECT NO. 06.1365.0001 | FILE NAME: UMITIL6.DWG

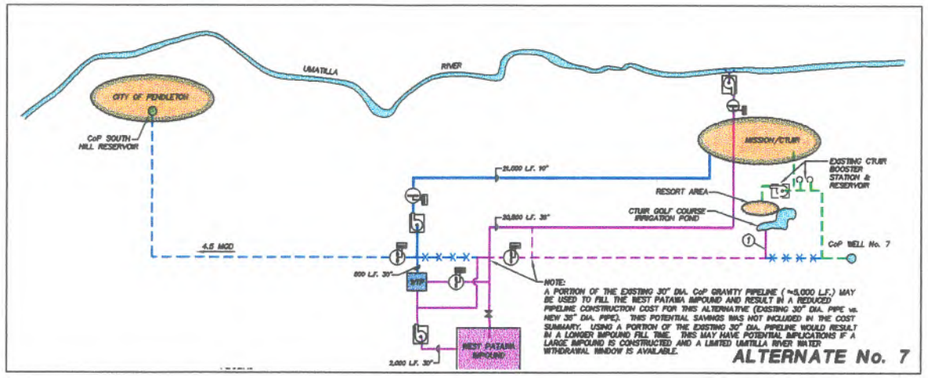
DESIGNED BY: DLU
DRAWN BY: kk
CHECKED BY: ____
APPROVED BY: ____

SHEET **SCHEMATIC No. 3**

SECTION, TOWNSHIP, RANGE:

LAST EDIT: 4/20/99

PLOT DATE:



ALTERNATE No. 7

ALTERNATIVE No. 7 - SUMMARY OF COST

INTAKE: CTUIR, WTP: WEST PATAVIA, IMPOUND: WEST PATAWA

WATER TREATMENT PLANT (WTP), 5.0 MGD		$5,250,000
INTAKE MANIFOLD		$230,000
PIPELINES	L.F.	
36" W/ APPURTENANCES	20,500	$2,665,000
30" W/ APPURTENANCES	2,500	$237,500
10" W/ APPURTENANCES	21,000	$420,000
BOOSTER PUMP STATIONS (BPS)		
INTAKE BPS, 40 CFS		$750,000
IMPOUND BPS, 15 CFS		$220,000
MISSION DELIVERY BPS, 1 CFS		$65,000
SUBTOTAL		$9,837,500
ADMINISTRATION/ENGINEERING (15%)		$1,475,600
CONTINGENCY (20%)		$1,967,500
TOTAL		$13,280,600

COSTS NOT INCLUDED IN BUDGETARY ESTIMATE:

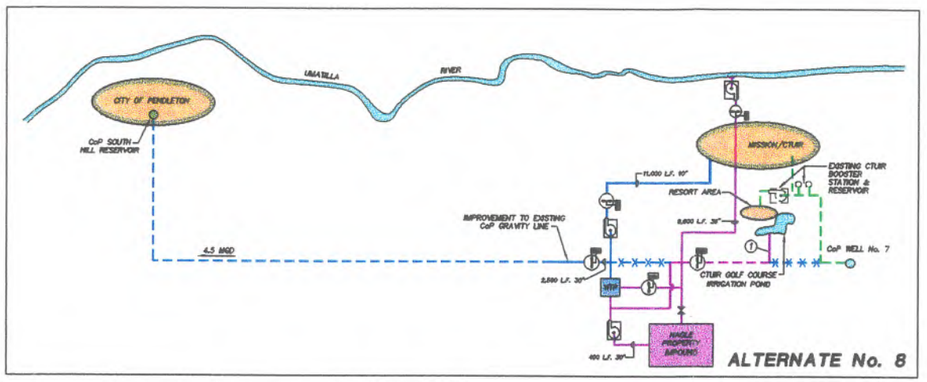
- SITE GRADING/DEVELOPMENT
- THREE PHASE POWER SERVICE
- CONTROL/MOITORING SYSTEM (SCADA)
- OPERATION & MAINTENANCE (O&M) EXPENSE
- IRRIGATION CONNECTION TO CTUIR GOLF COURSE
- IMPOUND
- FLOW METERING FACILITIES
- LAND ACQUISITION
- SITE DEWATERING

ADVANTAGES:

- CONSOLIDATES WTP & STORAGE WATER IMPOUND.
- UTILIZE EXISTING CoP GRAVITY PIPELINE.
- TREATED WATER TO SOUTH HILL SYSTEM FROM WTP WITHOUT NEED OF ADDITIONAL BOOSTER PUMP.
- WEST PATAWA IMPOUND OFFERS LARGE STORAGE POTENTIAL

DISADVANTAGES:

- POTENTIAL PROPERTY ACQUISITION COST.
- LONG LENGTH OF RAW WATER SUPPLY LINE.
- LONG LENGTH OF TREATED WATER SUPPLY LINE.
- RELIANCE ON INTEGRITY OF EXISTING CoP GRAVITY PIPELINE FOR TREATED WATER CONVEYANCE.
- WTP REMOTE FROM CoP.
- VANDALISM POTENTIAL.



ALTERNATE No. 8

ALTERNATIVE No. 8 - SUMMARY OF COST

INTAKE: CTUIR, WTP: NAGLE PROPERTY, IMPOUND: NAGLE PROPERTY

WATER TREATMENT PLANT (WTP), 5.0 MGD		$5,250,000
INTAKE MANIFOLD		$230,000
PIPELINES	L.F.	
36" W/ APPURTENANCES	9,600	$1,248,000
30" W/ APPURTENANCES	2,900	$275,500
10" W/ APPURTENANCES	11,000	$220,000
BOOSTER PUMP STATIONS (BPS)		
INTAKE BPS, 40 CFS		$750,000
IMPOUND BPS, 15 CFS		$220,000
MISSION DELIVERY BPS, 1 CFS		$65,000
SUBTOTAL		$8,258,500
ADMINISTRATION/ENGINEERING (15%)		$1,238,800
CONTINGENCY (20%)		$1,651,700
TOTAL		$11,149,000

COSTS NOT INCLUDED IN BUDGETARY ESTIMATE:

- SITE GRADING/DEVELOPMENT
- THREE PHASE POWER SERVICE
- CONTROL/MOITORING SYSTEM (SCADA)
- OPERATION & MAINTENANCE (O&M) EXPENSE
- IRRIGATION CONNECTION TO CTUIR GOLF COURSE
- IMPOUND
- FLOW METERING FACILITIES
- LAND ACQUISITION
- SITE DEWATERING

ADVANTAGES:

- CONSOLIDATES WTP & STORAGE WATER IMPOUND.
- IMPOUND PROPERTY UNDER CTUIR OWNERSHIP.
- UTILIZE EXISTING CoP GRAVITY PIPELINE.
- TREATED WATER TO SOUTH HILL SYSTEM FROM WTP WITHOUT NEED OF ADDITIONAL BOOSTER PUMP.

DISADVANTAGES:

- RELIANCE ON INTEGRITY OF EXISTING CoP GRAVITY PIPELINE FOR TREATED WATER CONVEYANCE.
- WTP REMOTE FROM CoP.
- VANDALISM POTENTIAL.
- POTENTIAL LACK OF LARGE STORAGE VOLUMES IN NAGLE PROPERTY IMPOUND

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CoP/CTUIR JOINT WATER PROJECT
SUMMARY OF COST
WTP/CONVEYANCE SYSTEMS
CoP/CTUIR OREGON

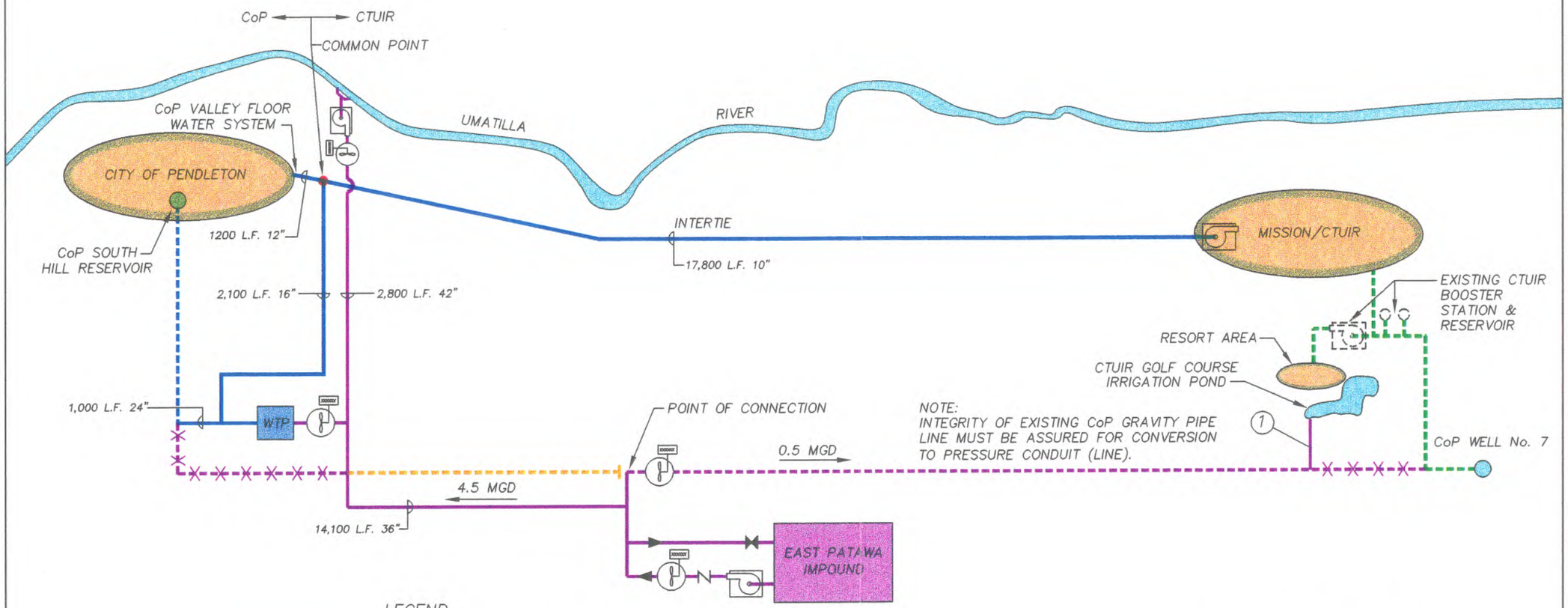
DESIGNED BY: DLU
DRAWN BY: kk
CHECKED BY: ____
APPROVED BY: ____

SCALE: N.T.S.
PROJECT NO. 06.1365.0001
FILE NAME: UMTLSUM4.DWG

SHEET **SUMMARY 4**

SECTION, TOWNSHIP, RANGE:

LAST EDIT: 5/13/99
PLOT DATE:



LEGEND

- PROPOSED TREATED (POTABLE) WATER
- TREATED (POTABLE) WATER CONVEYED INTO CoP SOUTH HILL RESERVOIR(S) VIA EXISTING GRAVITY LINE
- PROPOSED RAW WATER LINE
- EXISTING CoP GRAVITY LINE USED AS A PRESSURE LINE FOR RAW WATER DELIVERY TO CTUIR IRRIGATION
- ABANDON PORTION OF EXISTING CoP GRAVITY LINE
- EXISTING CTUIR WATER SYSTEM NETWORK
- EXISTING CoP GRAVITY LINE TO PROVIDE FUTURE PARALLEL LINE TO IMPOUND
- PROPOSED INTAKE STRUCTURE
- FLOW METERING FACILITY
- BOOSTER PUMP
- WTP — WATER TREATMENT PLANT
- (1) — RAW WATER TIE TO CTUIR GOLF COURSE
- ISOLATION VALVE (NO DURING IMPOUND FILL OPERATION) (NC DURING IMPOUND WITHDRAWAL)
- N — CHECK VALVE

ALTERNATIVE No.5

SITING – WATER PROJECT IMPROVEMENTS

INTAKE: CoP
WTP: UPPER GOAD ROAD
IMPOUND: EAST PATAWA

SEE APPENDIX III, SUMMARY SHEET 3 FOR COST INFORMATION

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CoP/CTUIR JOINT WATER PROJECT
IMPOUND/TREATMENT PLANT IMPROVEMENTS
SCHEMATIC DIAGRAM - ALTERNATIVE No. 5
CoP/CTUIR OREGON

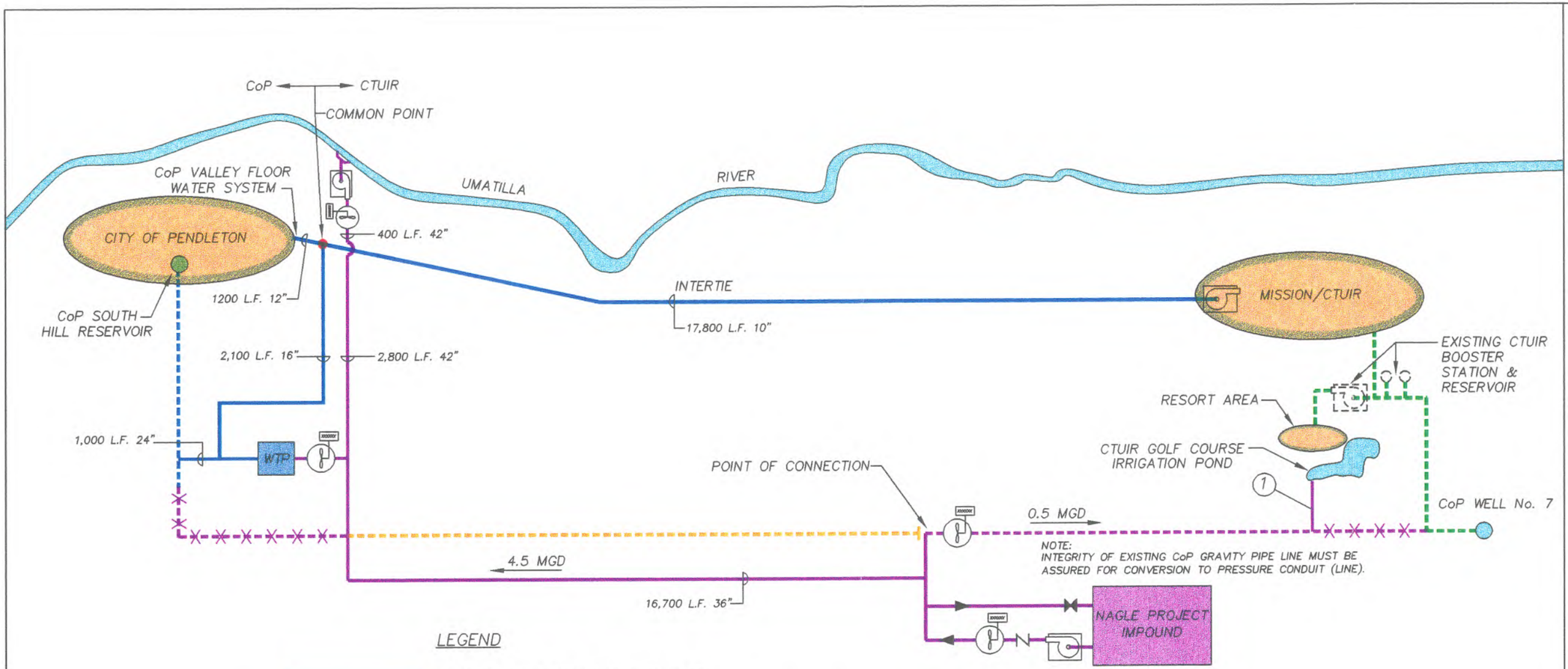
FILE NAME: UMITL10.DWG
PROJECT NO. 06.1365.0001
SCALE: N.T.S.

DESIGNED BY: DLU
DRAWN BY: kk
CHECKED BY:
APPROVED BY:

SHEET
SCHEMATIC No. 5

LAST EDIT: 4/20/99
PLOT DATE:

SECTION, TOWNSHIP, RANGE:



LEGEND

- PROPOSED TREATED (POTABLE) WATER
- TREATED (POTABLE) WATER CONVEYED INTO CoP SOUTH HILL RESERVOIR(S) VIA EXISTING GRAVITY LINE
- PROPOSED RAW WATER LINE
- EXISTING CoP GRAVITY LINE USED AS A PRESSURE LINE FOR RAW WATER DELIVERY TO CTUIR IRRIGATION
- ABANDON PORTION OF EXISTING CoP GRAVITY LINE
- EXISTING CTUIR WATER SYSTEM NETWORK
- EXISTING CoP GRAVITY LINE TO PROVIDE FUTURE PARALLEL LINE TO IMPOUND
- PROPOSED INTAKE STRUCTURE
- FLOW METERING FACILITY
- BOOSTER PUMP
- WTP — WATER TREATMENT PLANT
- (1) — RAW WATER TIE TO CTUIR GOLF COURSE
- ISOLATION VALVE (NO DURING IMPOUND FILL OPERATION) (NC DURING IMPOUND WITHDRAWAL)
- N — CHECK VALVE

ALTERNATIVE No.6

SITING – WATER PROJECT IMPROVEMENTS

INTAKE: CoP
WTP: UPPER GOAD ROAD
IMPOUND: NAGLE PROJECT

SEE APPENDIX III, SUMMARY SHEET 3 FOR COST INFORMATION

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CoP/CTUIR JOINT WATER PROJECT
IMPOUND/TREATMENT PLANT IMPROVEMENTS
SCHEMATIC DIAGRAM - ALTERNATIVE No. 6

CoP/CTUIR | OREGON

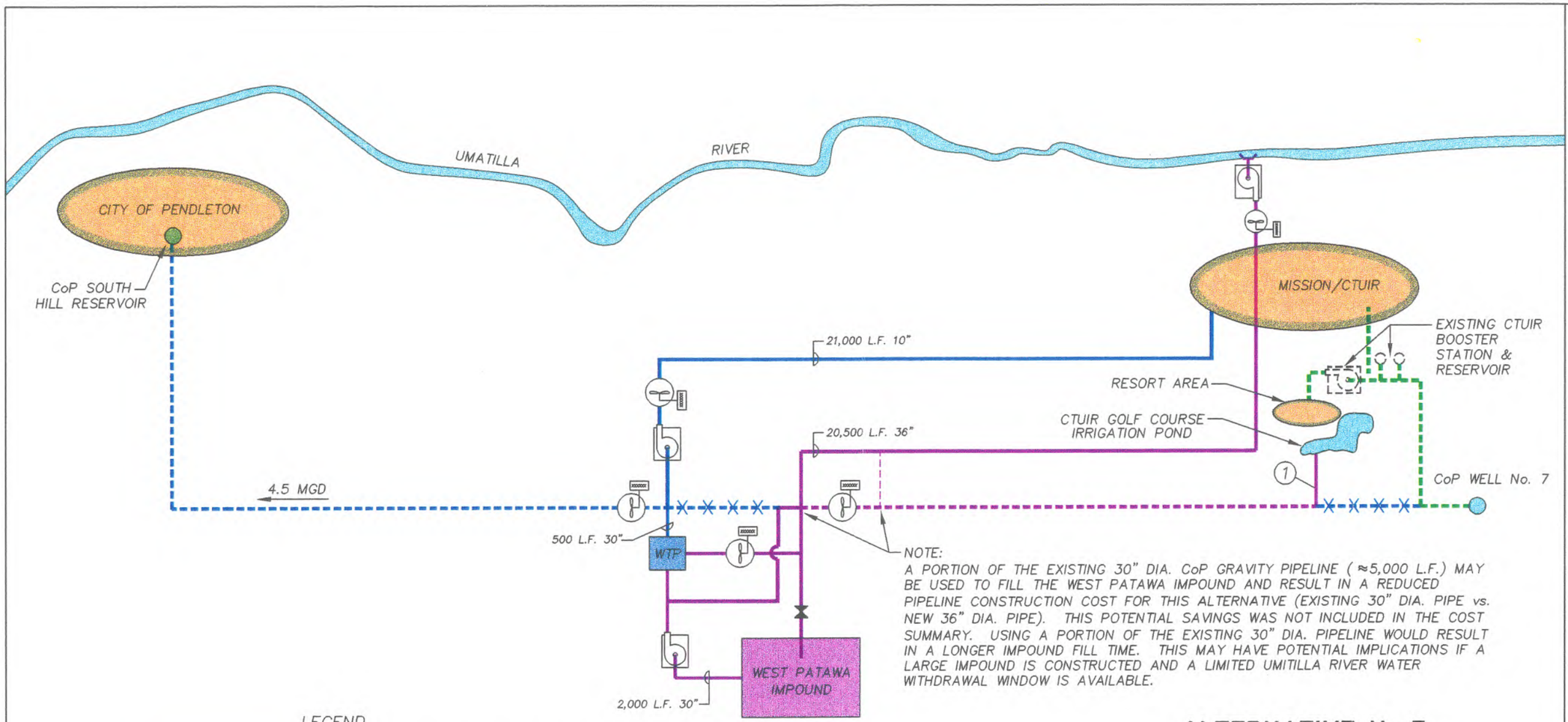
SCALE: N.T.S.
PROJECT NO. 06.1365.0001
FILE NAME: UMITIL9.DWG

DESIGNED BY: DLU
DRAWN BY: kk
CHECKED BY: ____
APPROVED BY: ____

SHEET
SCHEMATIC No. 6

SECTION, TOWNSHIP, RANGE:

LAST EDIT: 4/20/99
PLOT DATE:



LEGEND

- PROPOSED TREATED (POTABLE) WATER
- TREATED (POTABLE) WATER CONVEYED INTO CoP SOUTH HILL RESERVOIR(S) VIA EXISTING GRAVITY LINE
- ABANDON PORTION OF EXISTING CoP GRAVITY LINE
- PROPOSED RAW WATER LINE
- EXISTING CoP GRAVITY LINE USED AS A PRESSURE LINE FOR RAW WATER DELIVERY TO CTUIR IRRIGATION
- EXISTING CTUIR WATER SYSTEM NETWORK
- PROPOSED INTAKE STRUCTURE
- FLOW METERING FACILITY
- BOOSTER PUMP
- WTP — WATER TREATMENT PLANT
- (1) — RAW WATER TIE TO CTUIR GOLF COURSE
- ISOLATION VALVE (NO DURING IMPOUND FILL OPERATION) (NC DURING IMPOUND WITHDRAWAL)

ALTERNATIVE No.7

SITING – WATER PROJECT IMPROVEMENTS

INTAKE:	CTUIR
WTP:	WEST PATAWA
IMPOUND:	WEST PATAWA

SEE APPENDIX III, SUMMARY SHEET 4 FOR COST INFORMATION

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CoP/CTUIR JOINT WATER PROJECT
IMPOUND/TREATMENT PLANT IMPROVEMENTS
SCHEMATIC DIAGRAM - ALTERNATIVE No. 7
CoP/CTUIR OREGON

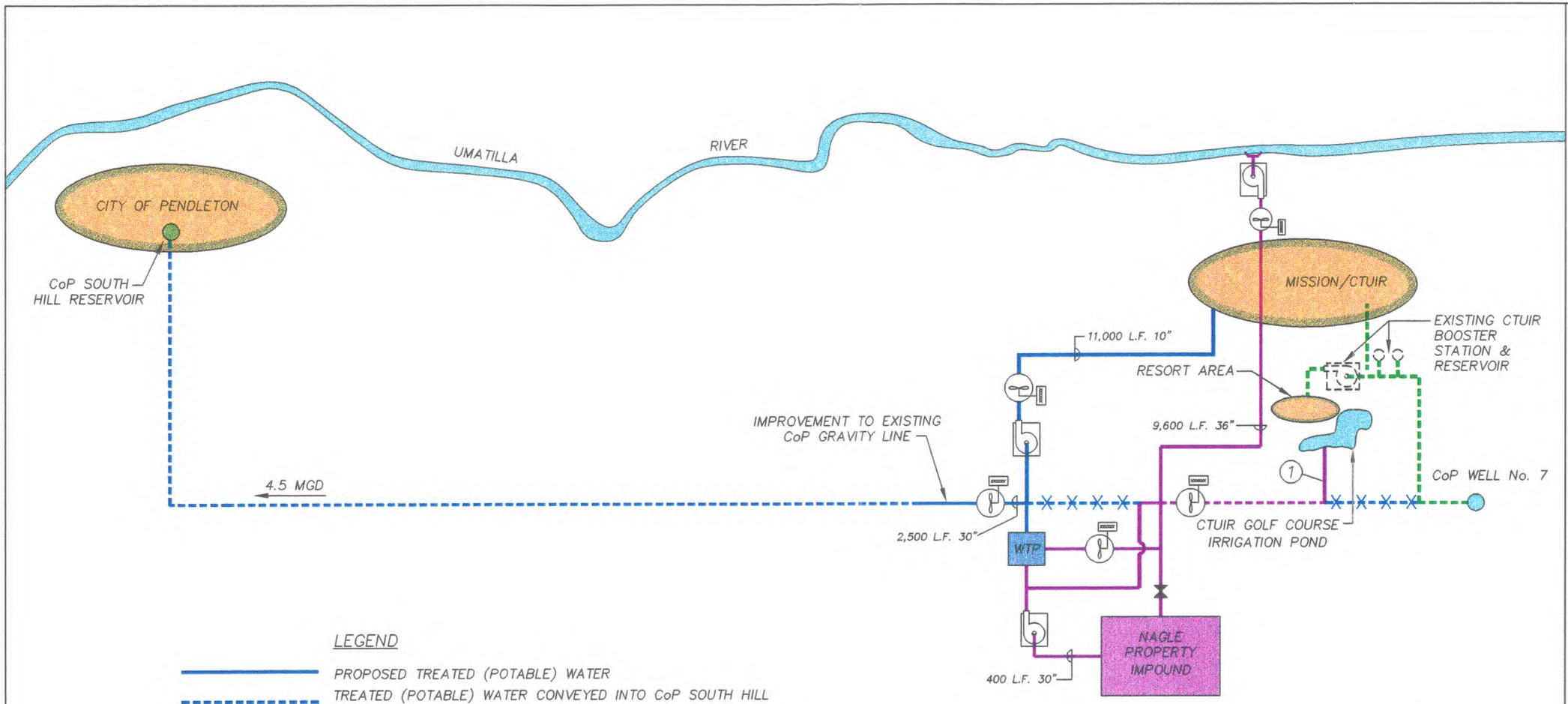
SCALE: N.T.S.
PROJECT NO. 06.1365.0001
FILE NAME: UMITIL15.DWG

DESIGNED BY: DLU
DRAWN BY: kk
CHECKED BY:
APPROVED BY:

SHEET **SCHEMATIC No. 7**

SECTION, TOWNSHIP, RANGE:

LAST EDIT: 4/20/99
PLOT DATE:



LEGEND

- PROPOSED TREATED (POTABLE) WATER
- TREATED (POTABLE) WATER CONVEYED INTO CoP SOUTH HILL RESERVOIR(S) VIA EXISTING GRAVITY LINE
- ABANDON PORTION OF EXISTING CoP GRAVITY LINE
- PROPOSED RAW WATER LINE
- EXISTING CoP GRAVITY LINE USED AS A PRESSURE LINE FOR RAW WATER DELIVERY TO CTUIR IRRIGATION
- EXISTING CTUIR WATER SYSTEM NETWORK
- PROPOSED INTAKE STRUCTURE
- FLOW METERING FACILITY
- BOOSTER PUMP
- WTP — WATER TREATMENT PLANT
- (1) — RAW WATER TIE TO CTUIR GOLF COURSE
- ISOLATION VALVE (NO DURING IMPOUND FILL OPERATION) (NC DURING IMPOUND WITHDRAWAL)

ALTERNATIVE No.8

SITING – WATER PROJECT IMPROVEMENTS

INTAKE: CTUIR
WTP: NAGLE PROPERTY
IMPOUND: NAGLE PROPERTY

SEE APPENDIX III, SUMMARY SHEET 4 FOR COST INFORMATION

CITY OF PENDLETON

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CoP/CTUIR JOINT WATER PROJECT
IMPOUND/TREATMENT PLANT IMPROVEMENTS
SCHEMATIC DIAGRAM - ALTERNATIVE No. 8
CoP/CTUIR — OREGON

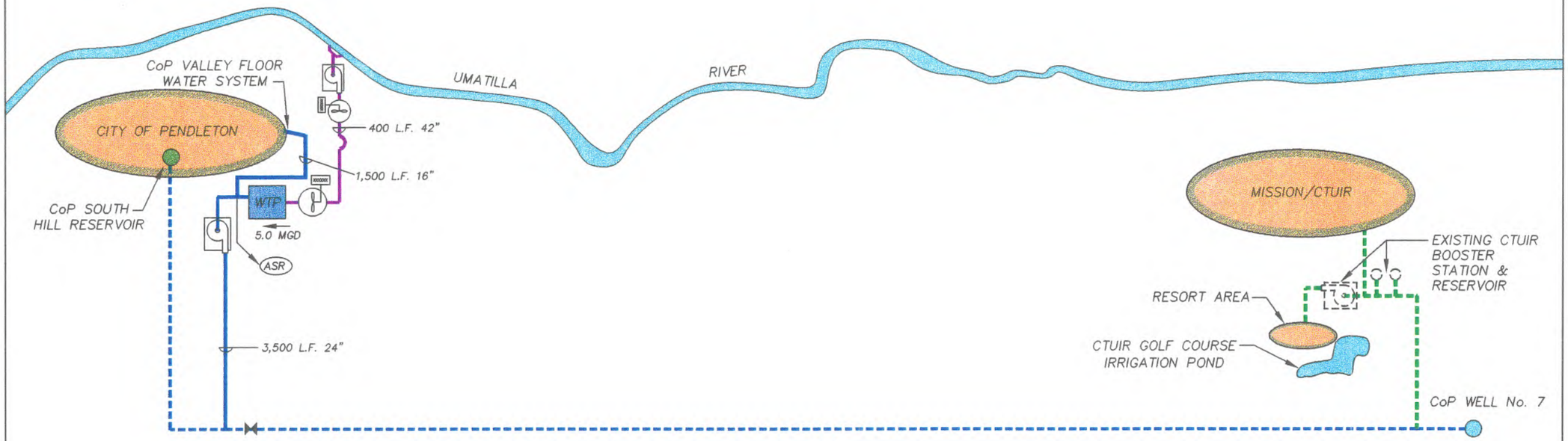
SCALE: N.T.S.
PROJECT NO. 06.1365.0001
FILE NAME: UMITIL16.DWG

DESIGNED BY: DLU
DRAWN BY: kk
CHECKED BY:
APPROVED BY:

SHEET
SCHEMATIC No. 8

SECTION, TOWNSHIP, RANGE:

LAST EDIT: 4/20/99
PLOT DATE:



LEGEND

- PROPOSED TREATED (POTABLE) WATER
- TREATED (POTABLE) WATER CONVEYED INTO CoP SOUTH HILL RESERVOIR(S) VIA EXISTING GRAVITY LINE
- PROPOSED RAW WATER LINE
- EXISTING CTUIR WATER SYSTEM NETWORK
- PROPOSED INTAKE STRUCTURE
- FLOW METERING FACILITY
- BOOSTER PUMP
- WTP — WATER TREATMENT PLANT
- ISOLATION VALVE

ALTERNATIVE No.9

SITING – WATER PROJECT IMPROVEMENTS

INTAKE: CoP
WTP: LOWER GOAD ROAD
IMPOUND: NONE (USE ASR)

SEE APPENDIX III, SUMMARY SHEET 5 FOR COST INFORMATION

CITY OF PENDLETON

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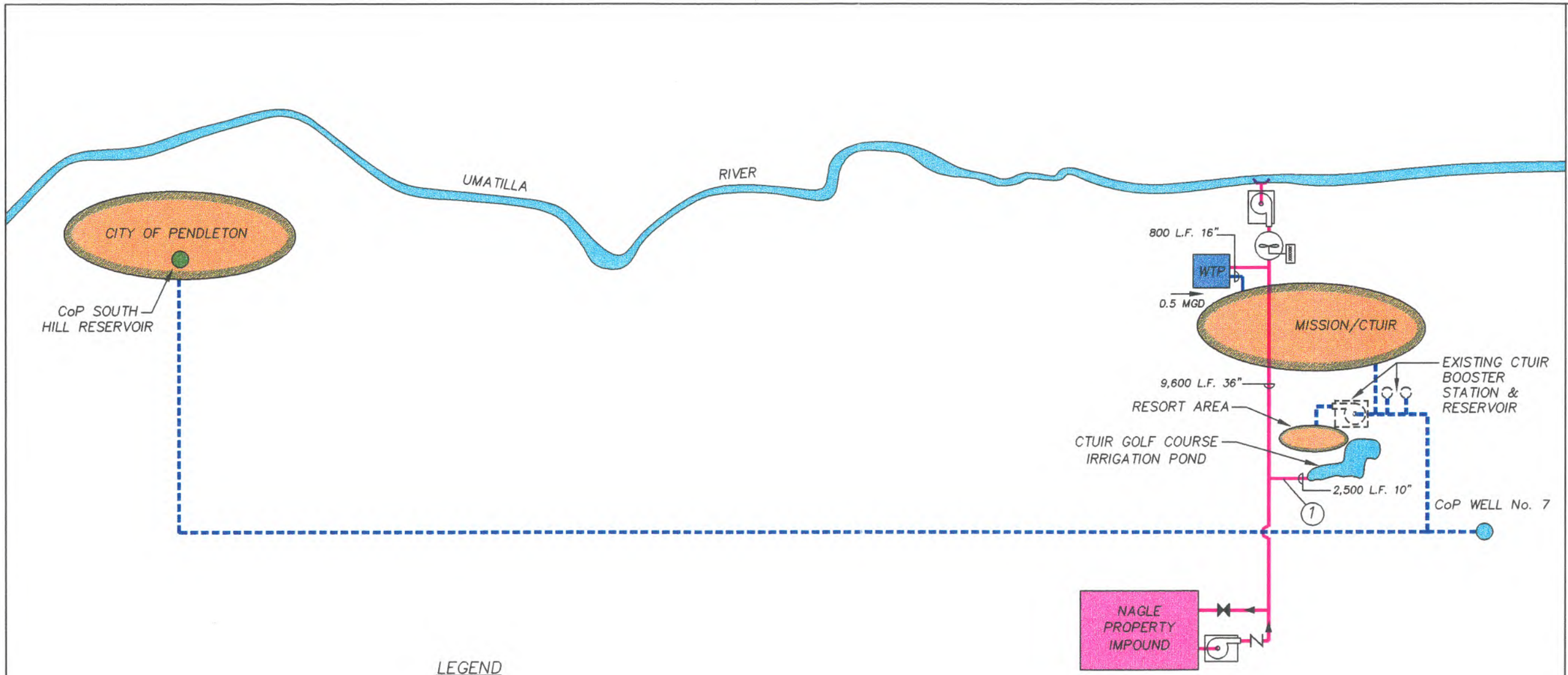
CoP/CTUIR JOINT WATER PROJECT
IMPOUND/TREATMENT PLANT IMPROVEMENTS
SCHEMATIC DIAGRAM - ALTERNATIVE No. 9
CoP/CTUIR OREGON

FILE NAME: UMITIL17.DWG
PROJECT NO. 06.1365.0001
SCALE: N.T.S.
DESIGNED BY: DLU
DRAWN BY: kk
CHECKED BY: ____
APPROVED BY: ____

SHEET **SCHEMATIC No. 9**

LAST EDIT: 5/13/99
PLOT DATE:

SECTION, TOWNSHIP, RANGE:



LEGEND

- PROPOSED TREATED (POTABLE) WATER
- TREATED (POTABLE) WATER CONVEYED INTO CoP SOUTH HILL RESERVOIR(S) AND CTUIR VIA EXISTING GRAVITY LINE (TO REMAIN IN ITS CURRENT STATE)
- PROPOSED RAW WATER LINE
- PROPOSED INTAKE STRUCTURE
- FLOW METERING FACILITY
- BOOSTER PUMP
- WTP — WATER TREATMENT PLANT
- (1) — RAW WATER TIE TO CTUIR GOLF COURSE
- ISOLATION VALVE (NO DURING IMPOUND FILL OPERATION) (NC DURING IMPOUND WITHDRAWAL)
- CHECK VALVE

ALTERNATIVE No.10
(CTUIR "STAND ALONE" WATER SYSTEM)

SITING – WATER PROJECT IMPROVEMENTS

INTAKE: CTUIR
WTP: MISSION
IMPOUND: NAGLE PROPERTY

SEE APPENDIX III, SUMMARY SHEET 5 FOR COST INFORMATION

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CoP/CTUIR JOINT WATER PROJECT
IMPOUND/TREATMENT PLANT IMPROVEMENTS
SCHEMATIC DIAGRAM - ALTERNATIVE No. 10
CoP/CTUIR OREGON

SCALE: N.T.S.
PROJECT NO. 06.1365.0001
FILE NAME: UMITIL11.DWG

DESIGNED BY: DLU
DRAWN BY: kk
CHECKED BY:
APPROVED BY:

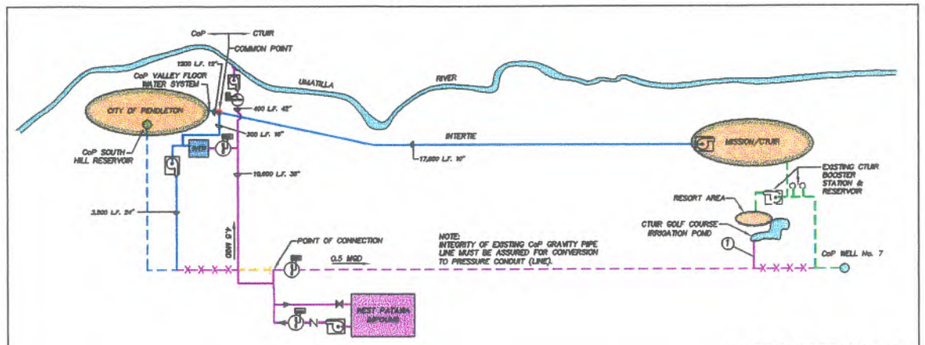
SHEET
SCHEMATIC No. 10

LAST EDIT: 4/20/99
PLOT DATE:

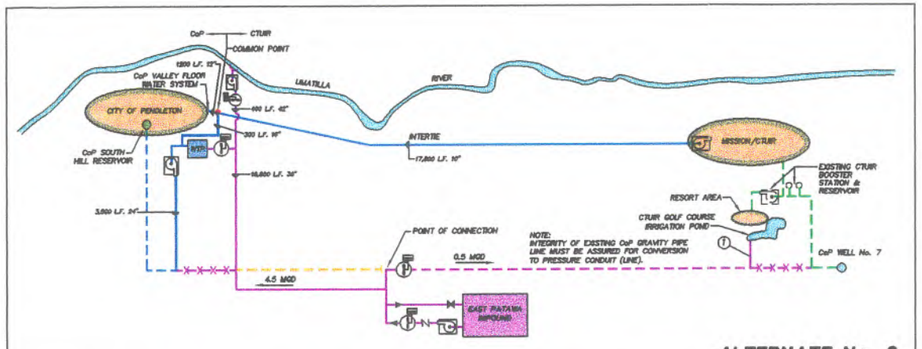
SECTION, TOWNSHIP, RANGE:

APPENDIX III SUMMARY OF COST

III.A Summary of Cost – WTP/Conveyance Systems



ALTERNATE No. 1



ALTERNATE No. 2

ALTERNATIVE No. 1 - SUMMARY OF COST

INTAKE: CoP, WTP: LOWER GOAD ROAD, IMPOUND: WEST PATAWA

WATER TREATMENT PLANT (WTP), 5.0 MGD		$5,250,000
INTAKE MANIFOLD		$250,000
PIPELINES	L.F.	
42" W/ APPURTENANCES	400	$64,000
36" W/ APPURTENANCES	10,600	$1,378,000
24" W/ APPURTENANCES	3,500	$245,000
16" W/ APPURTENANCES	300	$11,400
12" W/ APPURTENANCES	1,200	$28,800
10" W/ APPURTENANCES	17,800	$356,000
BOOSTER PUMP STATIONS (BPS)		
INTAKE BPS, 50 CFS		$750,000
IMPOUND BPS, 15 CFS		$220,000
SOUTH HILL ZONE BPS, 10 CFS		$160,000
MISSION INTERTIE BPS, 1 CFS		$75,000
SUBTOTAL		$8,788,200
ADMINISTRATION/ENGINEERING (15%)		$1,318,200
CONTINGENCY (20%)		$1,757,600
TOTAL		**$11,864,000**

COSTS NOT INCLUDED IN BUDGETARY ESTIMATE:

- SITE GRADING/DEVELOPMENT
- THREE PHASE POWER SERVICE
- CONTROL/MOITORING SYSTEM (SCADA)
- OPERATION & MAINTENANCE (O&M) EXPENSE
- IRRIGATION CONNECTION TO CTUIR GOLF COURSE
- IMPOUND
- FLOW METERING FACILITIES
- LAND ACQUISITION
- SITE DEWATERING
- UPGRADING EXISTING CoP GRAVITY LINE

ADVANTAGES:

- CONSOLIDATES INTAKE BOOSTER PUMP STATION & WTP.
- AVAILABILITY OF THREE PHASE POWER.
- UTILIZE EXISTING CoP GRAVITY PIPELINE.
- SUITABLE SITE FOR ASR (NEAR EXISTING WATER SYSTEM INFRASTRUCTURE).
- WEST PATAWA IMPOUND OFFERS LARGE STORAGE POTENTIAL

DISADVANTAGES:

- POTENTIAL PROPERTY ACQUISITION COST.
- BOOSTER PUMP STATION REQUIRED FOR SOUTH HILL ZONE.
- RELIANCE ON INTEGRITY OF EXISTING CoP GRAVITY FOR USE AS A PRESSURE CONDUIT.

ALTERNATIVE No. 2 - SUMMARY OF COST

INTAKE: CoP, WTP: LOWER GOAD ROAD, IMPOUND: EAST PATAWA

WATER TREATMENT PLANT (WTP), 5.0 MGD		$5,250,000
INTAKE MANIFOLD		$250,000
PIPELINES	L.F.	
42" W/ APPURTENANCES	400	$64,000
36" W/ APPURTENANCES	16,800	$2,184,000
24" W/ APPURTENANCES	3,500	$245,000
16" W/ APPURTENANCES	300	$11,400
12" W/ APPURTENANCES	1,200	$28,800
10" W/ APPURTENANCES	17,800	$356,000
BOOSTER PUMP STATIONS (BPS)		
INTAKE BPS, 50 CFS		$750,000
IMPOUND BPS, 15 CFS		$220,000
SOUTH HILL ZONE BPS, 10 CFS		$160,000
MISSION INTERTIE BPS, 1 CFS		$75,000
SUBTOTAL		$9,594,200
ADMINISTRATION/ENGINEERING (15%)		$1,439,100
CONTINGENCY (20%)		$1,198,800
TOTAL		**$12,952,100**

COSTS NOT INCLUDED IN BUDGETARY ESTIMATE:

- SITE GRADING/DEVELOPMENT
- THREE PHASE POWER SERVICE
- CONTROL/MOITORING SYSTEM (SCADA)
- OPERATION & MAINTENANCE (O&M) EXPENSE
- IRRIGATION CONNECTION TO CTUIR GOLF COURSE
- IMPOUND
- FLOW METERING FACILITIES
- LAND ACQUISITION
- SITE DEWATERING
- UPGRADING EXISTING CoP GRAVITY LINE

ADVANTAGES:

- CONSOLIDATES INTAKE BOOSTER PUMP STATION & WTP.
- AVAILABILITY OF THREE PHASE POWER.
- UTILIZE EXISTING CoP GRAVITY PIPELINE.
- SUITABLE SITE FOR ASR (NEAR EXISTING WATER SYSTEM INFRASTRUCTURE).
- EAST PATAWA IMPOUND OFFERS UP TO APPROXIMATELY 4,000 AC.-FT. OF STORAGE POTENTIAL

DISADVANTAGES:

- POTENTIAL PROPERTY ACQUISITION COST.
- BOOSTER PUMP STATION REQUIRED FOR SOUTH HILL ZONE.
- LONG LENGTH OF RAW WATER SUPPLY LINE.
- RELIANCE ON INTEGRITY OF EXISTING CoP GRAVITY FOR USE AS A PRESSURE CONDUIT

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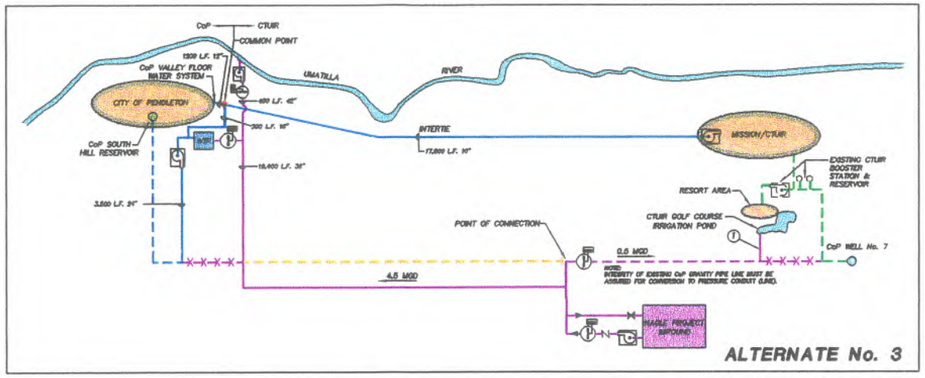
CoP/CTUIR JOINT WATER PROJECT
SUMMARY OF COST - WTP/CONVEYANCE SYSTEMS
CoP/CTUIR OREGON

PROJECT NO. 06.1365.0001
FILE NAME: UMTLSUM1.DWG
SCALE: N.T.S.
PLOT DATE:
LAST EDIT: 5/13/99

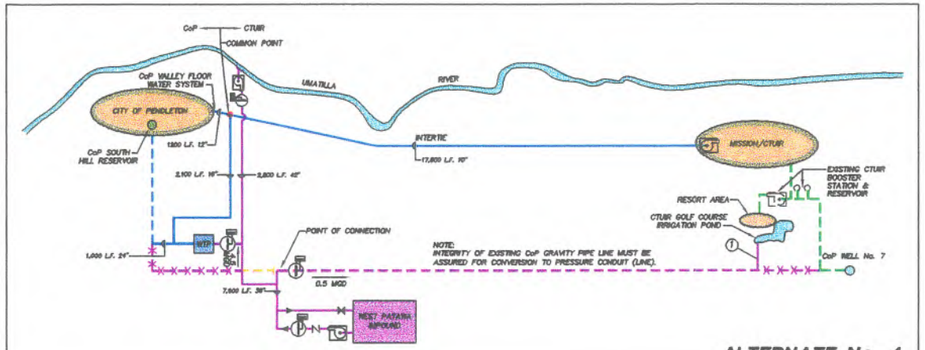
DESIGNED BY: DLU
DRAWN BY: kk
CHECKED BY: ____
APPROVED BY: ____

SHEET **SUMMARY 1**

SECTION, TOWNSHIP, RANGE:



ALTERNATE No. 3



ALTERNATE No. 4

ALTERNATIVE No. 3 - SUMMARY OF COST

INTAKE: CoP, WTP: LOWER GOAD ROAD, IMPOUND: NAGLE PROPERTY

WATER TREATMENT PLANT (WTP), 5.0 MGD		$5,250,000
INTAKE MANIFOLD		$250,000
PIPELINES	L.F.	
42" W/ APPURTENANCES	400	$64,000
36" W/ APPURTENANCES	19,400	$2,522,000
24" W/ APPURTENANCES	3,500	$245,000
16" W/ APPURTENANCES	300	$11,400
12" W/ APPURTENANCES	1,200	$28,800
10" W/ APPURTENANCES	17,800	$356,000
BOOSTER PUMP STATIONS (BPS)		
INTAKE BPS, 50 CFS		$790,000
IMPOUND BPS, 15 CFS		$220,000
SOUTH HILL ZONE BPS, 10 CFS		$160,000
MISSION INTERTIE BPS, 1 CFS		$75,000
SUBTOTAL		$9,972,200
ADMINISTRATION/ENGINEERING (15%)		$1,495,800
CONTINGENCY (20%)		$1,994,400
TOTAL		$13,462,400

COSTS NOT INCLUDED IN BUDGETARY ESTIMATE:

- SITE GRADING/DEVELOPMENT
- THREE PHASE POWER SERVICE
- CONTROL/MOITORING SYSTEM (SCADA)
- OPERATION & MAINTENANCE (O&M) EXPENSE
- IRRIGATION CONNECTION TO CTUIR GOLF COURSE
- IMPOUND
- FLOW METERING FACILITIES
- LAND ACQUISITION
- SITE DEWATERING
- UPGRADING EXISTING CoP GRAVITY LINE

ADVANTAGES:

- CONSOLIDATES INTAKE BOOSTER PUMP STATION & WTP.
- IMPOUND PROPERTY UNDER CTUIR OWNERSHIP.
- AVAILABILITY OF THREE PHASE POWER.
- UTILIZE EXISTING CoP GRAVITY PIPELINE.
- SUITABLE SITE FOR ASR (NEAR EXISTING WATER SYSTEM INFRASTRUCTURE).

DISADVANTAGES:

- BOOSTER PUMP STATION REQUIRED FOR SOUTH HILL ZONE.
- LONG LENGTH OF RAW WATER SUPPLY LINE.
- RELIANCE ON INTEGRITY OF EXISTING CoP GRAVITY PIPELINE FOR TREATED WATER CONVEYANCE.
- RELIANCE ON INTEGRITY OF EXISTING CoP GRAVITY FOR USE AS A PRESSURE CONDUIT
- POTENTIAL LACK OF LARGE STORAGE VOLUMES IN NAGLE PROPERTY IMPOUND

ALTERNATIVE No. 4 - SUMMARY OF COST

INTAKE: CoP, WTP: UPPER GOAD ROAD, IMPOUND: WEST PATAWA

WATER TREATMENT PLANT (WTP), 5.0 MGD		$5,250,000
INTAKE MANIFOLD		$250,000
PIPELINES	L.F.	
42" W/ APPURTENANCES	2,800	$448,000
36" W/ APPURTENANCES	7,900	$1,027,000
24" W/ APPURTENANCES	1,000	$70,000
16" W/ APPURTENANCES	2,100	$79,800
12" W/ APPURTENANCES	1,200	$28,800
10" W/ APPURTENANCES	17,800	$356,000
BOOSTER PUMP STATIONS (BPS)		
INTAKE BPS, 50 CFS		$750,000
IMPOUND BPS, 15 CFS		$220,000
MISSION INTERTIE BPS, 1 CFS		$75,000
SUBTOTAL		$8,554,600
ADMINISTRATION/ENGINEERING (15%)		$1,283,200
CONTINGENCY (20%)		$1,710,900
TOTAL		$11,548,700

COSTS NOT INCLUDED IN BUDGETARY ESTIMATE:

- SITE GRADING/DEVELOPMENT
- THREE PHASE POWER SERVICE
- CONTROL/MOITORING SYSTEM (SCADA)
- OPERATION & MAINTENANCE (O&M) EXPENSE
- IRRIGATION CONNECTION TO CTUIR GOLF COURSE
- IMPOUND
- FLOW METERING FACILITIES
- LAND ACQUISITION
- SITE DEWATERING
- UPGRADING EXISTING CoP GRAVITY LINE

ADVANTAGES:

- AVAILABILITY OF THREE PHASE POWER.
- UTILIZE EXISTING CoP GRAVITY PIPELINE.
- TREATED WATER TO SOUTH HILL SYSTEM FROM WTP WITHOUT NEED OF ADDITIONAL BOOSTER PUMP.
- SUITABLE SITE FOR ASR
- WEST PATAWA IMPOUND OFFERS LARGE STORAGE POTENTIAL

DISADVANTAGES:

- POTENTIAL PROPERTY ACQUISITION COST.
- RELIANCE ON INTEGRITY OF EXISTING CoP GRAVITY PIPELINE FOR TREATED WATER CONVEYANCE.
- SEPARATE THREE PHASE POWER SERVICE TO EACH MAJOR INFRASTRUCTURE COMPONENT.
- RELIANCE ON INTEGRITY OF EXISTING CoP GRAVITY FOR USE AS A PRESSURE CONDUIT

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CoP/CTUIR JOINT WATER PROJECT
SUMMARY OF COST
WTP/CONVEYANCE SYSTEMS
OREGON

CoP/CTUIR
SCALE: N.T.S.
PROJECT NO. 06.1365.0001
FILE NAME: UMTLSUM2.DWG

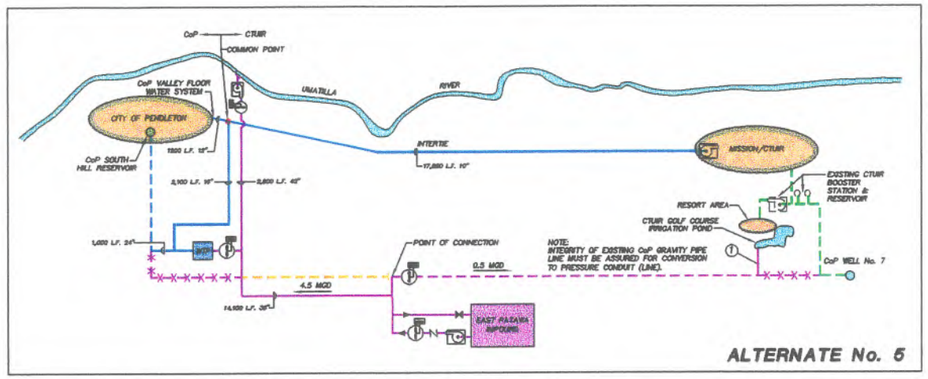
DESIGNED BY: DLU
DRAWN BY: kk
CHECKED BY: ____
APPROVED BY: ____

SHEET
SUMMARY 2

SECTION, TOWNSHIP, RANGE:

LAST EDIT: 5/13/99

PLOT DATE:



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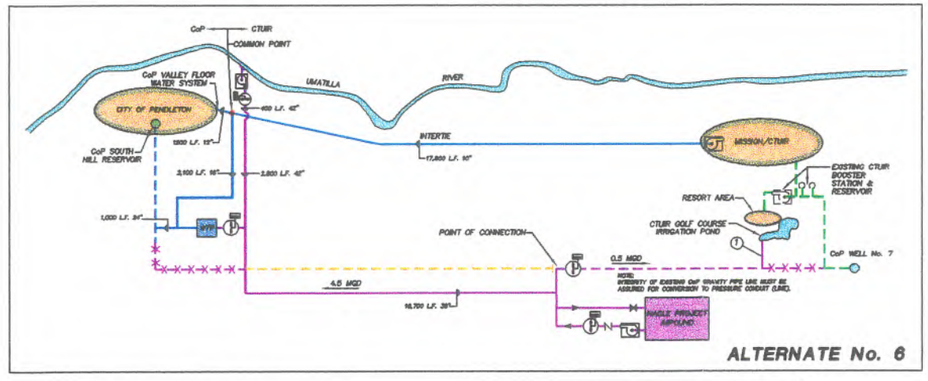

ALTERNATE No. 6

ALTERNATIVE No. 5 - SUMMARY OF COST

INTAKE: CoP, WTP: UPPER GOAD ROAD, IMPOUND: EAST PATAWA

WATER TREATMENT PLANT (WTP), 5.0 MGD		$5,250,000
INTAKE MANIFOLD		$250,000
PIPELINES	L.F.	
42" W/ APPURTENANCES	2,800	$448,000
36" W/ APPURTENANCES	14,100	$1,833,000
24" W/ APPURTENANCES	1,000	$70,000
16" W/ APPURTENANCES	2,100	$79,800
12" W/ APPURTENANCES	1,200	$28,800
10" W/ APPURTENANCES	17,800	$356,000
BOOSTER PUMP STATIONS (BPS)		
INTAKE BPS, 50 CFS		$770,000
IMPOUND BPS, 15 CFS		$220,000
MISSION INTERTIE BPS, 1 CFS		$75,000
SUBTOTAL		$9,380,600
ADMINISTRATION/ENGINEERING (15%)		$1,407,100
CONTINGENCY (20%)		$1,876,100
TOTAL		$12,663,800

COSTS NOT INCLUDED IN BUDGETARY ESTIMATE:

- SITE GRADING/DEVELOPMENT
- THREE PHASE POWER SERVICE
- CONTROL/MOITORING SYSTEM (SCADA)
- OPERATION & MAINTENANCE (O&M) EXPENSE
- IRRIGATION CONNECTION TO CTUIR GOLF COURSE
- IMPOUND
- FLOW METERING FACILITIES
- LAND ACQUISITION
- SITE DEWATERING
- UPGRADING EXISTING CoP GRAVITY LINE

ADVANTAGES:

- AVAILABILITY OF THREE PHASE POWER.
- UTILIZE EXISTING CoP GRAVITY PIPELINE.
- TREATED WATER TO SOUTH HILL SYSTEM FROM WTP WITHOUT NEED OF ADDITIONAL BOOSTER PUMP.
- SUITABLE SITE FOR ASR
- EAST PATAWA IMPOUND OFFERS UP TO APPROXIMATELY 4,000 AC.-FT. OF STORAGE POTENTIAL

DISADVANTAGES:

- POTENTIAL PROPERTY ACQUISITION COST.
- LONG LENGTH OF RAW WATER SUPPLY LINE.
- RELIANCE ON INTEGRITY OF EXISTING CoP GRAVITY PIPELINE FOR TREATED WATER CONVEYANCE.
- SEPARATE THREE PHASE POWER SERVICE TO EACH MAJOR INFRASTRUCTURE COMPONENT.
- RELIANCE ON INTEGRITY OF EXISTING CoP GRAVITY FOR USE AS A PRESSURE CONDUIT

ALTERNATIVE No. 6 - SUMMARY OF COST

INTAKE: CoP, WTP: UPPER GOAD ROAD, IMPOUND: NAGLE PROPERTY

WATER TREATMENT PLANT (WTP), 5.0 MGD		$5,250,000
INTAKE MANIFOLD		$250,000
PIPELINES	L.F.	
42" W/ APPURTENANCES	2,800	$448,000
36" W/ APPURTENANCES	16,700	$2,171,000
24" W/ APPURTENANCES	1,000	$70,000
16" W/ APPURTENANCES	2,100	$79,800
12" W/ APPURTENANCES	1,200	$28,800
10" W/ APPURTENANCES	17,800	$356,000
BOOSTER PUMP STATIONS (BPS)		
INTAKE BPS, 50 CFS		$790,000
IMPOUND BPS, 15 CFS		$220,000
MISSION INTERTIE BPS, 1 CFS		$75,000
SUBTOTAL		$9,738,600
ADMINISTRATION/ENGINEERING (15%)		$1,460,800
CONTINGENCY (20%)		$1,947,700
TOTAL		$13,147,100

COSTS NOT INCLUDED IN BUDGETARY ESTIMATE:

- SITE GRADING/DEVELOPMENT
- THREE PHASE POWER SERVICE
- CONTROL/MOITORING SYSTEM (SCADA)
- OPERATION & MAINTENANCE (O&M) EXPENSE
- IRRIGATION CONNECTION TO CTUIR GOLF COURSE
- IMPOUND
- FLOW METERING FACILITIES
- LAND ACQUISITION
- SITE DEWATERING
- UPGRADING EXISTING CoP GRAVITY LINE

ADVANTAGES:

- IMPOUND PROPERTY UNDER CTUIR OWNERSHIP.
- AVAILABILITY OF THREE PHASE POWER.
- UTILIZE EXISTING CoP GRAVITY PIPELINE.
- TREATED WATER TO SOUTH HILL SYSTEM FROM WTP WITHOUT NEED OF ADDITIONAL BOOSTER PUMP.
- SUITABLE SITE FOR ASR

DISADVANTAGES:

- LONG LENGTH OF RAW WATER SUPPLY LINE.
- RELIANCE ON INTEGRITY OF EXISTING CoP GRAVITY PIPELINE FOR TREATED WATER CONVEYANCE.
- SEPARATE THREE PHASE POWER SERVICE TO EACH MAJOR INFRASTRUCTURE COMPONENT.
- RELIANCE ON INTEGRITY OF EXISTING CoP GRAVITY FOR USE AS A PRESSURE CONDUIT
- POTENTIAL LACK OF LARGE STORAGE VOLUMES IN NAGLE PROPERTY IMPOUND

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CoP/CTUIR JOINT WATER PROJECT
SUMMARY OF COST
WTP/CONVEYANCE SYSTEMS
CoP/CTUIR
OREGON

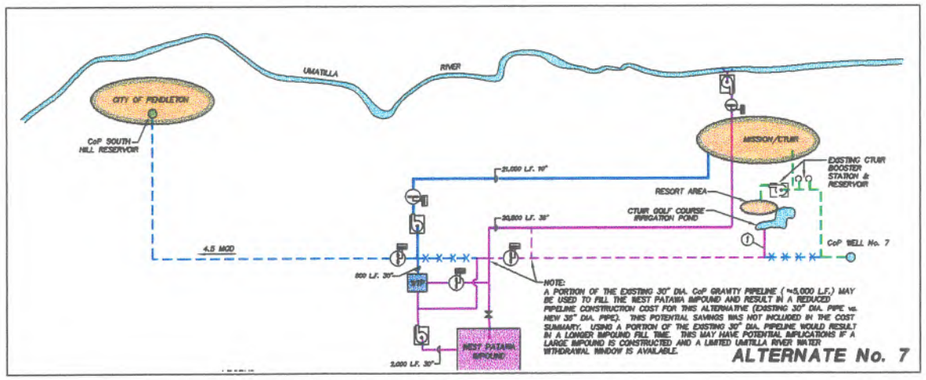
DESIGNED BY: DLU
DRAWN BY: kk
CHECKED BY:
APPROVED BY:

SCALE: N.T.S.
PROJECT NO. 06.1365.0001
FILE NAME: UMTLSUM3.DWG

SHEET
SUMMARY 3

SECTION, TOWNSHIP, RANGE:

LAST EDIT: 5/13/99
PLOT DATE:



ALTERNATE No. 7

ALTERNATIVE No. 7 - SUMMARY OF COST

INTAKE: CTUIR, WTP: WEST PATAVIA, IMPOUND: WEST PATAWA

WATER TREATMENT PLANT (WTP), 5.0 MGD		$5,250,000
INTAKE MANIFOLD		$230,000
PIPELINES	L.F.	
36" W/ APPURTENANCES	20,500	$2,665,000
30" W/ APPURTENANCES	2,500	$237,500
10" W/ APPURTENANCES	21,000	$420,000
BOOSTER PUMP STATIONS (BPS)		
INTAKE BPS, 40 CFS		$750,000
IMPOUND BPS, 15 CFS		$220,000
MISSION DELIVERY BPS, 1 CFS		$65,000
SUBTOTAL		$9,837,500
ADMINISTRATION/ENGINEERING (15%)		$1,475,600
CONTINGENCY (20%)		$1,967,500
TOTAL		$13,280,600

COSTS NOT INCLUDED IN BUDGETARY ESTIMATE:

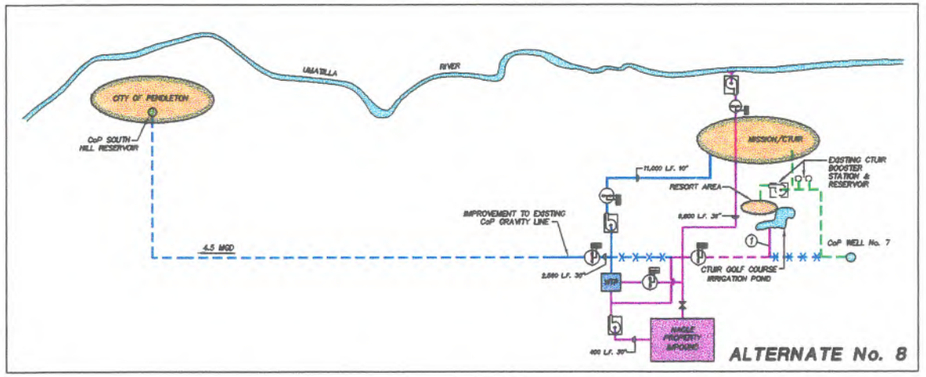
- SITE GRADING/DEVELOPMENT
- THREE PHASE POWER SERVICE
- CONTROL/MOITORING SYSTEM (SCADA)
- OPERATION & MAINTENANCE (O&M) EXPENSE
- IRRIGATION CONNECTION TO CTUIR GOLF COURSE
- IMPOUND
- FLOW METERING FACILITIES
- LAND ACQUISITION
- SITE DEWATERING

ADVANTAGES:

- CONSOLIDATES WTP & STORAGE WATER IMPOUND.
- UTILIZE EXISTING CoP GRAVITY PIPELINE.
- TREATED WATER TO SOUTH HILL SYSTEM FROM WTP WITHOUT NEED OF ADDITIONAL BOOSTER PUMP.
- WEST PATAWA IMPOUND OFFERS LARGE STORAGE POTENTIAL

DISADVANTAGES:

- POTENTIAL PROPERTY ACQUISITION COST.
- LONG LENGTH OF RAW WATER SUPPLY LINE.
- LONG LENGTH OF TREATED WATER SUPPLY LINE.
- RELIANCE ON INTEGRITY OF EXISTING CoP GRAVITY PIPELINE FOR TREATED WATER CONVEYANCE.
- WTP REMOTE FROM CoP.
- VANDALISM POTENTIAL.



ALTERNATE No. 8

ALTERNATIVE No. 8 - SUMMARY OF COST

INTAKE: CTUIR, WTP: NAGLE PROPERTY, IMPOUND: NAGLE PROPERTY

WATER TREATMENT PLANT (WTP), 5.0 MGD		$5,250,000
INTAKE MANIFOLD		$230,000
PIPELINES	L.F.	
36" W/ APPURTENANCES	9,600	$1,248,000
30" W/ APPURTENANCES	2,900	$275,500
10" W/ APPURTENANCES	11,000	$220,000
BOOSTER PUMP STATIONS (BPS)		
INTAKE BPS, 40 CFS		$750,000
IMPOUND BPS, 15 CFS		$220,000
MISSION DELIVERY BPS, 1 CFS		$65,000
SUBTOTAL		$8,258,500
ADMINISTRATION/ENGINEERING (15%)		$1,238,800
CONTINGENCY (20%)		$1,651,700
TOTAL		$11,149,000

COSTS NOT INCLUDED IN BUDGETARY ESTIMATE:

- SITE GRADING/DEVELOPMENT
- THREE PHASE POWER SERVICE
- CONTROL/MOITORING SYSTEM (SCADA)
- OPERATION & MAINTENANCE (O&M) EXPENSE
- IRRIGATION CONNECTION TO CTUIR GOLF COURSE
- IMPOUND
- FLOW METERING FACILITIES
- LAND ACQUISITION
- SITE DEWATERING

ADVANTAGES:

- CONSOLIDATES WTP & STORAGE WATER IMPOUND.
- IMPOUND PROPERTY UNDER CTUIR OWNERSHIP.
- UTILIZE EXISTING CoP GRAVITY PIPELINE.
- TREATED WATER TO SOUTH HILL SYSTEM FROM WTP WITHOUT NEED OF ADDITIONAL BOOSTER PUMP.

DISADVANTAGES:

- RELIANCE ON INTEGRITY OF EXISTING CoP GRAVITY PIPELINE FOR TREATED WATER CONVEYANCE.
- WTP REMOTE FROM CoP.
- VANDALISM POTENTIAL.
- POTENTIAL LACK OF LARGE STORAGE VOLUMES IN NAGLE PROPERTY IMPOUND

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CoP/CTUIR JOINT WATER PROJECT
SUMMARY OF COST
WTP/CONVEYANCE SYSTEMS
OREGON

CoP/CTUIR

SCALE: N.T.S.	PROJECT NO. 06.1365.0001
FILE NAME: UMTLSUM4.DWG	

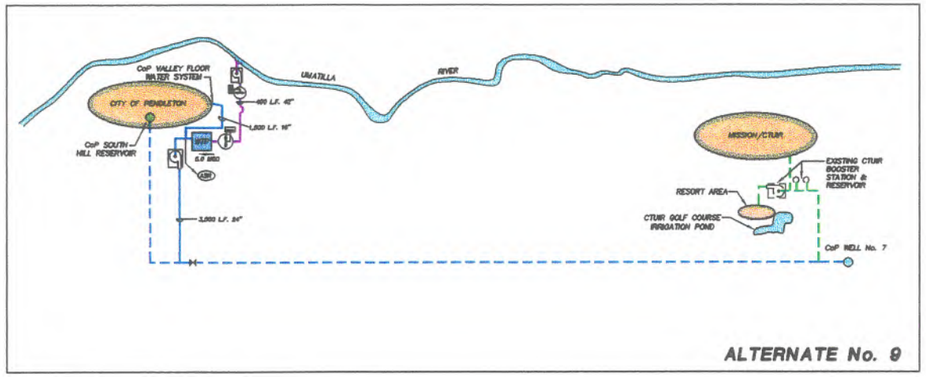
DESIGNED BY: DLU
DRAWN BY: kk
CHECKED BY: ____
APPROVED BY: ____

SHEET
SUMMARY 4

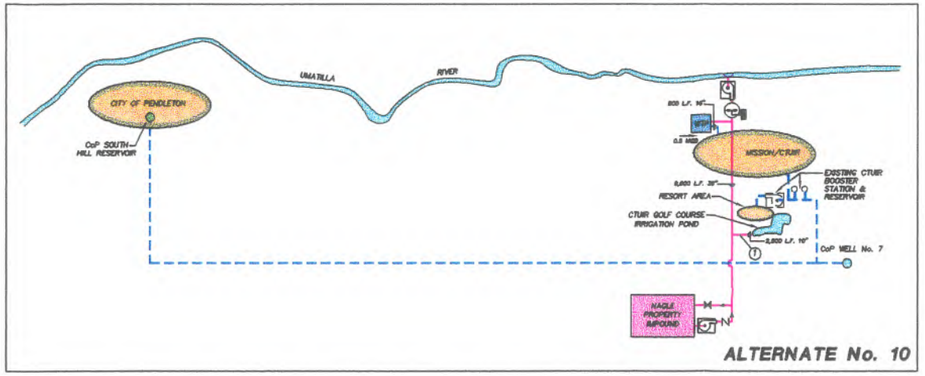
SECTION, TOWNSHIP, RANGE:

LAST EDIT: 5/13/99

PLOT DATE:



ALTERNATE No. 9



ALTERNATE No. 10

ALTERNATIVE No. 9 - SUMMARY OF COST

INTAKE: CoP, WTP: LOWER GOAD ROAD, IMPOUND: NONE (USE ASR)

WATER TREATMENT PLANT (WTP), 5.0 MGD		$5,250,000
INTAKE MANIFOLD		$250,000
PIPELINES	L.F.	
42" W/ APPURTENANCES	400	$64,000
24" W/ APPURTENANCES	3,500	$245,000
16" W/ APPURTENANCES	1,500	$57,000
BOOSTER PUMP STATIONS (BPS)		
INTAKE BPS, 50 CFS		$750,000
SOUTH HILL ZONE BPS, 10 CFS		$160,000
SUBTOTAL		$6,776,000
ADMINISTRATION/ENGINEERING (15%)		$1,016,400
CONTINGENCY (20%)		$1,355,200
TOTAL		**$9,147,600**

COSTS NOT INCLUDED IN BUDGETARY ESTIMATE:

- SITE GRADING/DEVELOPMENT
- THREE PHASE POWER SERVICE
- CONTROL/MOITORING SYSTEM (SCADA)
- OPERATION & MAINTENANCE (O&M) EXPENSE
- IRRIGATION CONNECTION TO CTUIR GOLF COURSE
- IMPOUND
- FLOW METERING FACILITIES
- LAND ACQUISITION
- SITE DEWATERING
- UPGRADING EXISTING CoP GRAVITY LINE

ADVANTAGES:

- CONSOLIDATES INTAKE BOOSTER PUMP STATION & WTP.
- AVAILABILITY OF THREE PHASE POWER.
- UTILIZE EXISTING CoP GRAVITY PIPELINE.
- SUITABLE SITE FOR ASR (NEAR EXISTING WATER SYSTEM INFRASTRUCTURE).

DISADVANTAGES:

- POTENTIAL PROPERTY ACQUISITION COST.
- BOOSTER PUMP STATION REQUIRED FOR SOUTH HILL ZONE.

ALTERNATIVE No. 10 - SUMMARY OF COST

INTAKE: CTUIR, WTP: MISSION, IMPOUND: NAGLE PROPERTY

WATER TREATMENT PLANT (WTP), 0.5 MGD		$600,000
INTAKE MANIFOLD		$230,000
PIPELINES	L.F.	
36" W/ APPURTENANCES	9,600	$1,248,000
16" W/ APPURTENANCES	800	$30,400
10" W/ APPURTENANCES	2,500	$50,000
BOOSTER PUMP STATIONS (BPS)		
INTAKE BPS, 40 CFS		$700,000
IMPOUND BPS, 4 CFS		$150,000
SUBTOTAL		$3,008,400
ADMINISTRATION/ENGINEERING (15%)		$451,300
CONTINGENCY (20%)		$601,700
TOTAL		**$4,061,400**

COSTS NOT INCLUDED IN BUDGETARY ESTIMATE:

- SITE GRADING/DEVELOPMENT
- THREE PHASE POWER SERVICE
- CONTROL/MOITORING SYSTEM (SCADA)
- OPERATION & MAINTENANCE (O&M) EXPENSE
- IMPOUND
- FLOW METERING FACILITIES
- LAND ACQUISITION
- SITE DEWATERING

ADVANTAGES:

- CONSOLIDATES WTP & STORAGE WATER IMPOUND.
- IMPOUND PROPERTY UNDER CTUIR OWNERSHIP.
- AVAILABILITY OF THREE PHASE POWER.

DISADVANTAGES:

- WTP REMOTE FROM CoP.
- NO WATER SUPPLIED TO CoP.
- POTENTIAL LACK OF LARGE STORAGE VOLUMES IN NAGLE PROPERTY IMPOUND

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CoP/CTUIR JOINT WATER PROJECT
SUMMARY OF COST
WTP/CONVEYANCE SYSTEMS
CoP/CTUIR OREGON

FILE NAME: UMTLSUM5.DWG
PROJECT NO. 06.1365.0001
SCALE: N.T.S.

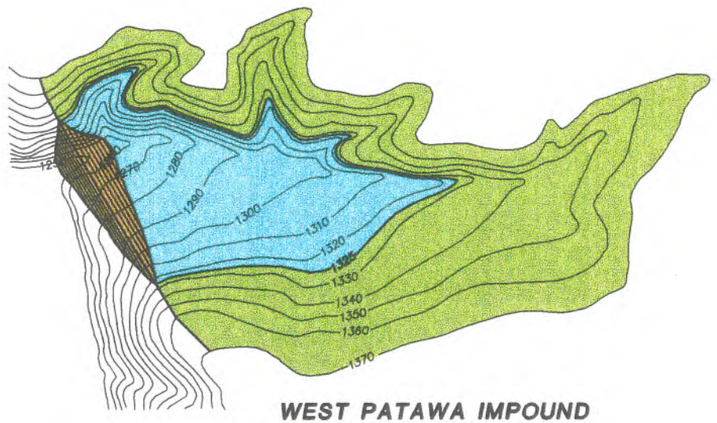
DESIGNED BY: DLU
DRAWN BY: kk
CHECKED BY:
APPROVED BY:

SHEET **SUMMARY 5**

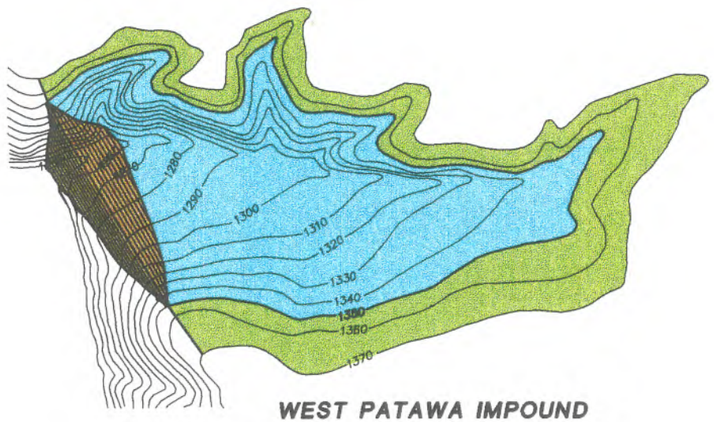
LAST EDIT: 5/13/99
PLOT DATE:

SECTION, TOWNSHIP, RANGE:

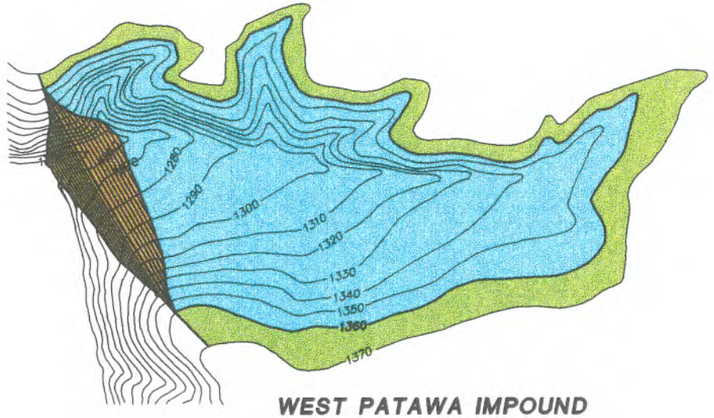
III.B Summary of Cost – Impounds



WEST PATAWA IMPOUND
1,000 ACRE FEET



WEST PATAWA IMPOUND
2,000 ACRE FEET



WEST PATAWA IMPOUND
4,000 ACRE FEET

WEST PATAWA IMPOUND
1,000 ACRE–FEET

NO.	ITEM	UNIT	EST. QTY.	UNIT PRICE	TOTAL
1	CLEARING & GRUBBING	AC	38	1,700	$64,600
2	EARTHWORK EXCAVATION	CY	348,900	1.50	$523,350
3	CUT–OFF TRENCH	CY	18,400	3.50	$64,400
4	EMBANKMENT BACKFILL	CY	258,100	2.75	$709,775
5	BENTONITE SOIL LINER	CY	90,600	4.40	$398,640
6	RIP–RAP FACING	SY	7,300	11.25	$82,125
7	SPILLWAY, OUTLET STRUCTURE	LS	–	160,000.00	$160,000
8	SECURITY FENCING	LF	6,770	16.00	$108,320
9	REVEGETATION	AC	2	850.00	$1,700
	SUBTOTAL				$2,112,900
	ENGINEERING, PERMITTING/REGULATORY REQUIREMENTS (20%)				$422,600
	CONTINENCY (20%)				$422,600
	LAND ACQUISITION COST NOT INCLUDED			TOTAL	$2,958,100

COST OF OPERATIONS AND MAINTENANCE (O&M)

O&M COSTS ASSUMES THAT OPERATION AND MAINTENANCE OF THE WATER STROAGE IMPOUND WOULD BE ACCOMPLISHED BY EXISTING CoP PUBLIC WORKS PERSONNEL WHICH CURRENTLY OPERATE AND MAINTAIN THE CITY'S WATER SYSTEM INFRASTRUCTURE.

PERSONNEL/ADMINISTRATION	$35,000
EQUIPMENT/SUPPLIES	$15,000
SPECIAL MAINTENANCE	$30,000
REPLACEMENT	$15,000
TOTAL	$95,000

WEST PATAWA IMPOUND
2,000 ACRE–FEET

NO.	ITEM	UNIT	EST. QTY.	UNIT PRICE	TOTAL
1	CLEARING & GRUBBING	AC	81	1,700	$137,700
2	EARTHWORK EXCAVATION	CY	849,900	1.50	$1,274,850
3	CUT–OFF TRENCH	CY	23,100	3.50	$80,850
4	EMBANKMENT BACKFILL	CY	588,800	2.75	$1,619,200
5	BENTONITE SOIL LINER	CY	261,500	4.40	$1,150,600
6	RIP–RAP FACING	SY	12,700	11.25	$142,875
7	SPILLWAY, OUTLET STRUCTURE	LS	–	180,000.00	$180,000
8	SECURITY FENCING	LF	10,500	16.00	$168,000
9	REVEGETATION	AC	5.25	850.00	$4,463
	SUBTOTAL				$4,758,500
	ENGINEERING, PERMITTING/REGULATORY REQUIREMENTS (20%)				$951,700
	CONTINENCY (20%)				$951,700
	LAND ACQUISITION COST NOT INCLUDED			TOTAL	$6,661,900

COST OF OPERATIONS AND MAINTENANCE (O&M)

O&M COSTS ASSUMES THAT OPERATION AND MAINTENANCE OF THE WATER STROAGE IMPOUND WOULD BE ACCOMPLISHED BY EXISTING CoP PUBLIC WORKS PERSONNEL WHICH CURRENTLY OPERATE AND MAINTAIN THE CITY'S WATER SYSTEM INFRASTRUCTURE.

PERSONNEL/ADMINISTRATION	$35,000
EQUIPMENT/SUPPLIES	$20,000
SPECIAL MAINTENANCE	$35,000
REPLACEMENT	$15,000
TOTAL	$105,000

WEST PATAWA IMPOUND
4,000 ACRE–FEET

NO.	ITEM	UNIT	EST. QTY.	UNIT PRICE	TOTAL
1	CLEARING & GRUBBING	AC	102	1,700	$173,400
2	EARTHWORK EXCAVATION	CY	1,155,600	1.50	$1,733,400
3	CUT–OFF TRENCH	CY	25,400	3.50	$88,900
4	EMBANKMENT BACKFILL	CY	776,400	2.75	$2,125,100
5	BENTONITE SOIL LINER	CY	330,200	4.40	$1,425,880
6	RIP–RAP FACING	SY	15,500	11.25	$174,375
7	SPILLWAY, OUTLET STRUCTURE	LS	–	200,000.00	$200,000
8	SECURITY FENCING	LF	12,000	16.00	$192,000
9	REVEGETATION	AC	6.5	850.00	$5,525
	SUBTOTAL				$6,155,600
	ENGINEERING, PERMITTING/REGULATORY REQUIREMENTS (20%)				$1,231,100
	CONTINENCY (20%)				$1,231,100
	LAND ACQUISITION COST NOT INCLUDED			TOTAL	$8,617,800

COST OF OPERATIONS AND MAINTENANCE (O&M)

O&M COSTS ASSUMES THAT OPERATION AND MAINTENANCE OF THE WATER STROAGE IMPOUND WOULD BE ACCOMPLISHED BY EXISTING CoP PUBLIC WORKS PERSONNEL WHICH CURRENTLY OPERATE AND MAINTAIN THE CITY'S WATER SYSTEM INFRASTRUCTURE.

PERSONNEL/ADMINISTRATION	$35,000
EQUIPMENT/SUPPLIES	$20,000
SPECIAL MAINTENANCE	$40,000
REPLACEMENT	$15,000
TOTAL	$110,000

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CoP/CTUIR JOINT WATER PROJECT
WEST PATAWA IMPOUND
SUMMARY OF COST-IMPOUND
OREGON

CoP/CTUIR

SCALE:	PROJECT NO.	FILE NAME:
N.T.S.	06.1365.0001	WESTEXBT.DWG

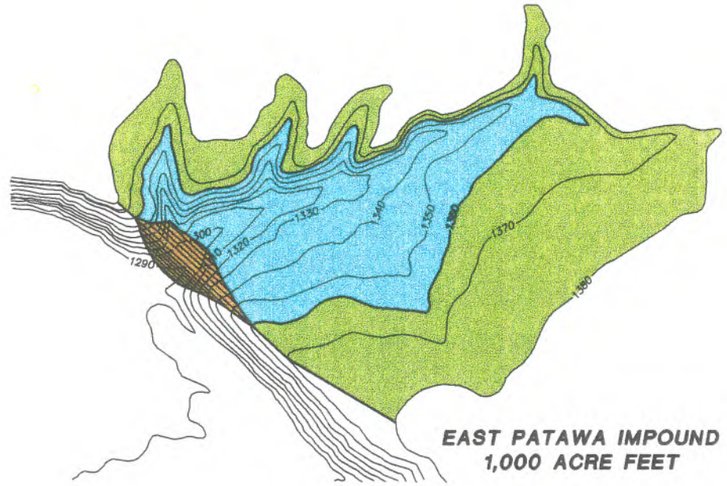
DESIGNED BY: DLU
DRAWN BY: kk
CHECKED BY: ____
APPROVED BY: ____

SHEET
SUMMARY 1

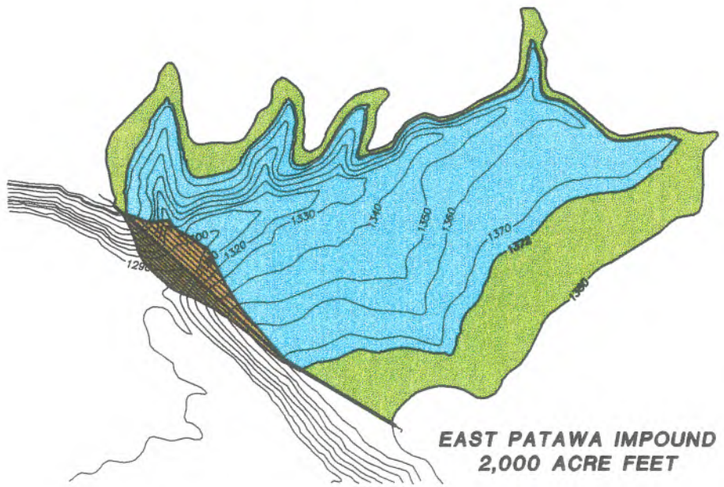
LAST EDIT: 4/20/99

PLOT DATE:

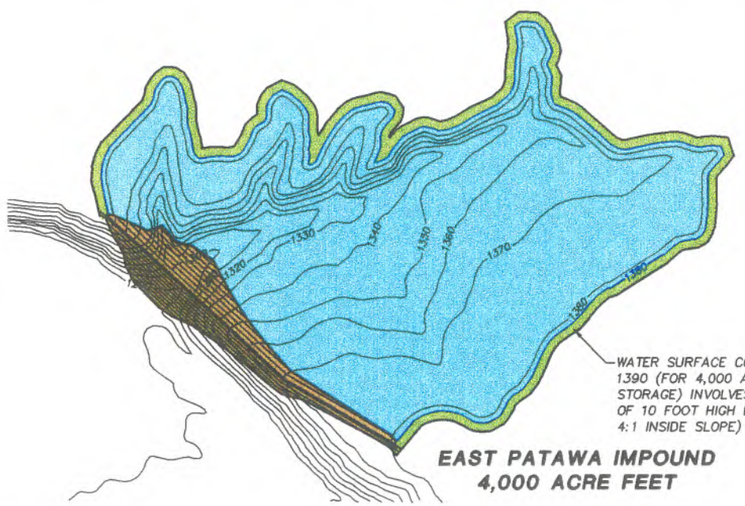
SECTION, TOWNSHIP, RANGE:



EAST PATAWA IMPOUND
1,000 ACRE FEET



EAST PATAWA IMPOUND
2,000 ACRE FEET



EAST PATAWA IMPOUND
4,000 ACRE FEET

EAST PATAWA IMPOUND
1,000 ACRE-FEET

NO.	ITEM	UNIT	EST. QTY.	UNIT PRICE	TOTAL
1	CLEARING & GRUBBING	AC	60	1,700	$102,000
2	EARTHWORK EXCAVATION	CY	327,600	1.50	$491,400
3	CUT-OFF TRENCH	CY	17,000	3.50	$59,500
4	EMBANKMENT BACKFILL	CY	188,000	2.75	$517,000
5	BENTONITE SOIL LINER	CY	140,400	4.40	$617,800
6	RIP-RAP FACING	SY	5,800	11.25	$65,300
7	SPILLWAY, OUTLET STRUCTURE	LS	–	160,000.00	$160,000
8	SECURITY FENCING	LF	10,200	16.00	$163,200
9	REVEGETATION	AC	2	850.00	$1,700
	SUBTOTAL				$2,177,900
	ENGINEERING, PERMITTING/REGULATORY REQUIREMENTS (20%)				$435,600
	CONTINENCY (20%)				$435,600
	LAND ACQUISITION COST NOT INCLUDED			TOTAL	$3,049,100

COST OF OPERATIONS AND MAINTENANCE (O&M)

O&M COSTS ASSUMES THAT OPERATION AND MAINTENANCE OF THE WATER STROAGE IMPOUND WOULD BE ACCOMPLISHED BY EXISTING CoP PUBLIC WORKS PERSONNEL WHICH CURRENTLY OPERATE AND MAINTAIN THE CITY'S WATER SYSTEM INFRASTRUCTURE.

PERSONNEL/ADMINISTRATION	$35,000
EQUIPMENT/SUPPLIES	$15,000
SPECIAL MAINTENANCE	$30,000
REPLACEMENT	$15,000
TOTAL	$95,000

EAST PATAWA IMPOUND
2,000 ACRE-FEET

NO.	ITEM	UNIT	EST. QTY.	UNIT PRICE	TOTAL
1	CLEARING & GRUBBING	AC	95	1,700	$161,500
2	EARTHWORK EXCAVATION	CY	615,000	1.50	$922,500
3	CUT-OFF TRENCH	CY	26,600	3.50	$93,100
4	EMBANKMENT BACKFILL	CY	302,200	2.75	$831,300
5	BENTONITE SOIL LINER	CY	307,500	4.40	$1,353,000
6	RIP-RAP FACING	SY	9,800	11.25	$110,250
7	SPILLWAY, OUTLET STRUCTURE	LS	–	180,000.00	$180,000
8	SECURITY FENCING	LF	12,800	16.00	$204,800
9	REVEGETATION	AC	10	850.00	$8,500
	SUBTOTAL				$3,865,000
	ENGINEERING, PERMITTING/REGULATORY REQUIREMENTS (20%)				$773,000
	CONTINENCY (20%)				$773,000
	LAND ACQUISITION COST NOT INCLUDED			TOTAL	$5,411,000

COST OF OPERATIONS AND MAINTENANCE (O&M)

O&M COSTS ASSUMES THAT OPERATION AND MAINTENANCE OF THE WATER STROAGE IMPOUND WOULD BE ACCOMPLISHED BY EXISTING CoP PUBLIC WORKS PERSONNEL WHICH CURRENTLY OPERATE AND MAINTAIN THE CITY'S WATER SYSTEM INFRASTRUCTURE.

PERSONNEL/ADMINISTRATION	$35,000
EQUIPMENT/SUPPLIES	$20,000
SPECIAL MAINTENANCE	$35,000
REPLACEMENT	$15,000
TOTAL	$105,000

EAST PATAWA IMPOUND
4,000 ACRE-FEET

NO.	ITEM	UNIT	EST. QTY.	UNIT PRICE	TOTAL
1	CLEARING & GRUBBING	AC	154	1,700	$261,800
2	EARTHWORK EXCAVATION	CY	1,537,000	1.50	$2,305,500
3	CUT-OFF TRENCH	CY	41,500	3.50	$145,250
4	EMBANKMENT BACKFILL	CY	1,041,900	2.75	$2,865,225
5	BENTONITE SOIL LINER	CY	495,000	4.40	$2,178,000
6	RIP-RAP FACING	SY	16,600	11.25	$186,750
7	SPILLWAY, OUTLET STRUCTURE	LS	–	200,000.00	$200,000
8	SECURITY FENCING	LF	15,000	16.00	$240,000
9	REVEGETATION	AC	19.3	850.00	$16,405
	SUBTOTAL				$8,398,900
	ENGINEERING, PERMITTING/REGULATORY REQUIREMENTS (20%)				$1,679,800
	CONTINENCY (20%)				$1,679,900
	LAND ACQUISITION COST NOT INCLUDED			TOTAL	$11,758,500

COST OF OPERATIONS AND MAINTENANCE (O&M)

O&M COSTS ASSUMES THAT OPERATION AND MAINTENANCE OF THE WATER STROAGE IMPOUND WOULD BE ACCOMPLISHED BY EXISTING CoP PUBLIC WORKS PERSONNEL WHICH CURRENTLY OPERATE AND MAINTAIN THE CITY'S WATER SYSTEM INFRASTRUCTURE.

PERSONNEL/ADMINISTRATION	$35,000
EQUIPMENT/SUPPLIES	$20,000
SPECIAL MAINTENANCE	$40,000
REPLACEMENT	$15,000
TOTAL	$110,000

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CoP/CTUIR JOINT WATER PROJECT
EAST PATAWA IMPOUND
SUMMARY OF COST-IMPOUND
CoP/CTUIR OREGON

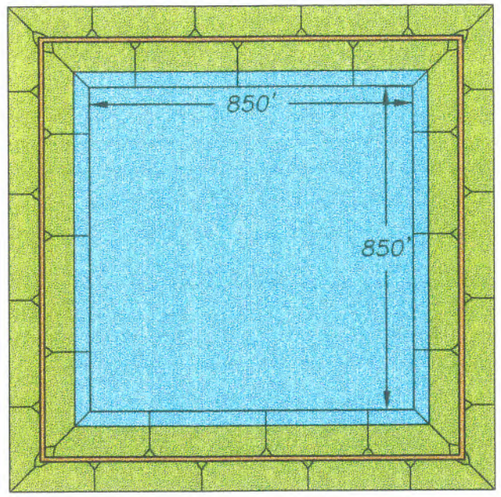
DESIGNED BY: DLU
DRAWN BY: kk
CHECKED BY:
APPROVED BY:

PROJECT NO. 06.1365.0001
FILE NAME: EASTEXBT.DWG
SCALE: N.T.S.

SHEET
SUMMARY 2

LAST EDIT: 4/20/99
PLOT DATE:

SECTION, TOWNSHIP, RANGE:



NAGLE PROPERTY IMPOUND
500 ACRE FEET

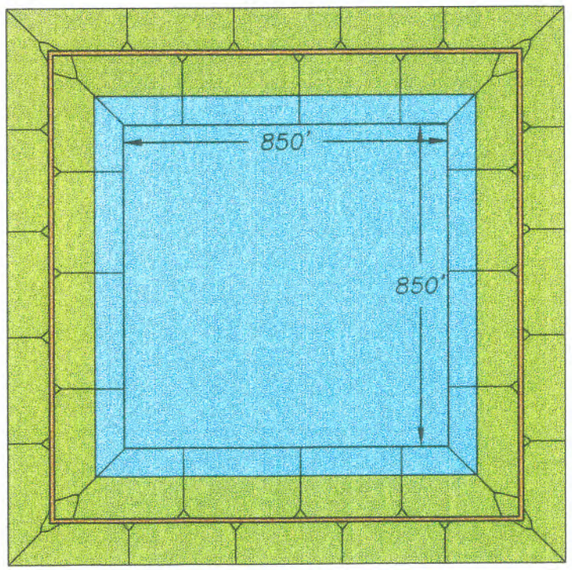
NAGLE PROPERTY IMPOUND
500 ACRE-FEET (850' x 850' BOTTOM FOOTPRINT)

NO.	ITEM	UNIT	EST. QTY.	UNIT PRICE	TOTAL
1	CLEARING & GRUBBING	AC	37	1,700	$62,900
2	EARTHWORK EXCAVATION	CY	292,600	1.50	$438,900
3	CUT-OFF TRENCH	CY	4,400	3.50	$15,400
4	EMBANKMENT BACKFILL	CY	292,600	2.75	$804,700
5	BENTONITE SOIL LINER	CY	67,200	4.40	$295,700
6	RIP-RAP FACING	SY	38,600	11.25	$434,300
7	SPILLWAY, OUTLET STRUCTURE	LS	–	100,000	$100,000
8	SECURITY FENCING	LF	5,080	16.00	$81,300
9	REVEGETATION	AC	9	850.00	$7,700
	SUBTOTAL				$2,240,900
	ENGINEERING, PERMITTING/REGULATORY REQUIREMENTS (20%)				$448,200
	CONTINENCY (20%)				$448,200
	LAND ACQUISITION COST NOT INCLUDED			TOTAL	$3,137,300

COST OF OPERATIONS AND MAINTENANCE (O&M)

O&M COSTS ASSUMES THAT OPERATION AND MAINTENANCE OF THE WATER STROAGE IMPOUND WOULD BE ACCOMPLISHED BY EXISTING CoP PUBLIC WORKS PERSONNEL WHICH CURRENTLY OPERATE AND MAINTAIN THE CITY'S WATER SYSTEM INFRASTRUCTURE.

PERSONNEL/ADMINISTRATION	$35,000
EQUIPMENT/SUPPLIES	$10,000
SPECIAL MAINTENANCE	$25,000
REPLACEMENT	$10,000
TOTAL	$80,000



NAGLE PROPERTY IMPOUND
1,000 ACRE FEET

NAGLE PROPERTY IMPOUND
1,000 ACRE-FEET (850' x 850' BOTTOM FOOTPRINT)

NO.	ITEM	UNIT	EST. QTY.	UNIT PRICE	TOTAL
1	CLEARING & GRUBBING	AC	50	1,700	$85,000
2	EARTHWORK EXCAVATION	CY	616,800	1.50	$925,200
3	CUT-OFF TRENCH	CY	4,950	3.50	$17,300
4	EMBANKMENT BACKFILL	CY	616,800	2.75	$1,696,200
5	BENTONITE SOIL LINER	CY	84,900	4.40	$373,600
6	RIP-RAP FACING	SY	60,600	11.25	$681,800
7	SPILLWAY, OUTLET STRUCTURE	LS	–	120,000.00	$120,000
8	SECURITY FENCING	LF	5,880	16.00	$94,100
9	REVEGETATION	AC	14	850.00	$11,900
	SUBTOTAL				$4,005,100
	ENGINEERING, PERMITTING/REGULATORY REQUIREMENTS (20%)				$801,000
	CONTINENCY (20%)				$801,000
	LAND ACQUISITION COST NOT INCLUDED			TOTAL	$5,607,100

COST OF OPERATIONS AND MAINTENANCE (O&M)

O&M COSTS ASSUMES THAT OPERATION AND MAINTENANCE OF THE WATER STROAGE IMPOUND WOULD BE ACCOMPLISHED BY EXISTING CoP PUBLIC WORKS PERSONNEL WHICH CURRENTLY OPERATE AND MAINTAIN THE CITY'S WATER SYSTEM INFRASTRUCTURE.

PERSONNEL/ADMINISTRATION	$35,000
EQUIPMENT/SUPPLIES	$15,000
SPECIAL MAINTENANCE	$30,000
REPLACEMENT	$15,000
TOTAL	$95,000

CONFEDERATED TRIBES OF THE UMATILLA INDIAN RESERVATION

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CoP/CTUIR JOINT WATER PROJECT
NAGLE PROPERTY IMPOUND
SUMMARY OF COST-IMPOUND
CoP/CTUIR OREGON

SCALE: N.T.S.
PROJECT NO. 06.1365.0001
FILE NAME: NAGLE-X1.DWG

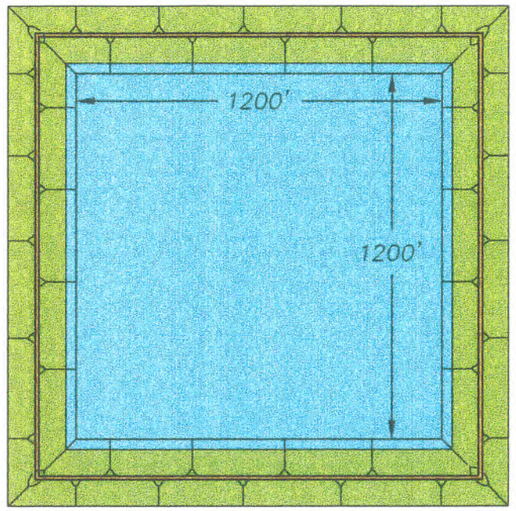
DESIGNED BY: DLU
DRAWN BY: kk
CHECKED BY: ____
APPROVED BY: ____

SHEET
SUMMARY 3A

SECTION, TOWNSHIP, RANGE:

LAST EDIT: 4/20/99

PLOT DATE:



NAGLE PROPERTY IMPOUND
1,000 ACRE FEET

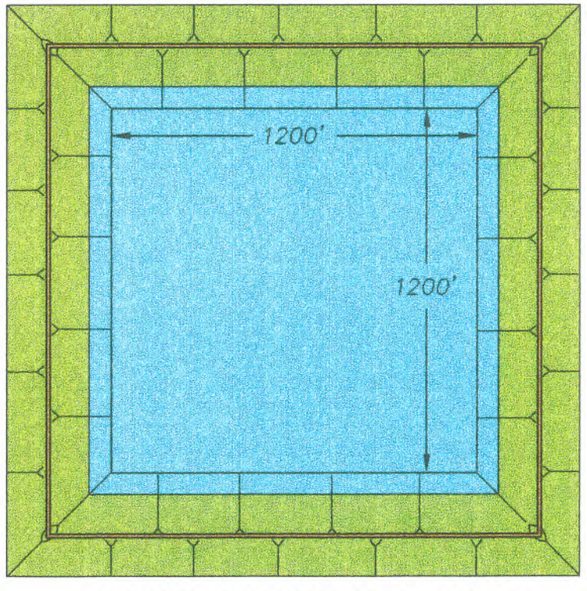
NAGLE PROPERTY IMPOUND
1,000 ACRE–FEET (1200' x 1200' BOTTOM FOOTPRINT)

NO.	ITEM	UNIT	EST. QTY.	UNIT PRICE	TOTAL
1	CLEARING & GRUBBING	AC	62	1,700	$105,400
2	EARTHWORK EXCAVATION	CY	482,100	1.50	$723,200
3	CUT–OFF TRENCH	CY	5,800	3.50	$20,300
4	EMBANKMENT BACKFILL	CY	481,600	2.75	$1,324,400
5	BENTONITE SOIL LINER	CY	118,000	4.40	$519,200
6	RIP–RAP FACING	SY	57,400	11.25	$645,800
7	SPILLWAY, OUTLET STRUCTURE	LS	–	120,000	$120,000
8	SECURITY FENCING	LF	6,600	16.00	$105,600
9	REVEGETATION	AC	14	850.00	$11,900
	SUBTOTAL				$3,575,800
	ENGINEERING, PERMITTING/REGULATORY REQUIREMENTS (20%)				$715,200
	CONTINENCY (20%)				$715,200
	LAND ACQUISITION COST NOT INCLUDED			TOTAL	$5,006,200

COST OF OPERATIONS AND MAINTENANCE (O&M)

O&M COSTS ASSUMES THAT OPERATION AND MAINTENANCE OF THE WATER STROAGE IMPOUND WOULD BE ACCOMPLISHED BY EXISTING CoP PUBLIC WORKS PERSONNEL WHICH CURRENTLY OPERATE AND MAINTAIN THE CITY'S WATER SYSTEM INFRASTRUCTURE.

PERSONNEL/ADMINISTRATION	$35,000
EQUIPMENT/SUPPLIES	$15,000
SPECIAL MAINTENANCE	$30,000
REPLACEMENT	$15,000
TOTAL	$95,000



NAGLE PROPERTY IMPOUND
2,000 ACRE FEET

NAGLE PROPERTY IMPOUND
2,000 ACRE–FEET (850' x 850' BOTTOM FOOTPRINT)

NO.	ITEM	UNIT	EST. QTY.	UNIT PRICE	TOTAL
1	CLEARING & GRUBBING	AC	80	1,700	$136,000
2	EARTHWORK EXCAVATION	CY	1,090,000	1.50	$1,635,000
3	CUT–OFF TRENCH	CY	6,450	3.50	$22,600
4	EMBANKMENT BACKFILL	CY	1,090,000	2.75	$2,997,500
5	BENTONITE SOIL LINER	CY	145,000	4.40	$638,000
6	RIP–RAP FACING	SY	92,000	11.25	$1,035,000
7	SPILLWAY, OUTLET STRUCTURE	LS	–	140,000.00	$140,000
8	SECURITY FENCING	LF	7,550	16.00	$120,800
9	REVEGETATION	AC	21	850.00	$17,900
	SUBTOTAL				$6,742,800
	ENGINEERING, PERMITTING/REGULATORY REQUIREMENTS (20%)				$1,348,600
	CONTINENCY (20%)				$1,348,600
	LAND ACQUISITION COST NOT INCLUDED			TOTAL	$9,440,000

COST OF OPERATIONS AND MAINTENANCE (O&M)

O&M COSTS ASSUMES THAT OPERATION AND MAINTENANCE OF THE WATER STROAGE IMPOUND WOULD BE ACCOMPLISHED BY EXISTING CoP PUBLIC WORKS PERSONNEL WHICH CURRENTLY OPERATE AND MAINTAIN THE CITY'S WATER SYSTEM INFRASTRUCTURE.

PERSONNEL/ADMINISTRATION	$35,000
EQUIPMENT/SUPPLIES	$20,000
SPECIAL MAINTENANCE	$35,000
REPLACEMENT	$15,000
TOTAL	$105,000

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CoP/CTUIR JOINT WATER PROJECT
NAGLE PROPERTY IMPOUND
SUMMARY OF COST-IMPOUND
CoP/CTUIR OREGON

FILE NAME: NAGLE-X2.DWG

DESIGNED BY: DLU
DRAWN BY: kk
CHECKED BY: ____
APPROVED BY: ____

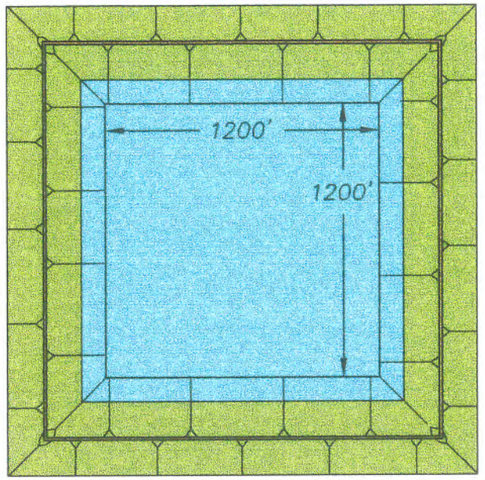
SCALE: N.T.S.
PROJECT NO. 06.1365.0001

SHEET
SUMMARY 3B

SECTION, TOWNSHIP, RANGE:

LAST EDIT: 4/20/99

PLOT DATE:



NAGLE PROPERTY IMPOUND
3,000 ACRE FEET

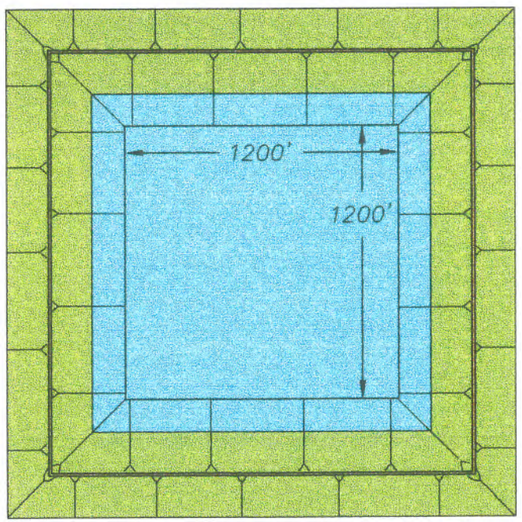
NAGLE PROPERTY IMPOUND
3,000 ACRE–FEET (1200' x 1200' BOTTOM FOOTPRINT)

NO.	ITEM	UNIT	EST. QTY.	UNIT PRICE	TOTAL
1	CLEARING & GRUBBING	AC	98	1,700	$166,600
2	EARTHWORK EXCAVATION	CY	1,693,700	1.50	$2,540,500
3	CUT–OFF TRENCH	CY	7,000	3.50	$24,500
4	EMBANKMENT BACKFILL	CY	1,693,700	2.75	$4,657,700
5	BENTONITE SOIL LINER	CY	167,700	4.40	$737,900
6	RIP–RAP FACING	SY	120,500	11.25	$1,355,600
7	SPILLWAY, OUTLET STRUCTURE	LS	–	160,000	$160,000
8	SECURITY FENCING	LF	8,250	16.00	$132,000
9	REVEGETATION	AC	28	850.00	$23,800
	SUBTOTAL				$9,798,600
	ENGINEERING, PERMITTING/REGULATORY REQUIREMENTS (20%)				$1,959,700
	CONTINENCY (20%)				$1,959,700
	LAND ACQUISITION COST NOT INCLUDED			TOTAL	$13,718,000

COST OF OPERATIONS AND MAINTENANCE (O&M)

O&M COSTS ASSUMES THAT OPERATION AND MAINTENANCE OF THE WATER STROAGE IMPOUND WOULD BE ACCOMPLISHED BY EXISTING CoP PUBLIC WORKS PERSONNEL WHICH CURRENTLY OPERATE AND MAINTAIN THE CITY'S WATER SYSTEM INFRASTRUCTURE.

PERSONNEL/ADMINISTRATION	$35,000
EQUIPMENT/SUPPLIES	$20,000
SPECIAL MAINTENANCE	$40,000
REPLACEMENT	$15,000
TOTAL	$110,000



NAGLE PROPERTY IMPOUND
4,000 ACRE FEET

NAGLE PROPERTY IMPOUND
4,000 ACRE–FEET (850' x 850' BOTTOM FOOTPRINT)

NO.	ITEM	UNIT	EST. QTY.	UNIT PRICE	TOTAL
1	CLEARING & GRUBBING	AC	115	1,700	$195,500
2	EARTHWORK EXCAVATION	CY	2,411,300	1.50	$3,617,000
3	CUT–OFF TRENCH	CY	7,400	3.50	$25,900
4	EMBANKMENT BACKFILL	CY	2,411,300	2.75	$6,631,100
5	BENTONITE SOIL LINER	CY	192,200	4.40	$845,700
6	RIP–RAP FACING	SY	149,800	11.25	$1,685,300
7	SPILLWAY, OUTLET STRUCTURE	LS	–	180,000.00	$180,000
8	SECURITY FENCING	LF	8,940	16.00	$143,000
9	REVEGETATION	AC	35	850.00	$29,800
	SUBTOTAL				$13,353,300
	ENGINEERING, PERMITTING/REGULATORY REQUIREMENTS (20%)				$2,670,700
	CONTINENCY (20%)				$2,670,700
	LAND ACQUISITION COST NOT INCLUDED			TOTAL	$18,694,700

COST OF OPERATIONS AND MAINTENANCE (O&M)

O&M COSTS ASSUMES THAT OPERATION AND MAINTENANCE OF THE WATER STROAGE IMPOUND WOULD BE ACCOMPLISHED BY EXISTING CoP PUBLIC WORKS PERSONNEL WHICH CURRENTLY OPERATE AND MAINTAIN THE CITY'S WATER SYSTEM INFRASTRUCTURE.

PERSONNEL/ADMINISTRATION	$35,000
EQUIPMENT/SUPPLIES	$20,000
SPECIAL MAINTENANCE	$40,000
REPLACEMENT	$15,000
TOTAL	$110,000

CONFEDERATED TRIBES OF THE UMATILLA INDIAN RESERVATION

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CoP/CTUIR JOINT WATER PROJECT
NAGLE PROPERTY IMPOUND
SUMMARY OF COST-IMPOUND
CoP/CTUIR OREGON

SCALE: N.T.S.
PROJECT NO. 06.1365.0001
FILE NAME: NAGLE-X3.DWG

DESIGNED BY: DLU
DRAWN BY: kk
CHECKED BY: ____
APPROVED BY: ____

SHEET
SUMMARY 3C

SECTION, TOWNSHIP, RANGE:

LAST EDIT: 4/20/99

PLOT DATE:

III.C Tabulated Summary of Cost – WTP/Conveyance Systems & Impounds

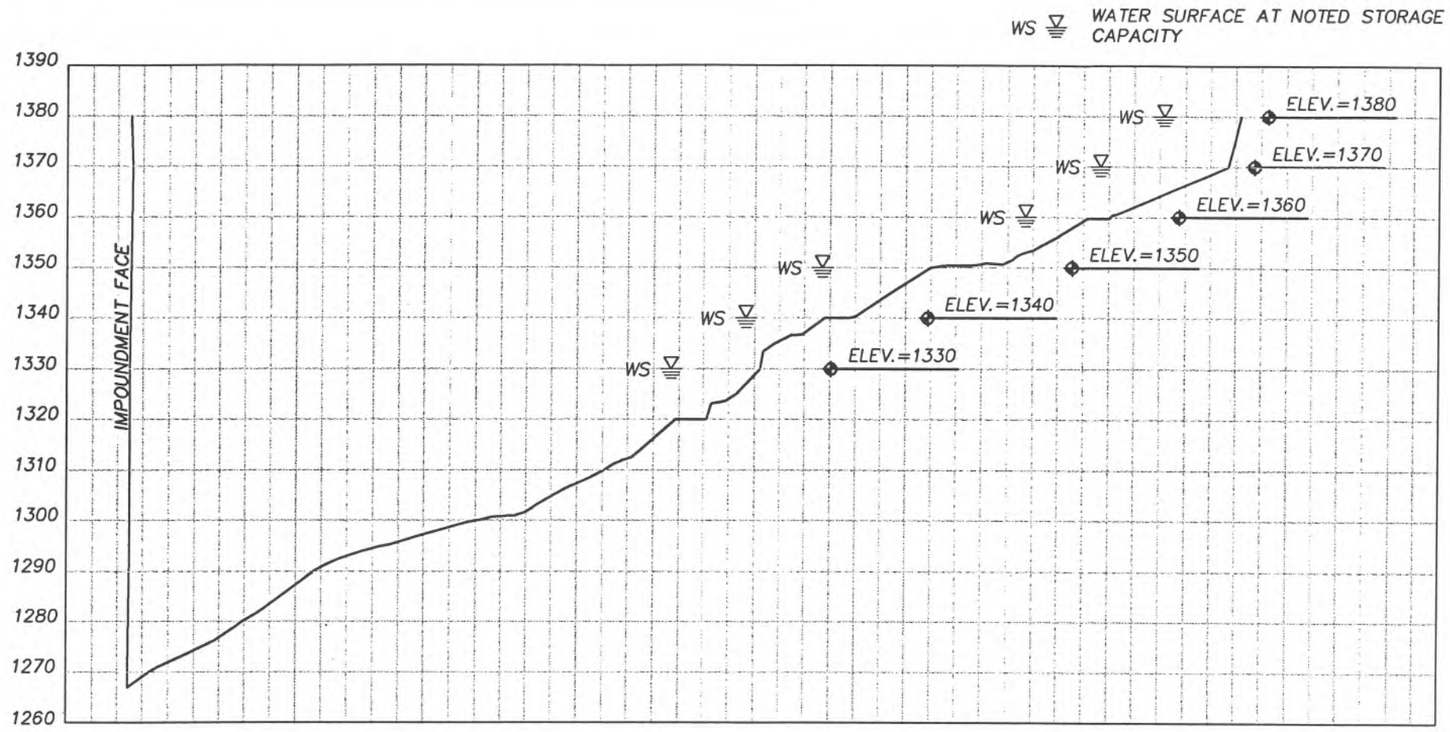
Tabulated Summary of Cost
CoP/CTUIR Joint Water Project Improvements

(1): WTP/Conveyance Systems, & (2): Impound

(1) WTP/Conveyance Systems	Cost
Alternative No. 1 Intake: CoP, WTP (5.0 MGD): Lower Goad Road, Impound: West Patawa	**$11,864,000**
Alternative No. 2 Intake: CoP, WTP (5.0 MGD): Lower Goad Road, Impound: East Patawa	**$12,952,100**
Alternative No. 3 Intake: CoP, WTP (5.0 MGD): Lower Goad Road, Impound: Nagle Property	**$13,462,400**
Alternative No. 4 Intake: CoP, WTP (5.0 MGD): Upper Goad Road, Impound: West Patawa	**$11,548,700**
Alternative No. 5 Intake: CoP, WTP (5.0 MGD): Upper Goad Road, Impound: East Patawa	**$12,663,800**
Alternative No. 6 Intake: CoP, WTP (5.0 MGD): Upper Goad Road, Impound: Nagle Property	**$13,147,100**
Alternative No. 7 Intake: CTUIR, WTP (5.0 MGD): West Patawa, Impound: West Patawa	**$13,280,600**
Alternative No. 8 Intake: CTUIR, WTP (5.0 MGD): Nagle Property, Impound: Nagle Property	**$11,149,000**
Alternative No. 9 Intake: CoP, WTP (5.0 MGD): Lower Goad Road, Impound: None (use ASR)	**$9,147,600**
Alternative No. 10 Intake: CTUIR, WTP (0.5 MGD): Mission, Impound: Nagle Property	**$4,061,400**
(2) Water Storage Impound	**Cost**
West Patawa	
1,000 acre-feet	**$2,958,100**
2,000 acre-feet	**$6,661,900**
4,000 acre-feet	**$8,617,800**
East Patawa	
1,000 acre-feet	**$3,049,100**
2,000 acre-feet	**$5,411,000**
4,000 acre-feet	**$11,758,500**
Nagle Property	
500 acre-feet (850' x 850' impound footprint)	**$3,137,300**
1,000 acre-feet (850' x 850' impound footprint)	**$5,607,100**
1,000 acre-feet (1200' x 1200' impound footprint)	**$5,006,200**
2,000 acre-feet (1200' x 1200' impound footprint)	**$9,440,000**
3,000 acre-feet (1200' x 1200' impound footprint)	**$13,718,000**
4,000 acre-feet (1200' x 1200' impound footprint)	**$18,694,700**

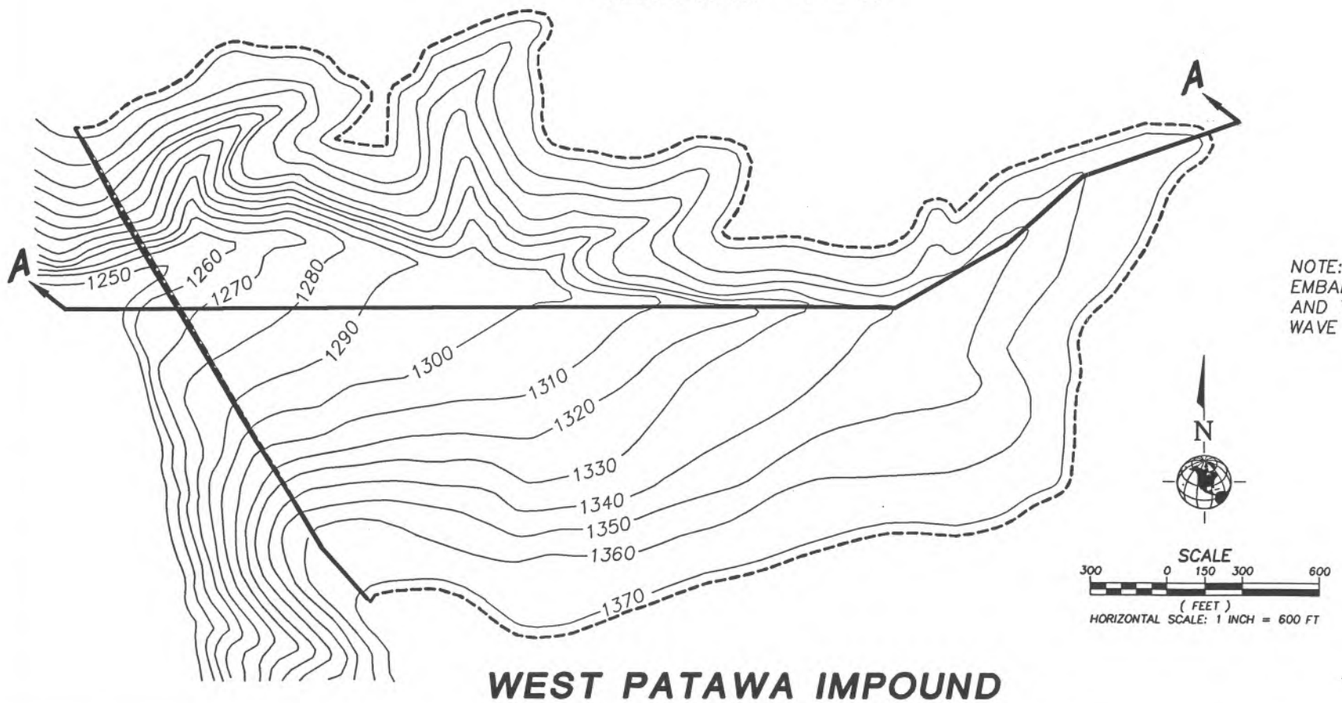
APPENDIX IV WATER STORAGE IMPOUNDMENTS - SIZING/CAPCAPITY ANALYSIS

Sheet 1 – West Patawa Impound
Sheet 2 – East Patawa Impound
Sheet 3A & 3B – Nagle Property Impound
(with Stage Storage Tables for each Nagle Property Impound configuration)



SECTION A-A

HORIZONTAL SCALE: 1" = 600'
VERTICAL SCALE: 1" = 30'



WEST PATAWA IMPOUND

STORAGE CAPACITY

WATER SURFACE CONTOUR	STORAGE CAPACITY AC-FT
1330	1,207
1340	1,739
1350	2,421
1360	3,351
1370	4,520
1380	5,925

SITE VOLUME TABLE: UNADJESTED

SITE	STRATUM	NET YARDS		METHOD
A	1330	1948052	(F)	END AREA
	1340	2807779	(F)	END AREA
	1350	3905716	(F)	END AREA
	1360	5405474	(F)	END AREA
	1370	7291548	(F)	END AREA
	1380	9558239	(F)	END AREA *

* WATER SURFACE CONTOUR OF 1380 INVOLVES PLACEMENT OF 10 FOOT HIGH BERM WITH 4:1 INSIDE SLOPE

NOTE: FREEBOARD MUST BE PROVIDED IN THE IMPOUND EMBANKMENT TO ALLOW FOR SURCHARGE HYDRAULIC HEAD, AND TO PREVENT OVERTOPPING OF THE EMBANKMENT BY WAVE ACTION.

CITY OF PENDLETON

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CoP/CTUIR JOINT WATER PROJECT
WEST PATAWA IMPOUND
SIZE/CAPACITY CONFIGURATION

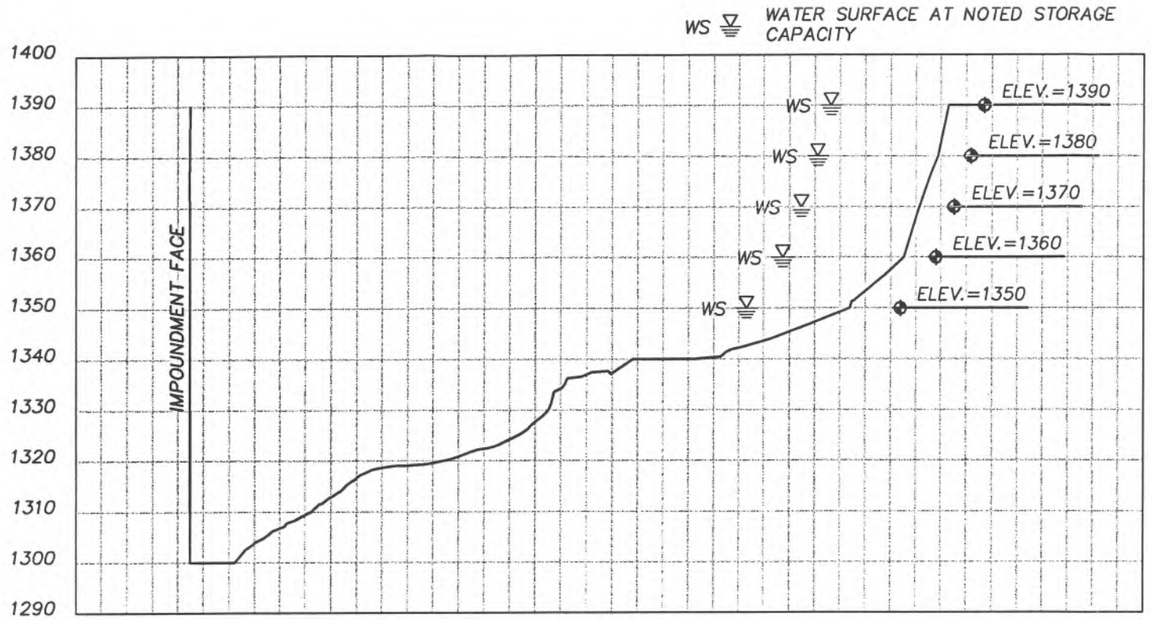
PENDLETON OREGON

SCALE: N.T.S.
PROJECT NO. 06.1365.0001
FILE NAME: LUTCTP02.DWG

DESIGNED BY: DLU
DRAWN BY: kk
CHECKED BY: ____
APPROVED BY: ____

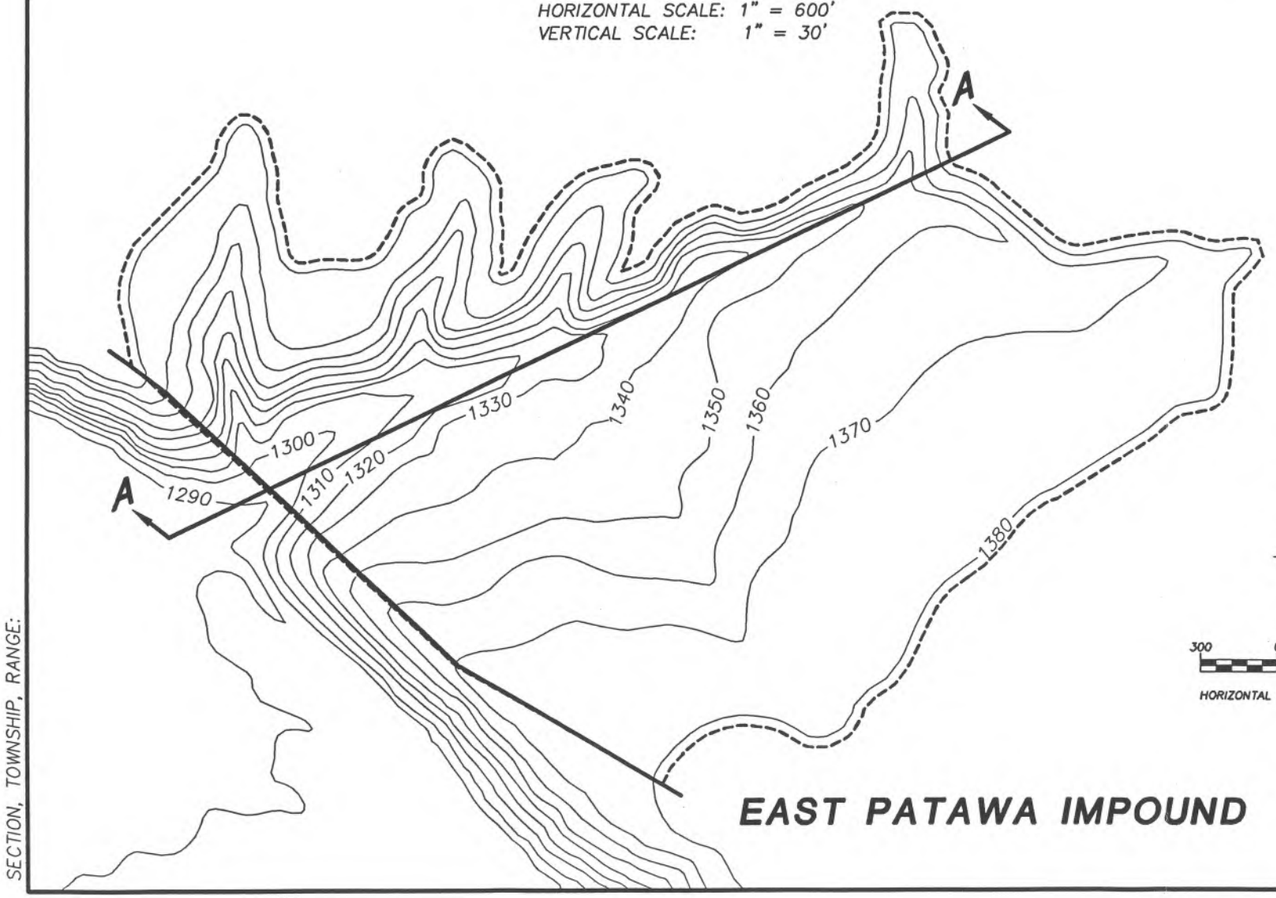
SHEET 1

PLOT DATE:
LAST EDIT: 4/20/99

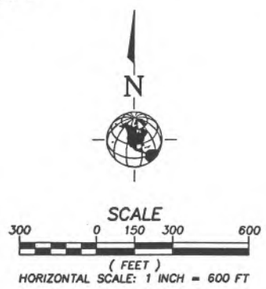


SECTION A-A

HORIZONTAL SCALE: 1" = 600'
VERTICAL SCALE: 1" = 30'



EAST PATAWA IMPOUND



STORAGE CAPACITY

WATER SURFACE CONTOUR	STORAGE CAPACITY AC-FT
1350	602
1360	1,079
1370	1,774
1380	2,769
1390	4,018

SITE VOLUME TABLE: UNADJESTED

SITE	STRATUM	NET YARDS	METHOD
B	1350	970738 (F)	END AREA
	1360	1740609 (F)	END AREA
	1370	2862440 (F)	END AREA
	1380	4467355 (F)	END AREA
	1390	6482413 (F)	END AREA *

* WATER SURFACE CONTOUR OF 1390 INVOLVES PLACEMENT OF 10 FOOT HIGH BERM WITH 4:1 INSIDE SLOPE

NOTE: FREEBOARD MUST BE PROVIDED IN THE IMPOUND EMBANKMENT TO ALLOW FOR SURCHARGE HYDRAULIC HEAD, AND TO PREVENT OVERTOPPING OF THE EMBANKMENT BY WAVE ACTION.

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CoP/CTUIR JOINT WATER PROJECT
EAST PATAWA IMPOUND
SIZE/CAPACITY CONFIGURATION

PENDLETON OREGON

SCALE: N.T.S.
PROJECT NO. 06.1365.0001
FILE NAME: LUTCTP01.DWG

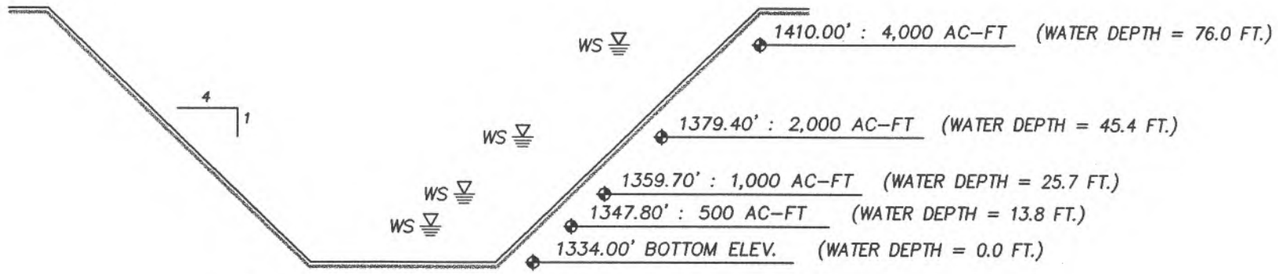
DESIGNED BY: DLU
DRAWN BY: kk
CHECKED BY: ____
APPROVED BY: ____

SHEET 2

SECTION, TOWNSHIP, RANGE:

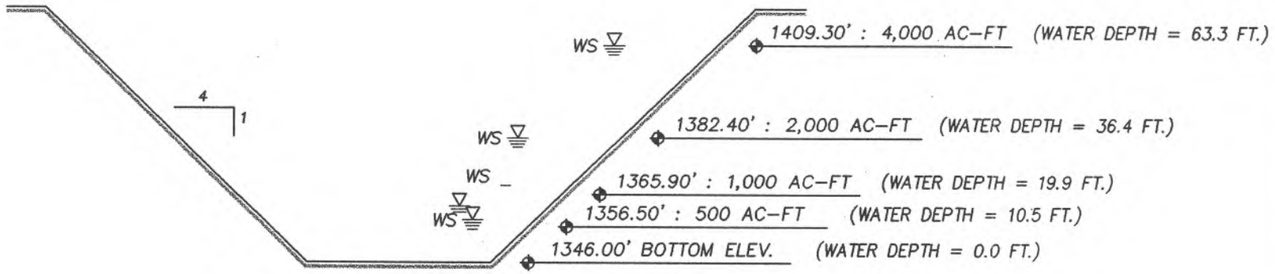
LAST EDIT: 4/20/99
PLOT DATE:

WS WATER SURFACE AT NOTED STORAGE CAPACITY



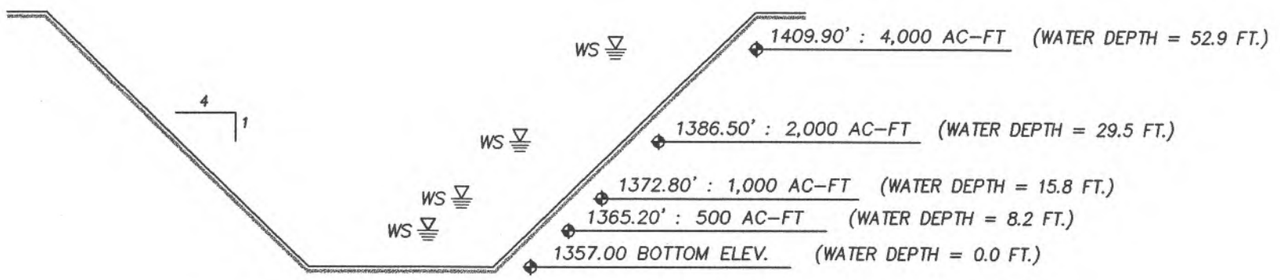
CONFIGURATION 1

1200 FT. x 1200 FT. (BOTTOM FOOTPRINT)
TRAPEZOIDAL BSIN IMPOUND
WATER SURFACE AREA @ 2,000 AC–FT = 56 ACRES
WATER SURFACE AREA @ 4,000 AC–FT = 75 ACRES



CONFIGURATION 2

1400 FT. x 1400 FT. (BOTTOM FOOTPRINT)
TRAPEZOIDAL BASIN IMPOUND
WATER SURFACE AREA @ 2,000 AC–FT = 66 ACRES
WATER SURFACE AREA @ 4,000 AC–FT = 83 ACRES



CONFIGURATION 3

1600 FT. x 1600 FT. (BOTTOM FOOTPRINT)
TRAPEZOIDAL BASIN IMPOUND
WATER SURFACE AREA @ 2,000 AC–FT = 77 ACRES
WATER SURFACE AREA @ 4,000 AC–FT = 94 ACRES

CITY OF PENDLETON

CONFEDERATED TRIBES OF THE UMATILLA INDIAN RESERVATION

NAGLE PROPERTY IMPOUND

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COP/CTUIR JOINT WATER PROJECT
NAGLE PROPERTY IMPOUND
SIZE/CAPACITY CONFIGURATION
(STORAGE CAPACITY TO 4,000 AC-FT)
PENDLETON OREGON

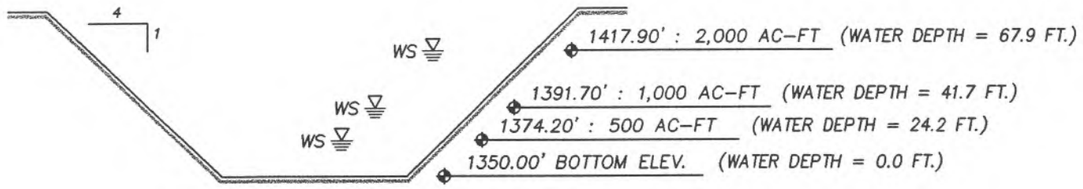
FILE NAME: UMITIL2.DWG
PROJECT NO. 06.1365.0001
SCALE: N.T.S.

DESIGNED BY: DLU
DRAWN BY: kk
CHECKED BY: ——
APPROVED BY: ——

SHEET 3A

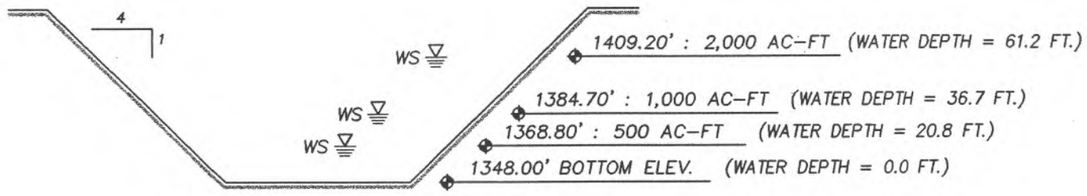
LAST EDIT: 4/1/99
PLOT DATE:

WS ▽ WATER SURFACE AT NOTED STORAGE CAPACITY



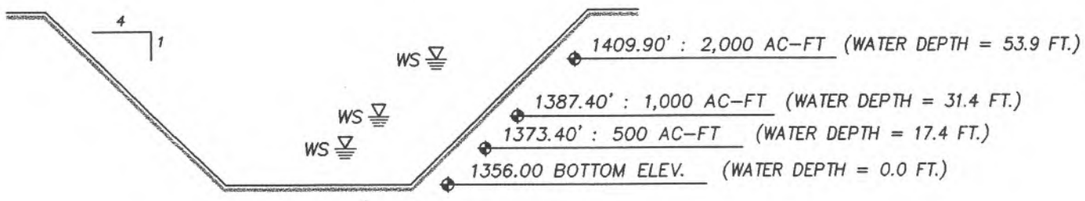
CONFIGURATION 4

850 FT. x 850 FT. (BOTTOM FOOTPRINT)
TRAPEZOIDAL BASIN IMPOUND
WATER SURFACE AREA @ 1,000 AC–FT = 32 ACRES
WATER SURFACE AREA @ 2,000 AC–FT = 45 ACRES



CONFIGURATION 5

940 FT. x 940 FT. (BOTTOM FOOTPRINT)
TRAPEZOIDAL BASIN IMPOUND
WATER SURFACE AREA @ 1,000 AC–FT = 35 ACRES
WATER SURFACE AREA @ 2,000 AC–FT = 47 ACRES



CONFIGURATION 6

1050 FT. x 1050 FT. (BOTTOM FOOTPRINT)
TRAPEZOIDAL BASIN IMPOUND
WATER SURFACE AREA @ 1,000 AC–FT = 39 ACRES
WATER SURFACE AREA @ 2,000 AC–FT = 50 ACRES

NAGLE PROPERTY IMPOUND

CITY OF PENDLETON

CONFEDERATED TRIBES OF THE UMATILLA INDIAN RESERVATION

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COP/CTUIR JOINT WATER PROJECT
NAGLE PROPERTY IMPOUND
SIZE/CAPACITY CONFIGURATION
(STORAGE CAPACITY TO 2,000 AC-FT)
PENDELETON OREGON

FILE NAME: UMITIL4.DWG
PROJECT NO. 06.1365.0001
SCALE: N.T.S.

DESIGNED BY: DLU
DRAWN BY: kk
CHECKED BY: ____
APPROVED BY: ____

SHEET 3B

LAST EDIT: 4/1/99
PLOT DATE:

CoP/CTUIR Joint Water Project

Nagle Property Impound
Size/Capacity Configuration

==========

STORAGE STRUCTURE LIST

TRAPEZOIDAL BASIN ID No. Config.1
Description: Nagle Property Impound
Length: 1200.00 ft. Width: 1200.00 ft.
Side Slope 1: 4 Side Slope 3: 4
Side Slope 2: 4 Side Slope 4: 4
Infiltration Rate: 0.00 min/inch

TRAPEZOIDAL BASIN ID No. Config.2
Description: Nagle Property Impound
Length: 1400.00 ft. Width: 1400.00 ft.
Side Slope 1: 4 Side Slope 3: 4
Side Slope 2: 4 Side Slope 4: 4
Infiltration Rate: 0.00 min/inch

TRAPEZOIDAL BASIN ID No. Config.3
Description: Nagle Property Impound
Length: 1600.00 ft. Width: 1600.00 ft.
Side Slope 1: 4 Side Slope 3: 4
Side Slope 2: 4 Side Slope 4: 4
Infiltration Rate: 0.00 min/inch

TRAPEZOIDAL BASIN ID No. Config.4
Description: Nagle Property Impound
Length: 850.00 ft. Width: 850.00 ft.
Side Slope 1: 4 Side Slope 3: 4
Side Slope 2: 4 Side Slope 4: 4
Infiltration Rate: 0.00 min/inch

TRAPEZOIDAL BASIN ID No. Config.5
Description: Nagle Property Impound
Length: 940.00 ft. Width: 940.00 ft.
Side Slope 1: 4 Side Slope 3: 4
Side Slope 2: 4 Side Slope 4: 4
Infiltration Rate: 0.00 min/inch

TRAPEZOIDAL BASIN ID No. Config.6
Description: Nagle Property Impound
Length: 1050.00 ft. Width: 1050.00 ft.
Side Slope 1: 4 Side Slope 3: 4
Side Slope 2: 4 Side Slope 4: 4
Infiltration Rate: 0.00 min/inch

CoP/CTUIR Joint Water Project

Nagle Property Impound

Size/Capacity Configuration

STAGE STORAGE TABLE

TRAPEZOIDAL BASIN ID No. Config.1

Description: Nagle Property Impound

Length: 1200.00 ft. Width: 1200.00 ft.

Side Slope 1: 4 Side Slope 3: 4

Side Slope 2: 4 Side Slope 4: 4

Infiltration Rate: 0.00 min/inch

STAGE	<----STORAGE---->		STAGE	<----STORAGE---->		STAGE	<----STORAGE---->		STAGE	<----STORAGE---->	
(ft)	---cf---	--Ac-Ft-	(ft)	---cf---	--Ac-Ft-	(ft)	---cf---	--Ac-Ft-	(ft)	---cf---	--Ac-Ft-
1334.00	0.0000	0.0000	1337.80	5611795	128.83	1341.60	11507861	264.18	1345.40	17695222	406.23
1334.10	144096	3.3080	1337.90	5763281	132.31	1341.70	11666923	267.84	1345.50	17862045	410.06
1334.20	288384	6.6204	1338.00	5914965	135.79	1341.80	11826188	271.49	1345.60	18029075	413.89
1334.30	432865	9.9372	1338.10	6066846	139.28	1341.90	11985654	275.15	1345.70	18196312	417.73
1334.40	577537	13.258	1338.20	6218925	142.77	1342.00	12145323	278.82	1345.80	18363755	421.57
1334.50	722403	16.584	1338.30	6371200	146.26	1342.10	12305193	282.49	1345.90	18531406	425.42
1334.60	867461	19.914	1338.40	6523673	149.76	1342.20	12465266	286.16	1346.00	18699264	429.28
1334.70	1012711	23.249	1338.50	6676344	153.27	1342.30	12625542	289.84	1346.10	18867329	433.13
1334.80	1158155	26.588	1338.60	6829212	156.78	1342.40	12786020	293.53	1346.20	19035602	437.00
1334.90	1303792	29.931	1338.70	6982279	160.29	1342.50	12946701	297.22	1346.30	19204082	440.87
1335.00	1449621	33.279	1338.80	7135543	163.81	1342.60	13107585	300.91	1346.40	19372771	444.74
1335.10	1595644	36.631	1338.90	7289006	167.33	1342.70	13268672	304.61	1346.50	19541667	448.61
1335.20	1741861	39.988	1339.00	7442667	170.86	1342.80	13429962	308.31	1346.60	19710771	452.50
1335.30	1888271	43.349	1339.10	7596526	174.39	1342.90	13591455	312.02	1346.70	19880083	456.38
1335.40	2034875	46.714	1339.20	7750584	177.93	1343.00	13753152	315.73	1346.80	20049603	460.28
1335.50	2181672	50.084	1339.30	7904840	181.47	1343.10	13915052	319.45	1346.90	20219332	464.17
1335.60	2328663	53.459	1339.40	8059295	185.02	1343.20	14077156	323.17	1347.00	20389269	468.07
1335.70	2475849	56.838	1339.50	8213949	188.57	1343.30	14239464	326.89	1347.10	20559415	471.98
1335.80	2623228	60.221	1339.60	8368802	192.12	1343.40	14401975	330.62	1347.20	20729770	475.89
1335.90	2770802	63.609	1339.70	8523855	195.68	1343.50	14564691	334.36	1347.30	20900334	479.81
1336.00	2918571	67.001	1339.80	8679106	199.24	1343.60	14727610	338.10	1347.40	21071106	483.73
1336.10	3066534	70.398	1339.90	8834557	202.81	1343.70	14890734	341.84	1347.50	21242088	487.65
1336.20	3214691	73.799	1340.00	8990208	206.39	1343.80	15054063	345.59	1347.60	21413279	491.58
1336.30	3363044	77.205	1340.10	9146058	209.96	1343.90	15217596	349.35	1347.70	21584679	495.52
1336.40	3511591	80.615	1340.20	9302108	213.55	1344.00	15381333	353.11	1347.80	21756289	499.46
1336.50	3660333	84.030	1340.30	9458358	217.13	1344.10	15545276	356.87	1347.90	21928109	503.40
1336.60	3809271	87.449	1340.40	9614808	220.73	1344.20	15709423	360.64	1348.00	22100139	507.35
1336.70	3958404	90.872	1340.50	9771459	224.32	1344.30	15873775	364.41	1348.10	22272378	511.30
1336.80	4107732	94.301	1340.60	9928309	227.92	1344.40	16038333	368.19	1348.20	22444827	515.26
1336.90	4257256	97.733	1340.70	10085360	231.53	1344.50	16203096	371.97	1348.30	22617487	519.23
1337.00	4406976	101.17	1340.80	10242612	235.14	1344.60	16368064	375.76	1348.40	22790357	523.19
1337.10	4556892	104.61	1340.90	10400064	238.75	1344.70	16533238	379.55	1348.50	22963437	527.17
1337.20	4707003	108.06	1341.00	10557717	242.37	1344.80	16698618	383.35	1348.60	23136728	531.15
1337.30	4857311	111.51	1341.10	10715571	246.00	1344.90	16864203	387.15	1348.70	23310230	535.13
1337.40	5007814	114.96	1341.20	10873627	249.62	1345.00	17029995	390.95	1348.80	23483942	539.12
1337.50	5158515	118.42	1341.30	11031883	253.26	1345.10	17195992	394.77	1348.90	23657865	543.11
1337.60	5309411	121.89	1341.40	11190341	256.89	1345.20	17362196	398.58	1349.00	23832000	547.11
1337.70	5460505	125.36	1341.50	11349000	260.54	1345.30	17528606	402.40	1349.10	24006346	551.11

CoP/CTUIR Joint Water Project

Nagle Property Impound

Size/Capacity Configuration

STAGE STORAGE TABLE

STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-	STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-	STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-	STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-
1349.20	24180902	555.12	1353.80	32441182	744.75	1358.40	41161361	944.93	1363.00	50353898	1156
1349.30	24355671	559.13	1353.90	32625815	748.99	1358.50	41356130	949.41	1363.10	50559075	1161
1349.40	24530651	563.15	1354.00	32810667	753.23	1358.60	41551124	953.88	1363.20	50764482	1165
1349.50	24705843	567.17	1354.10	32995735	757.48	1358.70	41746341	958.36	1363.30	50970117	1170
1349.60	24881246	571.19	1354.20	33181022	761.73	1358.80	41941781	962.85	1363.40	51175982	1175
1349.70	25056862	575.23	1354.30	33366526	765.99	1358.90	42137445	967.34	1363.50	51382077	1180
1349.80	25232689	579.26	1354.40	33552249	770.25	1359.00	42333333	971.84	1363.60	51588402	1184
1349.90	25408729	583.30	1354.50	33738189	774.52	1359.10	42529445	976.34	1363.70	51794956	1189
1350.00	25584981	587.35	1354.60	33924348	778.80	1359.20	42725781	980.85	1363.80	52001740	1194
1350.10	25761446	591.40	1354.70	34110725	783.07	1359.30	42922342	985.36	1363.90	52208755	1199
1350.20	25938123	595.46	1354.80	34297321	787.36	1359.40	43119127	989.88	1364.00	52416000	1203
1350.30	26115013	599.52	1354.90	34484135	791.65	1359.50	43316136	994.40	1364.10	52623475	1208
1350.40	26292116	603.58	1355.00	34671168	795.94	1359.60	43513370	998.93	1364.20	52831181	1213
1350.50	26469432	607.65	1355.10	34858420	800.24	1359.70	43710828	1003	1364.30	53039117	1218
1350.60	26646961	611.73	1355.20	35045891	804.54	1359.80	43908512	1008	1364.40	53247284	1222
1350.70	26824703	615.81	1355.30	35233581	808.85	1359.90	44106421	1013	1364.50	53455682	1227
1350.80	27002659	619.90	1355.40	35421490	813.17	1360.00	44304554	1017	1364.60	53664312	1232
1350.90	27180828	623.99	1355.50	35609619	817.48	1360.10	44502914	1022	1364.70	53873172	1237
1351.00	27359211	628.08	1355.60	35797967	821.81	1360.20	44701498	1026	1364.80	54082263	1242
1351.10	27537807	632.18	1355.70	35986535	826.14	1360.30	44900308	1031	1364.90	54291587	1246
1351.20	27716617	636.29	1355.80	36175322	830.47	1360.40	45099344	1035	1365.00	54501141	1251
1351.30	27895642	640.40	1355.90	36364330	834.81	1360.50	45298605	1040	1365.10	54710927	1256
1351.40	28074880	644.51	1356.00	36553557	839.15	1360.60	45498093	1044	1365.20	54920945	1261
1351.50	28254333	648.63	1356.10	36743005	843.50	1360.70	45697806	1049	1365.30	55131195	1266
1351.60	28434000	652.75	1356.20	36932673	847.86	1360.80	45897746	1054	1365.40	55341677	1270
1351.70	28613882	656.88	1356.30	37122561	852.22	1360.90	46097911	1058	1365.50	55552392	1275
1351.80	28793979	661.02	1356.40	37312670	856.58	1361.00	46298304	1063	1365.60	55763338	1280
1351.90	28974290	665.16	1356.50	37503000	860.95	1361.10	46498923	1067	1365.70	55974517	1285
1352.00	29154816	669.30	1356.60	37693550	865.32	1361.20	46699768	1072	1365.80	56185929	1290
1352.10	29335557	673.45	1356.70	37884322	869.70	1361.30	46900841	1077	1365.90	56397573	1295
1352.20	29516513	677.61	1356.80	38075314	874.09	1361.40	47102140	1081	1366.00	56609450	1300
1352.30	29697685	681.77	1356.90	38266528	878.48	1361.50	47303666	1086	1366.10	56821561	1304
1352.40	29879072	685.93	1357.00	38457963	882.87	1361.60	47505420	1091	1366.20	57033904	1309
1352.50	30060675	690.10	1357.10	38649619	887.27	1361.70	47707401	1095	1366.30	57246480	1314
1352.60	30242493	694.27	1357.20	38841497	891.68	1361.80	47909609	1100	1366.40	57459290	1319
1352.70	30424527	698.45	1357.30	39033596	896.09	1361.90	48112045	1105	1366.50	57672333	1324
1352.80	30606777	702.63	1357.40	39225918	900.50	1362.00	48314709	1109	1366.60	57885610	1329
1352.90	30789243	706.82	1357.50	39418461	904.92	1362.10	48517601	1114	1366.70	58099120	1334
1353.00	30971925	711.02	1357.60	39611227	909.35	1362.20	48720720	1118	1366.80	58312865	1339
1353.10	31154824	715.22	1357.70	39804214	913.78	1362.30	48924068	1123	1366.90	58526843	1344
1353.20	31337939	719.42	1357.80	39997424	918.21	1362.40	49127644	1128	1367.00	58741056	1349
1353.30	31521270	723.63	1357.90	40190857	922.66	1362.50	49331448	1132	1367.10	58955502	1353
1353.40	31704819	727.84	1358.00	40384512	927.10	1362.60	49535480	1137	1367.20	59170184	1358
1353.50	31888584	732.06	1358.10	40578390	931.55	1362.70	49739742	1142	1367.30	59385099	1363
1353.60	32072566	736.28	1358.20	40772490	936.01	1362.80	49944232	1147	1367.40	59600249	1368
1353.70	32256765	740.51	1358.30	40966814	940.47	1362.90	50148951	1151	1367.50	59815634	1373

CoP/CTUIR Joint Water Project

Nagle Property Impound

Size/Capacity Configuration

STAGE STORAGE TABLE

STAGE (ft)	STORAGE ---cf---	--Ac-Ft-	STAGE (ft)	STORAGE ---cf---	--Ac-Ft-	STAGE (ft)	STORAGE ---cf---	--Ac-Ft-	STAGE (ft)	STORAGE ---cf---	--Ac-Ft-
1367.60	60031254	1378	1372.20	70205887	1612	1376.80	80890256	1857	1381.40	92096819	2114
1367.70	60247109	1383	1372.30	70432691	1617	1376.90	81128279	1862	1381.50	92346333	2120
1367.80	60463199	1388	1372.40	70659735	1622	1377.00	81366549	1868	1381.60	92596099	2126
1367.90	60679524	1393	1372.50	70887021	1627	1377.10	81605066	1873	1381.70	92846119	2131
1368.00	60896085	1398	1372.60	71114548	1633	1377.20	81843830	1879	1381.80	93096391	2137
1368.10	61112881	1403	1372.70	71342317	1638	1377.30	82082842	1884	1381.90	93346917	2143
1368.20	61329913	1408	1372.80	71570327	1643	1377.40	82322101	1890	1382.00	93597696	2149
1368.30	61547181	1413	1372.90	71798578	1648	1377.50	82561608	1895	1382.10	93848728	2154
1368.40	61764684	1418	1373.00	72027072	1654	1377.60	82801362	1901	1382.20	94100014	2160
1368.50	61982424	1423	1373.10	72255807	1659	1377.70	83041364	1906	1382.30	94351553	2166
1368.60	62200399	1428	1373.20	72484784	1664	1377.80	83281614	1912	1382.40	94603347	2172
1368.70	62418611	1433	1373.30	72714004	1669	1377.90	83522112	1917	1382.50	94855394	2178
1368.80	62637060	1438	1373.40	72943466	1675	1378.00	83762858	1923	1382.60	95107696	2183
1368.90	62855745	1443	1373.50	73173170	1680	1378.10	84003853	1928	1382.70	95360251	2189
1369.00	63074666	1448	1373.60	73403117	1685	1378.20	84245096	1934	1382.80	95613061	2195
1369.10	63293825	1453	1373.70	73633307	1690	1378.30	84486587	1940	1382.90	95866126	2201
1369.20	63513220	1458	1373.80	73863739	1696	1378.40	84728328	1945	1383.00	96119445	2207
1369.30	63732853	1463	1373.90	74094415	1701	1378.50	84970317	1951	1383.10	96373019	2212
1369.40	63952722	1468	1374.00	74325333	1706	1378.60	85212555	1956	1383.20	96626847	2218
1369.50	64172829	1473	1374.10	74556495	1712	1378.70	85455042	1962	1383.30	96880931	2224
1369.60	64393173	1478	1374.20	74787900	1717	1378.80	85697779	1967	1383.40	97135270	2230
1369.70	64613755	1483	1374.30	75019548	1722	1378.90	85940764	1973	1383.50	97389864	2236
1369.80	64834575	1488	1374.40	75251440	1728	1379.00	86184000	1979	1383.60	97644713	2242
1369.90	65055632	1493	1374.50	75483576	1733	1379.10	86427484	1984	1383.70	97899818	2247
1370.00	65276928	1499	1374.60	75715955	1738	1379.20	86671219	1990	1383.80	98155178	2253
1370.10	65498461	1504	1374.70	75948579	1744	1379.30	86915203	1995	1383.90	98410794	2259
1370.20	65720233	1509	1374.80	76181446	1749	1379.40	87159438	2001	1384.00	98666666	2265
1370.30	65942243	1514	1374.90	76414558	1754	1379.50	87403922	2007	1384.10	98922794	2271
1370.40	66164491	1519	1375.00	76647914	1760	1379.60	87648657	2012	1384.20	99179178	2277
1370.50	66386978	1524	1375.10	76881515	1765	1379.70	87893642	2018	1384.30	99435819	2283
1370.60	66609704	1529	1375.20	77115360	1770	1379.80	88138878	2023	1384.40	99692716	2289
1370.70	66832669	1534	1375.30	77349450	1776	1379.90	88384364	2029	1384.50	99949869	2295
1370.80	67055872	1539	1375.40	77583785	1781	1380.00	88630101	2035	1384.60	100207279	2300
1370.90	67279315	1545	1375.50	77818365	1786	1380.10	88876089	2040	1384.70	100464945	2306
1371.00	67502997	1550	1375.60	78053190	1792	1380.20	89122328	2046	1384.80	100722869	2312
1371.10	67726918	1555	1375.70	78288260	1797	1380.30	89368818	2052	1384.90	100981050	2318
1371.20	67951079	1560	1375.80	78523576	1803	1380.40	89615559	2057	1385.00	101239488	2324
1371.30	68175480	1565	1375.90	78759137	1808	1380.50	89862552	2063	1385.10	101498183	2330
1371.40	68400120	1570	1376.00	78994944	1813	1380.60	90109796	2069	1385.20	101757135	2336
1371.50	68625000	1575	1376.10	79230996	1819	1380.70	90357292	2074	1385.30	102016345	2342
1371.60	68850120	1581	1376.20	79467295	1824	1380.80	90605039	2080	1385.40	102275813	2348
1371.70	69075480	1586	1376.30	79703839	1830	1380.90	90853039	2086	1385.50	102535538	2354
1371.80	69301080	1591	1376.40	79940629	1835	1381.00	91101290	2091	1385.60	102795522	2360
1371.90	69526921	1596	1376.50	80177666	1841	1381.10	91349794	2097	1385.70	103055763	2366
1372.00	69753002	1601	1376.60	80414950	1846	1381.20	91598550	2103	1385.80	103316263	2372
1372.10	69979324	1607	1376.70	80652479	1852	1381.30	91847558	2109	1385.90	103577020	2378

CoP/CTUIR Joint Water Project

Nagle Property Impound

Size/Capacity Configuration

STAGE STORAGE TABLE

STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-	STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-	STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-	STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-
1386.00	103838037	2384	1390.60	116126367	2666	1395.20	128974270	2961	1399.80	142394203	3269
1386.10	104099312	2390	1390.70	116399674	2672	1395.30	129259880	2967	1399.90	142692387	3276
1386.20	104360845	2396	1390.80	116673246	2678	1395.40	129545760	2974	1400.00	142990847	3283
1386.30	104622638	2402	1390.90	116947082	2685	1395.50	129831911	2981	1400.10	143289584	3289
1386.40	104884689	2408	1391.00	117221183	2691	1395.60	130118333	2987	1400.20	143588597	3296
1386.50	105146999	2414	1391.10	117495550	2697	1395.70	130405026	2994	1400.30	143887887	3303
1386.60	105409569	2420	1391.20	117770181	2704	1395.80	130691989	3000	1400.40	144187454	3310
1386.70	105672398	2426	1391.30	118045077	2710	1395.90	130979224	3007	1400.50	144487298	3317
1386.80	105935486	2432	1391.40	118320239	2716	1396.00	131266730	3013	1400.60	144787419	3324
1386.90	106198834	2438	1391.50	118595666	2723	1396.10	131554507	3020	1400.70	145087817	3331
1387.00	106462442	2444	1391.60	118871359	2729	1396.20	131842556	3027	1400.80	145388493	3338
1387.10	106726310	2450	1391.70	119147317	2735	1396.30	132130876	3033	1400.90	145689446	3345
1387.20	106990437	2456	1391.80	119423542	2742	1396.40	132419469	3040	1401.00	145990677	3351
1387.30	107254825	2462	1391.90	119700032	2748	1396.50	132708333	3047	1401.10	146292185	3358
1387.40	107519473	2468	1392.00	119976789	2754	1396.60	132997469	3053	1401.20	146593971	3365
1387.50	107784381	2474	1392.10	120253811	2761	1396.70	133286877	3060	1401.30	146896036	3372
1387.60	108049549	2480	1392.20	120531101	2767	1396.80	133576557	3066	1401.40	147198378	3379
1387.70	108314979	2487	1392.30	120808656	2773	1396.90	133866510	3073	1401.50	147500999	3386
1387.80	108580669	2493	1392.40	121086478	2780	1397.00	134156735	3080	1401.60	147803898	3393
1387.90	108846620	2499	1392.50	121364567	2786	1397.10	134447233	3086	1401.70	148107076	3400
1388.00	109112831	2505	1392.60	121642923	2793	1397.20	134738004	3093	1401.80	148410533	3407
1388.10	109379304	2511	1392.70	121921546	2799	1397.30	135029048	3100	1401.90	148714268	3414
1388.20	109646039	2517	1392.80	122200436	2805	1397.40	135320364	3107	1402.00	149018282	3421
1388.30	109913034	2523	1392.90	122479593	2812	1397.50	135611954	3113	1402.10	149322575	3428
1388.40	110180291	2529	1393.00	122759018	2818	1397.60	135903817	3120	1402.20	149627147	3435
1388.50	110447810	2536	1393.10	123038710	2825	1397.70	136195954	3127	1402.30	149931999	3442
1388.60	110715591	2542	1393.20	123318670	2831	1397.80	136488364	3133	1402.40	150237130	3449
1388.70	110983633	2548	1393.30	123598898	2837	1397.90	136781047	3140	1402.50	150542541	3456
1388.80	111251937	2554	1393.40	123879393	2844	1398.00	137074005	3147	1402.60	150848231	3463
1388.90	111520504	2560	1393.50	124160157	2850	1398.10	137367236	3154	1402.70	151154201	3470
1389.00	111789333	2566	1393.60	124441188	2857	1398.20	137660741	3160	1402.80	151460451	3477
1389.10	112058424	2573	1393.70	124722488	2863	1398.30	137954521	3167	1402.90	151766981	3484
1389.20	112327778	2579	1393.80	125004057	2870	1398.40	138248575	3174	1403.00	152073791	3491
1389.30	112597394	2585	1393.90	125285894	2876	1398.50	138542903	3181	1403.10	152380882	3498
1389.40	112867273	2591	1394.00	125567999	2883	1398.60	138837506	3187	1403.20	152688253	3505
1389.50	113137415	2597	1394.10	125850374	2889	1398.70	139132384	3194	1403.30	152995904	3512
1389.60	113407821	2603	1394.20	126133017	2896	1398.80	139427536	3201	1403.40	153303837	3519
1389.70	113678489	2610	1394.30	126415930	2902	1398.90	139722964	3208	1403.50	153612050	3526
1389.80	113949420	2616	1394.40	126699111	2909	1399.00	140018666	3214	1403.60	153920544	3534
1389.90	114220616	2622	1394.50	126982562	2915	1399.10	140314644	3221	1403.70	154229319	3541
1390.00	114492074	2628	1394.60	127266282	2922	1399.20	140610897	3228	1403.80	154538376	3548
1390.10	114763796	2635	1394.70	127550272	2928	1399.30	140907425	3235	1403.90	154847713	3555
1390.20	115035782	2641	1394.80	127834532	2935	1399.40	141204229	3242	1404.00	155157333	3562
1390.30	115308032	2647	1394.90	128119061	2941	1399.50	141501309	3248	1404.10	155467233	3569
1390.40	115580546	2653	1395.00	128403861	2948	1399.60	141798664	3255	1404.20	155777416	3576
1390.50	115853325	2660	1395.10	128688930	2954	1399.70	142096296	3262	1404.30	156087880	3583

CoP/CTUIR Joint Water Project

Nagle Property Impound

Size/Capacity Configuration

STAGE STORAGE TABLE

STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-	STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-	STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-	STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-
1404.40	156398627	3590	1405.90	161093748	3698	1407.40	165852776	3807	1408.90	170676143	3918
1404.50	156709655	3598	1406.00	161409023	3705	1407.50	166172327	3815	1409.00	170999999	3926
1404.60	157020966	3605	1406.10	161724583	3713	1407.60	166492165	3822	1409.10	171324143	3933
1404.70	157332559	3612	1406.20	162040427	3720	1407.70	166812288	3829	1409.20	171648575	3941
1404.80	157644435	3619	1406.30	162356555	3727	1407.80	167132698	3837	1409.30	171973296	3948
1404.90	157956593	3626	1406.40	162672968	3734	1407.90	167453395	3844	1409.40	172298304	3955
1405.00	158269034	3633	1406.50	162989666	3742	1408.00	167774378	3852	1409.50	172623602	3963
1405.10	158581758	3641	1406.60	163306648	3749	1408.10	168095648	3859	1409.60	172949188	3970
1405.20	158894765	3648	1406.70	163623916	3756	1408.20	168417204	3866	1409.70	173275062	3978
1405.30	159208055	3655	1406.80	163941468	3764	1408.30	168739048	3874	1409.80	173601226	3985
1405.40	159521628	3662	1406.90	164259306	3771	1408.40	169061178	3881	1409.90	173927679	3993
1405.50	159835484	3669	1407.00	164577428	3778	1408.50	169383596	3889	1410.00	174254420	4000
1405.60	160149625	3677	1407.10	164895837	3785	1408.60	169706302	3896	1410.00	174254421	4000
1405.70	160464049	3684	1407.20	165214531	3793	1408.70	170029295	3903			
1405.80	160778756	3691	1407.30	165533510	3800	1408.80	170352575	3911			

CoP/CTUIR Joint Water Project

Nagle Property Impound
Size/Capacity Configuration

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STAGE STORAGE TABLE

TRAPEZOIDAL BASIN ID No. Config.2
Description: Nagle Property Impound
Length: 1400.00 ft. Width: 1400.00 ft.
Side Slope 1: 4 Side Slope 3: 4
Side Slope 2: 4 Side Slope 4: 4
Infiltration Rate: 0.00 min/inch

STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-	STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-	STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-	STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-
1346.00	0.0000	0.0000	1349.80	7610899	174.72	1353.60	15552277	357.03	1357.40	23831158	547.09
1346.10	196112	4.5021	1349.90	7815617	179.42	1353.70	15765787	361.93	1357.50	24053645	552.20
1346.20	392448	9.0094	1350.00	8020565	184.13	1353.80	15979532	366.84	1357.60	24276371	557.31
1346.30	589009	13.522	1350.10	8225742	188.84	1353.90	16193510	371.75	1357.70	24499336	562.43
1346.40	785793	18.039	1350.20	8431149	193.55	1354.00	16407723	376.67	1357.80	24722539	567.55
1346.50	982803	22.562	1350.30	8636784	198.27	1354.10	16622169	381.59	1357.90	24945982	572.68
1346.60	1180037	27.090	1350.40	8842649	203.00	1354.20	16836850	386.52	1358.00	25169664	577.82
1346.70	1377495	31.623	1350.50	9048744	207.73	1354.30	17051766	391.45	1358.10	25393585	582.96
1346.80	1575179	36.161	1350.60	9255068	212.47	1354.40	17266916	396.39	1358.20	25617746	588.10
1346.90	1773088	40.704	1350.70	9461623	217.21	1354.50	17482301	401.34	1358.30	25842146	593.25
1347.00	1971221	45.253	1350.80	9668407	221.96	1354.60	17697921	406.29	1358.40	26066787	598.41
1347.10	2169580	49.807	1350.90	9875422	226.71	1354.70	17913776	411.24	1358.50	26291667	603.57
1347.20	2368165	54.366	1351.00	10082667	231.47	1354.80	18129866	416.20	1358.60	26516787	608.74
1347.30	2566975	58.930	1351.10	10290142	236.23	1354.90	18346191	421.17	1358.70	26742147	613.92
1347.40	2766011	63.499	1351.20	10497848	241.00	1355.00	18562752	426.14	1358.80	26967747	619.09
1347.50	2965272	68.073	1351.30	10705784	245.77	1355.10	18779548	431.12	1358.90	27193588	624.28
1347.60	3164759	72.653	1351.40	10913951	250.55	1355.20	18996580	436.10	1359.00	27419669	629.47
1347.70	3364473	77.238	1351.50	11122349	255.33	1355.30	19213848	441.09	1359.10	27645991	634.66
1347.80	3564412	81.828	1351.60	11330978	260.12	1355.40	19431351	446.08	1359.20	27872554	639.87
1347.90	3764578	86.423	1351.70	11539839	264.92	1355.50	19649091	451.08	1359.30	28099357	645.07
1348.00	3964971	91.023	1351.80	11748930	269.72	1355.60	19867066	456.09	1359.40	28326402	650.28
1348.10	4165590	95.629	1351.90	11958253	274.52	1355.70	20085278	461.09	1359.50	28553688	655.50
1348.20	4366435	100.24	1352.00	12167808	279.33	1355.80	20303727	466.11	1359.60	28781215	660.73
1348.30	4567508	104.86	1352.10	12377594	284.15	1355.90	20522412	471.13	1359.70	29008983	665.95
1348.40	4768807	109.48	1352.20	12587612	288.97	1356.00	20741333	476.16	1359.80	29236993	671.19
1348.50	4970333	114.10	1352.30	12797862	293.80	1356.10	20960492	481.19	1359.90	29465245	676.43
1348.60	5172087	118.73	1352.40	13008344	298.63	1356.20	21179887	486.22	1360.00	29693739	681.67
1348.70	5374068	123.37	1352.50	13219059	303.47	1356.30	21399519	491.27	1360.10	29922474	686.93
1348.80	5576276	128.01	1352.60	13430005	308.31	1356.40	21619389	496.31	1360.20	30151451	692.18
1348.90	5778712	132.66	1352.70	13641184	313.16	1356.50	21839496	501.37	1360.30	30380671	697.44
1349.00	5981376	137.31	1352.80	13852596	318.01	1356.60	22059840	506.42	1360.40	30610133	702.71
1349.10	6184268	141.97	1352.90	14064240	322.87	1356.70	22280422	511.49	1360.50	30839837	707.99
1349.20	6387387	146.63	1353.00	14276117	327.73	1356.80	22501242	516.56	1360.60	31069784	713.26
1349.30	6590735	151.30	1353.10	14488227	332.60	1356.90	22722299	521.63	1360.70	31299974	718.55
1349.40	6794310	155.98	1353.20	14700571	337.48	1357.00	22943595	526.71	1360.80	31530406	723.84
1349.50	6998115	160.65	1353.30	14913147	342.36	1357.10	23165128	531.80	1360.90	31761081	729.13
1349.60	7202147	165.34	1353.40	15125957	347.24	1357.20	23386900	536.89	1361.00	31992000	734.44
1349.70	7406409	170.03	1353.50	15339000	352.13	1357.30	23608910	541.99	1361.10	32223161	739.74

CoP/CTUIR Joint Water Project

Nagle Property Impound

Size/Capacity Configuration

STAGE STORAGE TABLE

STAGE (ft)	STORAGE ---cf---	--Ac-Ft-	STAGE (ft)	STORAGE ---cf---	--Ac-Ft-	STAGE (ft)	STORAGE ---cf---	--Ac-Ft-	STAGE (ft)	STORAGE ---cf---	--Ac-Ft-
1361.20	32454566	745.05	1365.80	43364446	995.51	1370.40	54801936	1258	1375.00	66779498	1533
1361.30	32686215	750.37	1365.90	43607431	1001	1370.50	55056530	1264	1375.10	67045971	1539
1361.40	32918107	755.70	1366.00	43850666	1007	1370.60	55311380	1270	1375.20	67312706	1545
1361.50	33150243	761.02	1366.10	44094151	1012	1370.70	55566485	1276	1375.30	67579701	1551
1361.60	33382622	766.36	1366.20	44337886	1018	1370.80	55821845	1281	1375.40	67846958	1558
1361.70	33615246	771.70	1366.30	44581870	1023	1370.90	56077461	1287	1375.50	68114477	1564
1361.80	33848113	777.05	1366.40	44826105	1029	1371.00	56333333	1293	1375.60	68382258	1570
1361.90	34081225	782.40	1366.50	45070589	1035	1371.10	56589461	1299	1375.70	68650300	1576
1362.00	34314581	787.75	1366.60	45315324	1040	1371.20	56845845	1305	1375.80	68918604	1582
1362.10	34548182	793.12	1366.70	45560309	1046	1371.30	57102486	1311	1375.90	69187171	1588
1362.20	34782027	798.49	1366.80	45805545	1052	1371.40	57359382	1317	1376.00	69456000	1594
1362.30	35016117	803.86	1366.90	46051031	1057	1371.50	57616536	1323	1376.10	69725091	1601
1362.40	35250452	809.24	1367.00	46296768	1063	1371.60	57873946	1329	1376.20	69994445	1607
1362.50	35485032	814.62	1367.10	46542756	1068	1371.70	58131612	1335	1376.30	70264061	1613
1362.60	35719857	820.02	1367.20	46788995	1074	1371.80	58389536	1340	1376.40	70533940	1619
1362.70	35954927	825.41	1367.30	47035485	1080	1371.90	58647717	1346	1376.50	70804082	1625
1362.80	36190243	830.81	1367.40	47282226	1085	1372.00	58906154	1352	1376.60	71074487	1632
1362.90	36425804	836.22	1367.50	47529218	1091	1372.10	59164849	1358	1376.70	71345156	1638
1363.00	36661611	841.63	1367.60	47776463	1097	1372.20	59423802	1364	1376.80	71616087	1644
1363.10	36897663	847.05	1367.70	48023958	1102	1372.30	59683012	1370	1376.90	71887282	1650
1363.20	37133961	852.48	1367.80	48271706	1108	1372.40	59942480	1376	1377.00	72158741	1657
1363.30	37370506	857.91	1367.90	48519706	1114	1372.50	60202205	1382	1377.10	72430463	1663
1363.40	37607296	863.34	1368.00	48767957	1120	1372.60	60462188	1388	1377.20	72702449	1669
1363.50	37844333	868.79	1368.10	49016461	1125	1372.70	60722430	1394	1377.30	72974699	1675
1363.60	38081616	874.23	1368.20	49265217	1131	1372.80	60982929	1400	1377.40	73247213	1682
1363.70	38319146	879.69	1368.30	49514225	1137	1372.90	61243687	1406	1377.50	73519992	1688
1363.80	38556923	885.15	1368.40	49763486	1142	1373.00	61504704	1412	1377.60	73793034	1694
1363.90	38794946	890.61	1368.50	50013000	1148	1373.10	61765979	1418	1377.70	74066341	1700
1364.00	39033216	896.08	1368.60	50262766	1154	1373.20	62027512	1424	1377.80	74339913	1707
1364.10	39271733	901.55	1368.70	50512786	1160	1373.30	62289305	1430	1377.90	74613749	1713
1364.20	39510497	907.04	1368.80	50763058	1165	1373.40	62551356	1436	1378.00	74887850	1719
1364.30	39749509	912.52	1368.90	51013584	1171	1373.50	62813666	1442	1378.10	75162216	1725
1364.40	39988768	918.02	1369.00	51264362	1177	1373.60	63076236	1448	1378.20	75436848	1732
1364.50	40228275	923.51	1369.10	51515395	1183	1373.70	63339065	1454	1378.30	75711744	1738
1364.60	40468029	929.02	1369.20	51766681	1188	1373.80	63602153	1460	1378.40	75986906	1744
1364.70	40708031	934.53	1369.30	52018220	1194	1373.90	63865501	1466	1378.50	76262333	1751
1364.80	40948281	940.04	1369.40	52270014	1200	1374.00	64129109	1472	1378.60	76538026	1757
1364.90	41188779	945.56	1369.50	52522061	1206	1374.10	64392977	1478	1378.70	76813984	1763
1365.00	41429525	951.09	1369.60	52774363	1212	1374.20	64657104	1484	1378.80	77090209	1770
1365.10	41670520	956.62	1369.70	53026918	1217	1374.30	64921492	1490	1378.90	77366699	1776
1365.20	41911763	962.16	1369.80	53279728	1223	1374.40	65186140	1496	1379.00	77643456	1782
1365.30	42153254	967.71	1369.90	53532793	1229	1374.50	65451048	1503	1379.10	77920478	1789
1365.40	42394995	973.26	1370.00	53786112	1235	1374.60	65716216	1509	1379.20	78197768	1795
1365.50	42636984	978.81	1370.10	54039686	1241	1374.70	65981646	1515	1379.30	78475323	1802
1365.60	42879222	984.37	1370.20	54293514	1246	1374.80	66247336	1521	1379.40	78753145	1808
1365.70	43121709	989.94	1370.30	54547598	1252	1374.90	66513287	1527	1379.50	79031234	1814

CoP/CTUIR Joint Water Project

Nagle Property Impound

Size/Capacity Configuration

STAGE STORAGE TABLE

STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-	STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-	STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-	STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-
1379.60	79309590	1821	1384.20	92404671	2121	1388.80	106077200	2435	1393.40	120339635	2763
1379.70	79588213	1827	1384.30	92695715	2128	1388.90	106380935	2442	1393.50	120656333	2770
1379.80	79867103	1833	1384.40	92987031	2135	1389.00	106684949	2449	1393.60	120973315	2777
1379.90	80146260	1840	1384.50	93278621	2141	1389.10	106989242	2456	1393.70	121290583	2784
1380.00	80425685	1846	1384.60	93570484	2148	1389.20	107293814	2463	1393.80	121608135	2792
1380.10	80705377	1853	1384.70	93862620	2155	1389.30	107598666	2470	1393.90	121925973	2799
1380.20	80985337	1859	1384.80	94155030	2162	1389.40	107903797	2477	1394.00	122244095	2806
1380.30	81265565	1866	1384.90	94447714	2168	1389.50	108209208	2484	1394.10	122562504	2814
1380.40	81546060	1872	1385.00	94740672	2175	1389.60	108514898	2491	1394.20	122881198	2821
1380.50	81826824	1878	1385.10	95033903	2182	1389.70	108820868	2498	1394.30	123200177	2828
1380.60	82107855	1885	1385.20	95327408	2188	1389.80	109127118	2505	1394.40	123519443	2836
1380.70	82389155	1891	1385.30	95621188	2195	1389.90	109433648	2512	1394.50	123838994	2843
1380.80	82670724	1898	1385.40	95915242	2202	1390.00	109740458	2519	1394.60	124158832	2850
1380.90	82952561	1904	1385.50	96209570	2209	1390.10	110047549	2526	1394.70	124478955	2858
1381.00	83234666	1911	1385.60	96504173	2215	1390.20	110354920	2533	1394.80	124799365	2865
1381.10	83517041	1917	1385.70	96799051	2222	1390.30	110662571	2540	1394.90	125120062	2872
1381.20	83799684	1924	1385.80	97094203	2229	1390.40	110970504	2548	1395.00	125441045	2880
1381.30	84082596	1930	1385.90	97389630	2236	1390.50	111278717	2555	1395.10	125762315	2887
1381.40	84365778	1937	1386.00	97685333	2243	1390.60	111587211	2562	1395.20	126083871	2894
1381.50	84649229	1943	1386.10	97981311	2249	1390.70	111895986	2569	1395.30	126405715	2902
1381.60	84932949	1950	1386.20	98277563	2256	1390.80	112205043	2576	1395.40	126727845	2909
1381.70	85216939	1956	1386.30	98574092	2263	1390.90	112514380	2583	1395.50	127050263	2917
1381.80	85501199	1963	1386.40	98870896	2270	1391.00	112823999	2590	1395.60	127372969	2924
1381.90	85785728	1969	1386.50	99167976	2277	1391.10	113133900	2597	1395.70	127695961	2931
1382.00	86070528	1976	1386.60	99465331	2283	1391.20	113444083	2604	1395.80	128019242	2939
1382.10	86355597	1982	1386.70	99762963	2290	1391.30	113754547	2611	1395.90	128342810	2946
1382.20	86640937	1989	1386.80	100060870	2297	1391.40	114065294	2619	1396.00	128666666	2954
1382.30	86926547	1996	1386.90	100359054	2304	1391.50	114376322	2626	1396.10	128990810	2961
1382.40	87212427	2002	1387.00	100657514	2311	1391.60	114687633	2633	1396.20	129315242	2969
1382.50	87498578	2009	1387.10	100956251	2318	1391.70	114999226	2640	1396.30	129639963	2976
1382.60	87785000	2015	1387.20	101255264	2325	1391.80	115311102	2647	1396.40	129964971	2984
1382.70	88071693	2022	1387.30	101554554	2331	1391.90	115623260	2654	1396.50	130290269	2991
1382.80	88358656	2028	1387.40	101854121	2338	1392.00	115935701	2662	1396.60	130615855	2999
1382.90	88645891	2035	1387.50	102153965	2345	1392.10	116248425	2669	1396.70	130941729	3006
1383.00	88933397	2042	1387.60	102454086	2352	1392.20	116561432	2676	1396.80	131267893	3013
1383.10	89221174	2048	1387.70	102754484	2359	1392.30	116874722	2683	1396.90	131594346	3021
1383.20	89509223	2055	1387.80	103055160	2366	1392.40	117188295	2690	1397.00	131921087	3028
1383.30	89797543	2061	1387.90	103356113	2373	1392.50	117502151	2697	1397.10	132248118	3036
1383.40	90086136	2068	1388.00	103657344	2380	1392.60	117816292	2705	1397.20	132575439	3044
1383.50	90375000	2075	1388.10	103958852	2387	1392.70	118130715	2712	1397.30	132903049	3051
1383.60	90664136	2081	1388.20	104260638	2393	1392.80	118445423	2719	1397.40	133230949	3059
1383.70	90953544	2088	1388.30	104562703	2400	1392.90	118760415	2726	1397.50	133559138	3066
1383.80	91243224	2095	1388.40	104865045	2407	1393.00	119075690	2734	1397.60	133887617	3074
1383.90	91533177	2101	1388.50	105167666	2414	1393.10	119391250	2741	1397.70	134216387	3081
1384.00	91823402	2108	1388.60	105470565	2421	1393.20	119707094	2748	1397.80	134545446	3089
1384.10	92113900	2115	1388.70	105773743	2428	1393.30	120023222	2755	1397.90	134874796	3096

CoP/CTUIR Joint Water Project

Nagle Property Impound
Size/Capacity Configuration

STAGE STORAGE TABLE

STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-	STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-	STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-	STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-
1398.00	135204437	3104	1401.10	145568040	3342	1404.20	156214684	3586	1407.30	167148184	3837
1398.10	135534368	3111	1401.20	145907042	3350	1404.30	156562880	3594	1407.40	167505696	3845
1398.20	135864589	3119	1401.30	146246338	3357	1404.40	156911374	3602	1407.50	167863511	3854
1398.30	136195102	3127	1401.40	146585929	3365	1404.50	157260167	3610	1407.60	168221629	3862
1398.40	136525905	3134	1401.50	146925815	3373	1404.60	157609259	3618	1407.70	168580050	3870
1398.50	136856999	3142	1401.60	147265996	3381	1404.70	157958650	3626	1407.80	168938773	3878
1398.60	137188385	3149	1401.70	147606473	3389	1404.80	158308340	3634	1407.90	169297800	3887
1398.70	137520062	3157	1401.80	147947244	3396	1404.90	158658329	3642	1408.00	169657130	3895
1398.80	137852030	3165	1401.90	148288311	3404	1405.00	159008618	3650	1408.10	170016763	3903
1398.90	138184290	3172	1402.00	148629674	3412	1405.10	159359206	3658	1408.20	170376700	3911
1399.00	138516842	3180	1402.10	148971332	3420	1405.20	159710094	3666	1408.30	170736940	3920
1399.10	138849686	3188	1402.20	149313286	3428	1405.30	160061282	3675	1408.40	171097484	3928
1399.20	139182821	3195	1402.30	149655536	3436	1405.40	160412769	3683	1408.50	171458332	3936
1399.30	139516249	3203	1402.40	149998082	3443	1405.50	160764557	3691	1408.60	171819485	3944
1399.40	139849968	3211	1402.50	150340925	3451	1405.60	161116644	3699	1408.70	172180941	3953
1399.50	140183981	3218	1402.60	150684063	3459	1405.70	161469032	3707	1408.80	172542701	3961
1399.60	140518285	3226	1402.70	151027498	3467	1405.80	161821721	3715	1408.90	172904766	3969
1399.70	140852883	3234	1402.80	151371230	3475	1405.90	162174710	3723	1409.00	173267135	3978
1399.80	141187773	3241	1402.90	151715258	3483	1406.00	162527999	3731	1409.10	173629809	3986
1399.90	141522955	3249	1403.00	152059583	3491	1406.10	162881590	3739	1409.20	173992788	3994
1400.00	141858431	3257	1403.10	152404205	3499	1406.20	163235481	3747	1409.30	174356071	4003
1400.10	142194200	3264	1403.20	152749125	3507	1406.30	163589673	3756	1409.40	174719660	4011
1400.20	142530263	3272	1403.30	153094341	3515	1406.40	163944167	3764	1409.50	175083554	4019
1400.30	142866618	3280	1403.40	153439855	3522	1406.50	164298962	3772	1409.60	175447753	4028
1400.40	143203267	3287	1403.50	153785666	3530	1406.60	164654058	3780	1409.70	175812257	4036
1400.50	143540210	3295	1403.60	154131775	3538	1406.70	165009456	3788	1409.80	176177067	4044
1400.60	143877446	3303	1403.70	154478181	3546	1406.80	165365156	3796	1409.90	176542183	4053
1400.70	144214977	3311	1403.80	154824886	3554	1406.90	165721157	3804	1410.00	176907604	4061
1400.80	144552801	3318	1403.90	155171888	3562	1407.00	166077461	3813	1410.00	176907605	4061
1400.90	144890920	3326	1404.00	155519189	3570	1407.10	166434066	3821			
1401.00	145229333	3334	1404.10	155866787	3578	1407.20	166790974	3829			

CoP/CTUIR Joint Water Project

Nagle Property Impound
Size/Capacity Configuration

STAGE STORAGE TABLE

TRAPEZOIDAL BASIN ID No. Config.3
Description: Nagle Property Impound
Length: 1600.00 ft. Width: 1600.00 ft.
Side Slope 1: 4 Side Slope 3: 4
Side Slope 2: 4 Side Slope 4: 4
Infiltration Rate: 0.00 min/inch

STAGE	<----STORAGE---->		STAGE	<----STORAGE---->		STAGE	<----STORAGE---->		STAGE	<----STORAGE---->	
(ft)	---cf---	--Ac-Ft-	(ft)	---cf---	--Ac-Ft-	(ft)	---cf---	--Ac-Ft-	(ft)	---cf---	--Ac-Ft-
1357.00	0.0000	0.0000	1360.80	9914003	227.59	1364.60	20204693	463.84	1368.40	30879094	708.89
1357.10	256128	5.8799	1360.90	10179953	233.70	1364.70	20480651	470.17	1368.50	31165245	715.46
1357.20	512512	11.766	1361.00	10446165	239.81	1364.80	20756876	476.51	1368.60	31451667	722.03
1357.30	769153	17.657	1361.10	10712638	245.93	1364.90	21033366	482.86	1368.70	31738360	728.61
1357.40	1026049	23.555	1361.20	10979373	252.05	1365.00	21310123	489.21	1368.80	32025323	735.20
1357.50	1283203	29.458	1361.30	11246368	258.18	1365.10	21587145	495.57	1368.90	32312558	741.79
1357.60	1540613	35.368	1361.40	11513625	264.32	1365.20	21864434	501.94	1369.00	32600064	748.39
1357.70	1798279	41.283	1361.50	11781144	270.46	1365.30	22141990	508.31	1369.10	32887841	755.00
1357.80	2056203	47.204	1361.60	12048924	276.61	1365.40	22419812	514.69	1369.20	33175890	761.61
1357.90	2314384	53.131	1361.70	12316967	282.76	1365.50	22697901	521.07	1369.30	33464210	768.23
1358.00	2572821	59.064	1361.80	12585271	288.92	1365.60	22976257	527.46	1369.40	33752803	774.86
1358.10	2831516	65.003	1361.90	12853838	295.08	1365.70	23254880	533.86	1369.50	34041667	781.49
1358.20	3090469	70.947	1362.00	13122667	301.25	1365.80	23533770	540.26	1369.60	34330803	788.13
1358.30	3349679	76.898	1362.10	13391758	307.43	1365.90	23812927	546.67	1369.70	34620211	794.77
1358.40	3609147	82.855	1362.20	13661112	313.62	1366.00	24092352	553.08	1369.80	34909891	801.42
1358.50	3868872	88.817	1362.30	13930728	319.81	1366.10	24372044	559.51	1369.90	35199844	808.08
1358.60	4128855	94.785	1362.40	14200607	326.00	1366.20	24652004	565.93	1370.00	35490069	814.74
1358.70	4389097	100.76	1362.50	14470749	332.20	1366.30	24932232	572.37	1370.10	35780567	821.41
1358.80	4649596	106.74	1362.60	14741154	338.41	1366.40	25212727	578.80	1370.20	36071338	828.08
1358.90	4910354	112.73	1362.70	15011823	344.62	1366.50	25493491	585.25	1370.30	36362381	834.77
1359.00	5171371	118.72	1362.80	15282754	350.84	1366.60	25774522	591.70	1370.40	36653698	841.45
1359.10	5432646	124.72	1362.90	15553949	357.07	1366.70	26055822	598.16	1370.50	36945288	848.15
1359.20	5694179	130.72	1363.00	15825408	363.30	1366.80	26337391	604.62	1370.60	37237151	854.85
1359.30	5955972	136.73	1363.10	16097130	369.54	1366.90	26619228	611.09	1370.70	37529287	861.55
1359.40	6218023	142.75	1363.20	16369116	375.78	1367.00	26901333	617.57	1370.80	37821697	868.27
1359.50	6480333	148.77	1363.30	16641366	382.03	1367.10	27183708	624.05	1370.90	38114381	874.99
1359.60	6742903	154.80	1363.40	16913880	388.29	1367.20	27466351	630.54	1371.00	38407339	881.71
1359.70	7005732	160.83	1363.50	17186659	394.55	1367.30	27749263	637.04	1371.10	38700570	888.44
1359.80	7268820	166.87	1363.60	17459701	400.82	1367.40	28032445	643.54	1371.20	38994075	895.18
1359.90	7532168	172.91	1363.70	17733008	407.09	1367.50	28315896	650.04	1371.30	39287855	901.93
1360.00	7795776	178.97	1363.80	18006580	413.37	1367.60	28599616	656.56	1371.40	39581909	908.68
1360.10	8059644	185.02	1363.90	18280416	419.66	1367.70	28883606	663.08	1371.50	39876237	915.43
1360.20	8323771	191.09	1364.00	18554517	425.95	1367.80	29167866	669.60	1371.60	40170840	922.20
1360.30	8588159	197.16	1364.10	18828883	432.25	1367.90	29452395	676.13	1371.70	40465718	928.97
1360.40	8852806	203.23	1364.20	19103515	438.56	1368.00	29737195	682.67	1371.80	40760870	935.74
1360.50	9117715	209.31	1364.30	19378411	444.87	1368.10	30022264	689.22	1371.90	41056297	942.52
1360.60	9382883	215.40	1364.40	19653573	451.18	1368.20	30307604	695.77	1372.00	41352000	949.31
1360.70	9648313	221.49	1364.50	19929000	457.51	1368.30	30593214	702.32	1372.10	41647977	956.11

CoP/CTUIR Joint Water Project

Nagle Property Impound
Size/Capacity Configuration

STAGE STORAGE TABLE

STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-	STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-	STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-	STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-
1372.20	41944230	962.91	1376.80	55871709	1283	1381.40	70394512	1616	1386.00	85525098	1963
1372.30	42240759	969.71	1376.90	56181047	1290	1381.50	70716930	1623	1386.10	85860867	1971
1372.40	42537563	976.53	1377.00	56490666	1297	1381.60	71039636	1631	1386.20	86196930	1979
1372.50	42834642	983.35	1377.10	56800567	1304	1381.70	71362628	1638	1386.30	86533285	1987
1372.60	43131998	990.17	1377.20	57110750	1311	1381.80	71685909	1646	1386.40	86869934	1994
1372.70	43429630	997.01	1377.30	57421214	1318	1381.90	72009477	1653	1386.50	87206877	2002
1372.80	43727537	1004	1377.40	57731961	1325	1382.00	72333333	1661	1386.60	87544113	2010
1372.90	44025721	1011	1377.50	58042989	1332	1382.10	72657477	1668	1386.70	87881644	2017
1373.00	44324181	1018	1377.60	58354300	1340	1382.20	72981909	1675	1386.80	88219468	2025
1373.10	44622918	1024	1377.70	58665893	1347	1382.30	73306630	1683	1386.90	88557587	2033
1373.20	44921931	1031	1377.80	58977769	1354	1382.40	73631638	1690	1387.00	88896000	2041
1373.30	45221221	1038	1377.90	59289927	1361	1382.50	73956936	1698	1387.10	89234707	2049
1373.40	45520788	1045	1378.00	59602368	1368	1382.60	74282522	1705	1387.20	89573709	2056
1373.50	45820632	1052	1378.10	59915092	1375	1382.70	74608396	1713	1387.30	89913005	2064
1373.60	46120753	1059	1378.20	60228098	1383	1382.80	74934560	1720	1387.40	90252596	2072
1373.70	46421151	1066	1378.30	60541388	1390	1382.90	75261013	1728	1387.50	90592482	2080
1373.80	46721827	1073	1378.40	60854962	1397	1383.00	75587754	1735	1387.60	90932663	2088
1373.90	47022780	1079	1378.50	61168818	1404	1383.10	75914785	1743	1387.70	91273140	2095
1374.00	47324010	1086	1378.60	61482959	1411	1383.20	76242106	1750	1387.80	91613911	2103
1374.10	47625519	1093	1378.70	61797382	1419	1383.30	76569716	1758	1387.90	91954978	2111
1374.20	47927305	1100	1378.80	62112090	1426	1383.40	76897616	1765	1388.00	92296341	2119
1374.30	48229370	1107	1378.90	62427082	1433	1383.50	77225805	1773	1388.10	92637999	2127
1374.40	48531712	1114	1379.00	62742357	1440	1383.60	77554284	1780	1388.20	92979953	2135
1374.50	48834333	1121	1379.10	63057917	1448	1383.70	77883054	1788	1388.30	93322203	2142
1374.60	49137232	1128	1379.20	63373761	1455	1383.80	78212113	1796	1388.40	93664749	2150
1374.70	49440410	1135	1379.30	63689889	1462	1383.90	78541463	1803	1388.50	94007592	2158
1374.80	49743867	1142	1379.40	64006302	1469	1384.00	78871104	1811	1388.60	94350730	2166
1374.90	50047602	1149	1379.50	64323000	1477	1384.10	79201035	1818	1388.70	94694165	2174
1375.00	50351616	1156	1379.60	64639982	1484	1384.20	79531256	1826	1388.80	95037897	2182
1375.10	50655909	1163	1379.70	64957250	1491	1384.30	79861769	1833	1388.90	95381925	2190
1375.20	50960481	1170	1379.80	65274802	1499	1384.40	80192572	1841	1389.00	95726250	2198
1375.30	51265333	1177	1379.90	65592639	1506	1384.50	80523666	1849	1389.10	96070872	2205
1375.40	51570464	1184	1380.00	65910762	1513	1384.60	80855052	1856	1389.20	96415792	2213
1375.50	51875874	1191	1380.10	66229171	1520	1384.70	81186729	1864	1389.30	96761008	2221
1375.60	52181565	1198	1380.20	66547865	1528	1384.80	81518697	1871	1389.40	97106522	2229
1375.70	52487535	1205	1380.30	66866844	1535	1384.90	81850957	1879	1389.50	97452333	2237
1375.80	52793785	1212	1380.40	67186110	1542	1385.00	82183509	1887	1389.60	97798442	2245
1375.90	53100315	1219	1380.50	67505661	1550	1385.10	82516353	1894	1389.70	98144848	2253
1376.00	53407125	1226	1380.60	67825499	1557	1385.20	82849488	1902	1389.80	98491553	2261
1376.10	53714216	1233	1380.70	68145622	1564	1385.30	83182916	1910	1389.90	98838555	2269
1376.20	54021587	1240	1380.80	68466032	1572	1385.40	83516635	1917	1390.00	99185856	2277
1376.30	54329238	1247	1380.90	68786729	1579	1385.50	83850648	1925	1390.10	99533454	2285
1376.40	54637171	1254	1381.00	69107712	1586	1385.60	84184952	1933	1390.20	99881351	2293
1376.50	54945384	1261	1381.10	69428981	1594	1385.70	84519550	1940	1390.30	100229547	2301
1376.60	55253878	1268	1381.20	69750538	1601	1385.80	84854440	1948	1390.40	100578041	2309
1376.70	55562653	1276	1381.30	70072382	1609	1385.90	85189622	1956	1390.50	100926834	2317

CoP/CTUIR Joint Water Project

Nagle Property Impound

Size/Capacity Configuration

STAGE STORAGE TABLE

STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-	STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-	STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-	STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-
1390.60	101275926	2325	1395.20	117659455	2701	1399.80	134688143	3092	1404.40	152374451	3498
1390.70	101625317	2333	1395.30	118022738	2709	1399.90	135065591	3101	1404.50	152766333	3507
1390.80	101975007	2341	1395.40	118386327	2718	1400.00	135443349	3109	1404.60	153158531	3516
1390.90	102324996	2349	1395.50	118750221	2726	1400.10	135821418	3118	1404.70	153551046	3525
1391.00	102675285	2357	1395.60	119114420	2734	1400.20	136199798	3127	1404.80	153943879	3534
1391.10	103025873	2365	1395.70	119478924	2743	1400.30	136578490	3135	1404.90	154337028	3543
1391.20	103376761	2373	1395.80	119843734	2751	1400.40	136957493	3144	1405.00	154730495	3552
1391.30	103727949	2381	1395.90	120208850	2760	1400.50	137336807	3153	1405.10	155124280	3561
1391.40	104079436	2389	1396.00	120574271	2768	1400.60	137716434	3162	1405.20	155518382	3570
1391.50	104431224	2397	1396.10	120939999	2776	1400.70	138096372	3170	1405.30	155912801	3579
1391.60	104783311	2405	1396.20	121306032	2785	1400.80	138476622	3179	1405.40	156307539	3588
1391.70	105135699	2414	1396.30	121672372	2793	1400.90	138857184	3188	1405.50	156702594	3597
1391.80	105488388	2422	1396.40	122039018	2802	1401.00	139238058	3196	1405.60	157097967	3606
1391.90	105841377	2430	1396.50	122405970	2810	1401.10	139619245	3205	1405.70	157493659	3616
1392.00	106194666	2438	1396.60	122773229	2818	1401.20	140000744	3214	1405.80	157889669	3625
1392.10	106548257	2446	1396.70	123140795	2827	1401.30	140382555	3223	1405.90	158285998	3634
1392.20	106902148	2454	1396.80	123508667	2835	1401.40	140764680	3232	1406.00	158682645	3643
1392.30	107256340	2462	1396.90	123876846	2844	1401.50	141147117	3240	1406.10	159079610	3652
1392.40	107610834	2470	1397.00	124245333	2852	1401.60	141529867	3249	1406.20	159476895	3661
1392.50	107965629	2479	1397.10	124614126	2861	1401.70	141912930	3258	1406.30	159874499	3670
1392.60	108320725	2487	1397.20	124983227	2869	1401.80	142296306	3267	1406.40	160272421	3679
1392.70	108676123	2495	1397.30	125352636	2878	1401.90	142679996	3275	1406.50	160670663	3688
1392.80	109031823	2503	1397.40	125722352	2886	1402.00	143063999	3284	1406.60	161069225	3698
1392.90	109387824	2511	1397.50	126092375	2895	1402.10	143448316	3293	1406.70	161468105	3707
1393.00	109744128	2519	1397.60	126462707	2903	1402.20	143832947	3302	1406.80	161867306	3716
1393.10	110100733	2528	1397.70	126833346	2912	1402.30	144217891	3311	1406.90	162266826	3725
1393.20	110457641	2536	1397.80	127204294	2920	1402.40	144603150	3320	1407.00	162666666	3734
1393.30	110814851	2544	1397.90	127575550	2929	1402.50	144988722	3328	1407.10	163066826	3743
1393.40	111172363	2552	1398.00	127947114	2937	1402.60	145374609	3337	1407.20	163467306	3753
1393.50	111530178	2560	1398.10	128318987	2946	1402.70	145760810	3346	1407.30	163868106	3762
1393.60	111888296	2569	1398.20	128691168	2954	1402.80	146147325	3355	1407.40	164269227	3771
1393.70	112246717	2577	1398.30	129063658	2963	1402.90	146534156	3364	1407.50	164670669	3780
1393.80	112605440	2585	1398.40	129436457	2971	1403.00	146921301	3373	1407.60	165072431	3790
1393.90	112964467	2593	1398.50	129809565	2980	1403.10	147308761	3382	1407.70	165474513	3799
1394.00	113323797	2602	1398.60	130182982	2989	1403.20	147696535	3391	1407.80	165876917	3808
1394.10	113683430	2610	1398.70	130556708	2997	1403.30	148084625	3400	1407.90	166279641	3817
1394.20	114043367	2618	1398.80	130930744	3006	1403.40	148473031	3408	1408.00	166682687	3827
1394.30	114403607	2626	1398.90	131305089	3014	1403.50	148861751	3417	1408.10	167086054	3836
1394.40	114764151	2635	1399.00	131679743	3023	1403.60	149250788	3426	1408.20	167489743	3845
1394.50	115124999	2643	1399.10	132054708	3032	1403.70	149640139	3435	1408.30	167893753	3854
1394.60	115486152	2651	1399.20	132429982	3040	1403.80	150029807	3444	1408.40	168298084	3864
1394.70	115847608	2659	1399.30	132805567	3049	1403.90	150419790	3453	1408.50	168702738	3873
1394.80	116209368	2668	1399.40	133181461	3057	1404.00	150810090	3462	1408.60	169107713	3882
1394.90	116571433	2676	1399.50	133557666	3066	1404.10	151200706	3471	1408.70	169513011	3891
1395.00	116933802	2684	1399.60	133934181	3075	1404.20	151591638	3480	1408.80	169918630	3901
1395.10	117296476	2693	1399.70	134311007	3083	1404.30	151982886	3489	1408.90	170324572	3910

CoP/CTUIR Joint Water Project

Nagle Property Impound

Size/Capacity Configuration

STAGE STORAGE TABLE

STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-	STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-	STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-	STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-
1409.00	170730837	3919	1409.30	171951565	3947	1409.60	173175201	3976	1409.90	174401746	4004
1409.10	171137423	3929	1409.40	172359121	3957	1409.70	173583726	3985	1410.00	174811242	4013
1409.20	171544333	3938	1409.50	172766999	3966	1409.80	173992574	3994	1410.00	174811243	4013

CoP/CTUIR Joint Water Project

Nagle Property Impound
Size/Capacity Configuration

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STAGE STORAGE TABLE

TRAPEZOIDAL BASIN ID No. Config.4
Description: Nagle Property Impound
Length: 850.00 ft. Width: 850.00 ft.
Side Slope 1: 4 Side Slope 3: 4
Side Slope 2: 4 Side Slope 4: 4
Infiltration Rate: 0.00 min/inch

STAGE	<----STORAGE---->		STAGE	<----STORAGE---->		STAGE	<----STORAGE---->		STAGE	<----STORAGE---->	
(ft)	---cf---	--Ac-Ft-	(ft)	---cf---	--Ac-Ft-	(ft)	---cf---	--Ac-Ft-	(ft)	---cf---	--Ac-Ft-
1350.00	0.0000	0.0000	1353.80	2844863	65.309	1357.60	5893133	135.29	1361.40	9151834	210.10
1350.10	72318	1.6602	1353.90	2922443	67.090	1357.70	5976161	137.19	1361.50	9240495	212.13
1350.20	144772	3.3235	1354.00	3000165	68.874	1357.80	6059336	139.10	1361.60	9329307	214.17
1350.30	217363	4.9900	1354.10	3078028	70.662	1357.90	6142656	141.02	1361.70	9418270	216.21
1350.40	290089	6.6595	1354.20	3156033	72.453	1358.00	6226123	142.93	1361.80	9507383	218.26
1350.50	362953	8.3322	1354.30	3234178	74.247	1358.10	6309735	144.85	1361.90	9596648	220.31
1350.60	435953	10.008	1354.40	3312465	76.044	1358.20	6393494	146.77	1362.00	9686064	222.36
1350.70	509089	11.687	1354.50	3390894	77.844	1358.30	6477400	148.70	1362.10	9775631	224.42
1350.80	582363	13.369	1354.60	3469464	79.648	1358.40	6561452	150.63	1362.20	9865350	226.48
1350.90	655774	15.054	1354.70	3548177	81.455	1358.50	6645651	152.56	1362.30	9955220	228.54
1351.00	729321	16.743	1354.80	3627031	83.265	1358.60	6729997	154.50	1362.40	10045243	230.61
1351.10	803006	18.434	1354.90	3706028	85.079	1358.70	6814490	156.44	1362.50	10135417	232.68
1351.20	876829	20.129	1355.00	3785167	86.895	1358.80	6899130	158.38	1362.60	10225743	234.75
1351.30	950789	21.827	1355.10	3864448	88.716	1358.90	6983917	160.33	1362.70	10316221	236.83
1351.40	1024887	23.528	1355.20	3943872	90.539	1359.00	7068852	162.28	1362.80	10406851	238.91
1351.50	1099122	25.232	1355.30	4023438	92.365	1359.10	7153934	164.23	1362.90	10497634	240.99
1351.60	1173495	26.940	1355.40	4103147	94.195	1359.20	7239164	166.19	1363.00	10588569	243.08
1351.70	1248007	28.650	1355.50	4182999	96.028	1359.30	7324542	168.15	1363.10	10679657	245.17
1351.80	1322656	30.364	1355.60	4262994	97.865	1359.40	7410067	170.11	1363.20	10770898	247.27
1351.90	1397444	32.081	1355.70	4343133	99.705	1359.50	7495741	172.08	1363.30	10862292	249.36
1352.00	1472371	33.801	1355.80	4423414	101.55	1359.60	7581562	174.05	1363.40	10953838	251.47
1352.10	1547436	35.524	1355.90	4503839	103.39	1359.70	7667532	176.02	1363.50	11045538	253.57
1352.20	1622639	37.251	1356.00	4584408	105.24	1359.80	7753651	178.00	1363.60	11137391	255.68
1352.30	1697982	38.980	1356.10	4665120	107.10	1359.90	7839918	179.98	1363.70	11229397	257.79
1352.40	1773463	40.713	1356.20	4745976	108.95	1360.00	7926333	181.96	1363.80	11321557	259.91
1352.50	1849083	42.449	1356.30	4826976	110.81	1360.10	8012898	183.95	1363.90	11413871	262.03
1352.60	1924843	44.188	1356.40	4908120	112.67	1360.20	8099611	185.94	1364.00	11506339	264.15
1352.70	2000742	45.931	1356.50	4989409	114.54	1360.30	8186473	187.94	1364.10	11598960	266.28
1352.80	2076780	47.676	1356.60	5070841	116.41	1360.40	8273485	189.93	1364.20	11691735	268.41
1352.90	2152958	49.425	1356.70	5152418	118.28	1360.50	8360646	191.93	1364.30	11784665	270.54
1353.00	2229276	51.177	1356.80	5234140	120.16	1360.60	8447956	193.94	1364.40	11877749	272.68
1353.10	2305734	52.932	1356.90	5316006	122.04	1360.70	8535416	195.95	1364.50	11970987	274.82
1353.20	2382331	54.691	1357.00	5398017	123.92	1360.80	8623026	197.96	1364.60	12064380	276.96
1353.30	2459069	56.452	1357.10	5480173	125.81	1360.90	8710785	199.97	1364.70	12157928	279.11
1353.40	2535946	58.217	1357.20	5562475	127.70	1361.00	8798695	201.99	1364.80	12251630	281.26
1353.50	2612965	59.985	1357.30	5644921	129.59	1361.10	8886754	204.01	1364.90	12345488	283.41
1353.60	2690123	61.757	1357.40	5727513	131.49	1361.20	8974964	206.04	1365.00	12439500	285.57
1353.70	2767423	63.531	1357.50	5810250	133.38	1361.30	9063324	208.07	1365.10	12533668	287.73

CoP/CTUIR Joint Water Project

Nagle Property Impound

Size/Capacity Configuration

STAGE STORAGE TABLE

STAGE (ft)	STORAGE ---cf---	STORAGE --Ac-Ft-	STAGE (ft)	STORAGE ---cf---	STORAGE --Ac-Ft-	STAGE (ft)	STORAGE ---cf---	STORAGE --Ac-Ft-	STAGE (ft)	STORAGE ---cf---	STORAGE --Ac-Ft-
1365.20	12627991	289.90	1369.80	17136970	393.41	1374.40	21987353	504.76	1379.00	27191599	624.23
1365.30	12722469	292.07	1369.90	17238737	395.75	1374.50	22096681	507.27	1379.10	27308758	626.92
1365.40	12817103	294.24	1370.00	17340667	398.09	1374.60	22206176	509.78	1379.20	27426090	629.62
1365.50	12911893	296.42	1370.10	17442757	400.43	1374.70	22315839	512.30	1379.30	27543595	632.31
1365.60	13006838	298.60	1370.20	17545010	402.78	1374.80	22425669	514.82	1379.40	27661274	635.02
1365.70	13101940	300.78	1370.30	17647424	405.13	1374.90	22535667	517.35	1379.50	27779127	637.72
1365.80	13197197	302.97	1370.40	17750001	407.48	1375.00	22645833	519.88	1379.60	27897154	640.43
1365.90	13292611	305.16	1370.50	17852739	409.84	1375.10	22756167	522.41	1379.70	28015354	643.14
1366.00	13388181	307.35	1370.60	17955640	412.20	1375.20	22866669	524.95	1379.80	28133728	645.86
1366.10	13483908	309.55	1370.70	18058703	414.57	1375.30	22977340	527.49	1379.90	28252277	648.58
1366.20	13579791	311.75	1370.80	18161929	416.94	1375.40	23088179	530.03	1380.00	28371000	651.31
1366.30	13675831	313.95	1370.90	18265317	419.31	1375.50	23199186	532.58	1380.10	28489897	654.04
1366.40	13772028	316.16	1371.00	18368868	421.69	1375.60	23310362	535.13	1380.20	28608969	656.77
1366.50	13868382	318.37	1371.10	18472582	424.07	1375.70	23421707	537.69	1380.30	28728215	659.51
1366.60	13964893	320.59	1371.20	18576459	426.46	1375.80	23533220	540.25	1380.40	28847636	662.25
1366.70	14061561	322.81	1371.30	18680499	428.85	1375.90	23644903	542.81	1380.50	28967233	665.00
1366.80	14158387	325.03	1371.40	18784702	431.24	1376.00	23756755	545.38	1380.60	29087004	667.75
1366.90	14255370	327.26	1371.50	18889069	433.63	1376.10	23868776	547.95	1380.70	29206950	670.50
1367.00	14352511	329.49	1371.60	18993599	436.03	1376.20	23980966	550.53	1380.80	29327072	673.26
1367.10	14449809	331.72	1371.70	19098293	438.44	1376.30	24093326	553.11	1380.90	29447369	676.02
1367.20	14547265	333.96	1371.80	19203150	440.84	1376.40	24205856	555.69	1381.00	29567841	678.78
1367.30	14644880	336.20	1371.90	19308172	443.25	1376.50	24318555	558.28	1381.10	29688489	681.55
1367.40	14742652	338.44	1372.00	19413357	445.67	1376.60	24431425	560.87	1381.20	29809314	684.33
1367.50	14840583	340.69	1372.10	19518707	448.09	1376.70	24544464	563.46	1381.30	29930314	687.11
1367.60	14938672	342.94	1372.20	19624221	450.51	1376.80	24657674	566.06	1381.40	30051490	689.89
1367.70	15036920	345.20	1372.30	19729899	452.94	1376.90	24771054	568.67	1381.50	30172842	692.67
1367.80	15135327	347.46	1372.40	19835742	455.37	1377.00	24884604	571.27	1381.60	30294370	695.46
1367.90	15233892	349.72	1372.50	19941750	457.80	1377.10	24998325	573.88	1381.70	30416075	698.26
1368.00	15332616	351.99	1372.60	20047922	460.24	1377.20	25112216	576.50	1381.80	30537957	701.06
1368.10	15431499	354.26	1372.70	20154260	462.68	1377.30	25226279	579.12	1381.90	30660015	703.86
1368.20	15530541	356.53	1372.80	20260762	465.12	1377.40	25340512	581.74	1382.00	30782251	706.66
1368.30	15629743	358.81	1372.90	20367430	467.57	1377.50	25454917	584.36	1382.10	30904663	709.47
1368.40	15729104	361.09	1373.00	20474263	470.02	1377.60	25569492	586.99	1382.20	31027252	712.29
1368.50	15828625	363.38	1373.10	20581261	472.48	1377.70	25684239	589.63	1382.30	31150018	715.11
1368.60	15928305	365.66	1373.20	20688425	474.94	1377.80	25799158	592.27	1382.40	31272962	717.93
1368.70	16028145	367.96	1373.30	20795754	477.40	1377.90	25914248	594.91	1382.50	31396083	720.75
1368.80	16128145	370.25	1373.40	20903250	479.87	1378.00	26029509	597.56	1382.60	31519382	723.59
1368.90	16228305	372.55	1373.50	21010911	482.34	1378.10	26144943	600.21	1382.70	31642859	726.42
1369.00	16328625	374.85	1373.60	21118739	484.82	1378.20	26260548	602.86	1382.80	31766513	729.26
1369.10	16429106	377.16	1373.70	21226732	487.30	1378.30	26376326	605.52	1382.90	31890345	732.10
1369.20	16529747	379.47	1373.80	21334892	489.78	1378.40	26492276	608.18	1383.00	32014356	734.95
1369.30	16630548	381.78	1373.90	21443219	492.27	1378.50	26608398	610.84	1383.10	32138545	737.80
1369.40	16731511	384.10	1374.00	21551712	494.76	1378.60	26724693	613.51	1383.20	32262912	740.65
1369.50	16832634	386.42	1374.10	21660372	497.25	1378.70	26841160	616.19	1383.30	32387457	743.51
1369.60	16933918	388.75	1374.20	21769198	499.75	1378.80	26957800	618.87	1383.40	32512182	746.38
1369.70	17035363	391.08	1374.30	21878192	502.25	1378.90	27074613	621.55	1383.50	32637085	749.24

CoP/CTUIR Joint Water Project

Nagle Property Impound

Size/Capacity Configuration

STAGE STORAGE TABLE

STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-	STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-	STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-	STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-
1383.60	32762166	752.12	1388.20	38711515	888.69	1392.80	45052104	1034	1397.40	51796391	1189
1383.70	32887427	754.99	1388.30	38845149	891.76	1392.90	45194381	1038	1397.50	51947583	1193
1383.80	33012867	757.87	1388.40	38978967	894.83	1393.00	45336849	1041	1397.60	52098971	1196
1383.90	33138487	760.75	1388.50	39112971	897.91	1393.10	45479508	1044	1397.70	52250557	1200
1384.00	33264285	763.64	1388.60	39247160	900.99	1393.20	45622359	1047	1397.80	52402339	1203
1384.10	33390263	766.53	1388.70	39381535	904.08	1393.30	45765400	1051	1397.90	52554319	1206
1384.20	33516421	769.43	1388.80	39516095	907.16	1393.40	45908633	1054	1398.00	52706496	1210
1384.30	33642759	772.33	1388.90	39650840	910.26	1393.50	46052058	1057	1398.10	52858870	1213
1384.40	33769276	775.24	1389.00	39785772	913.36	1393.60	46195674	1061	1398.20	53011442	1217
1384.50	33895974	778.14	1389.10	39920889	916.46	1393.70	46339482	1064	1398.30	53164212	1220
1384.60	34022852	781.06	1389.20	40056193	919.56	1393.80	46483482	1067	1398.40	53317179	1224
1384.70	34149910	783.97	1389.30	40191682	922.67	1393.90	46627674	1070	1398.50	53470344	1228
1384.80	34277148	786.90	1389.40	40327358	925.79	1394.00	46772058	1074	1398.60	53623708	1231
1384.90	34404567	789.82	1389.50	40463220	928.91	1394.10	46916635	1077	1398.70	53777270	1235
1385.00	34532167	792.75	1389.60	40599269	932.03	1394.20	47061404	1080	1398.80	53931030	1238
1385.10	34659947	795.68	1389.70	40735505	935.16	1394.30	47206366	1084	1398.90	54084988	1242
1385.20	34787908	798.62	1389.80	40871927	938.29	1394.40	47351520	1087	1399.00	54239145	1245
1385.30	34916051	801.56	1389.90	41008537	941.43	1394.50	47496867	1090	1399.10	54393501	1249
1385.40	35044374	804.51	1390.00	41145333	944.57	1394.60	47642407	1094	1399.20	54548055	1252
1385.50	35172879	807.46	1390.10	41282317	947.71	1394.70	47788140	1097	1399.30	54702809	1256
1385.60	35301566	810.41	1390.20	41419488	950.86	1394.80	47934067	1100	1399.40	54857762	1259
1385.70	35430433	813.37	1390.30	41556846	954.01	1394.90	48080187	1104	1399.50	55012914	1263
1385.80	35559483	816.33	1390.40	41694392	957.17	1395.00	48226500	1107	1399.60	55168265	1266
1385.90	35688714	819.30	1390.50	41832126	960.33	1395.10	48373007	1110	1399.70	55323816	1270
1386.00	35818128	822.27	1390.60	41970047	963.50	1395.20	48519707	1114	1399.80	55479566	1274
1386.10	35947723	825.25	1390.70	42108157	966.67	1395.30	48666602	1117	1399.90	55635516	1277
1386.20	36077501	828.23	1390.80	42246454	969.85	1395.40	48813690	1121	1400.00	55791666	1281
1386.30	36207461	831.21	1390.90	42384940	973.02	1395.50	48960972	1124	1400.10	55948016	1284
1386.40	36337603	834.20	1391.00	42523614	976.21	1395.60	49108449	1127	1400.20	56104567	1288
1386.50	36467928	837.19	1391.10	42662477	979.40	1395.70	49256120	1131	1400.30	56261317	1292
1386.60	36598436	840.18	1391.20	42801528	982.59	1395.80	49403986	1134	1400.40	56418268	1295
1386.70	36729127	843.18	1391.30	42940768	985.78	1395.90	49552046	1138	1400.50	56575419	1299
1386.80	36860001	846.19	1391.40	43080197	988.99	1396.00	49700301	1141	1400.60	56732771	1302
1386.90	36991057	849.20	1391.50	43219815	992.19	1396.10	49848751	1144	1400.70	56890324	1306
1387.00	37122297	852.21	1391.60	43359622	995.40	1396.20	49997396	1148	1400.80	57048077	1310
1387.10	37253720	855.23	1391.70	43499618	998.61	1396.30	50146236	1151	1400.90	57206032	1313
1387.20	37385327	858.25	1391.80	43639804	1002	1396.40	50295271	1155	1401.00	57364188	1317
1387.30	37517118	861.27	1391.90	43780179	1005	1396.50	50444502	1158	1401.10	57522545	1321
1387.40	37649092	864.30	1392.00	43920744	1008	1396.60	50593928	1161	1401.20	57681103	1324
1387.50	37781250	867.34	1392.10	44061498	1012	1396.70	50743550	1165	1401.30	57839863	1328
1387.60	37913592	870.38	1392.20	44202443	1015	1396.80	50893367	1168	1401.40	57998825	1331
1387.70	38046118	873.42	1392.30	44343577	1018	1396.90	51043381	1172	1401.50	58157988	1335
1387.80	38178828	876.47	1392.40	44484902	1021	1397.00	51193590	1175	1401.60	58317354	1339
1387.90	38311723	879.52	1392.50	44626416	1024	1397.10	51343996	1179	1401.70	58476921	1342
1388.00	38444802	882.57	1392.60	44768122	1028	1397.20	51494598	1182	1401.80	58636691	1346
1388.10	38578066	885.63	1392.70	44910017	1031	1397.30	51645396	1186	1401.90	58796663	1350

CoP/CTUIR Joint Water Project

Nagle Property Impound

Size/Capacity Configuration

STAGE STORAGE TABLE

STAGE (ft)	STORAGE ---cf---	--Ac-Ft-	STAGE (ft)	STORAGE ---cf---	--Ac-Ft-	STAGE (ft)	STORAGE ---cf---	--Ac-Ft-	STAGE (ft)	STORAGE ---cf---	--Ac-Ft-
1402.00	58956837	1353	1406.10	65699859	1508	1410.20	72792205	1671	1414.30	80242699	1842
1402.10	59117214	1357	1406.20	65868651	1512	1410.30	72969628	1675	1414.40	80428967	1846
1402.20	59277794	1361	1406.30	66037651	1516	1410.40	73147263	1679	1414.50	80615454	1851
1402.30	59438576	1365	1406.40	66206859	1520	1410.50	73325112	1683	1414.60	80802158	1855
1402.40	59599561	1368	1406.50	66376275	1524	1410.60	73503175	1687	1414.70	80989082	1859
1402.50	59760750	1372	1406.60	66545900	1528	1410.70	73681451	1691	1414.80	81176224	1864
1402.60	59922141	1376	1406.70	66715733	1532	1410.80	73859940	1696	1414.90	81363586	1868
1402.70	60083736	1379	1406.80	66885774	1535	1410.90	74038644	1700	1415.00	81551166	1872
1402.80	60245535	1383	1406.90	67056024	1539	1411.00	74217561	1704	1415.10	81738966	1876
1402.90	60407537	1387	1407.00	67226484	1543	1411.10	74396692	1708	1415.20	81926985	1881
1403.00	60569742	1390	1407.10	67397152	1547	1411.20	74576038	1712	1415.30	82115223	1885
1403.10	60732152	1394	1407.20	67568029	1551	1411.30	74755598	1716	1415.40	82303681	1889
1403.20	60894765	1398	1407.30	67739115	1555	1411.40	74935373	1720	1415.50	82492359	1894
1403.30	61057583	1402	1407.40	67910411	1559	1411.50	75115362	1724	1415.60	82681256	1898
1403.40	61220605	1405	1407.50	68081916	1563	1411.60	75295565	1729	1415.70	82870374	1902
1403.50	61383831	1409	1407.60	68253631	1567	1411.70	75475984	1733	1415.80	83059712	1907
1403.60	61547262	1413	1407.70	68425556	1571	1411.80	75656618	1737	1415.90	83249269	1911
1403.70	61710897	1417	1407.80	68597690	1575	1411.90	75837466	1741	1416.00	83439048	1915
1403.80	61874737	1420	1407.90	68770034	1579	1412.00	76018530	1745	1416.10	83629046	1920
1403.90	62038782	1424	1408.00	68942589	1583	1412.10	76199810	1749	1416.20	83819265	1924
1404.00	62203032	1428	1408.10	69115354	1587	1412.20	76381304	1753	1416.30	84009705	1929
1404.10	62367487	1432	1408.20	69288329	1591	1412.30	76563015	1758	1416.40	84200366	1933
1404.20	62532147	1436	1408.30	69461514	1595	1412.40	76744941	1762	1416.50	84391248	1937
1404.30	62697012	1439	1408.40	69634911	1599	1412.50	76927083	1766	1416.60	84582351	1942
1404.40	62862084	1443	1408.50	69808518	1603	1412.60	77109441	1770	1416.70	84773675	1946
1404.50	63027360	1447	1408.60	69982335	1607	1412.70	77292015	1774	1416.80	84965221	1951
1404.60	63192843	1451	1408.70	70156364	1611	1412.80	77474805	1779	1416.90	85156988	1955
1404.70	63358531	1455	1408.80	70330604	1615	1412.90	77657812	1783	1417.00	85348977	1959
1404.80	63524426	1458	1408.90	70505056	1619	1413.00	77841036	1787	1417.10	85541187	1964
1404.90	63690526	1462	1409.00	70679718	1623	1413.10	78024476	1791	1417.20	85733620	1968
1405.00	63856833	1466	1409.10	70854592	1627	1413.20	78208132	1795	1417.30	85926274	1973
1405.10	64023346	1470	1409.20	71029678	1631	1413.30	78392006	1800	1417.40	86119151	1977
1405.20	64190066	1474	1409.30	71204976	1635	1413.40	78576096	1804	1417.50	86312250	1981
1405.30	64356992	1477	1409.40	71380485	1639	1413.50	78760404	1808	1417.60	86505571	1986
1405.40	64524126	1481	1409.50	71556207	1643	1413.60	78944929	1812	1417.70	86699114	1990
1405.50	64691466	1485	1409.60	71732141	1647	1413.70	79129672	1817	1417.80	86892881	1995
1405.60	64859013	1489	1409.70	71908287	1651	1413.80	79314632	1821	1417.90	87086870	1999
1405.70	65026767	1493	1409.80	72084645	1655	1413.90	79499809	1825	1418.00	87281082	2004
1405.80	65194729	1497	1409.90	72261216	1659	1414.00	79685205	1829	1418.00	87281083	2004
1405.90	65362898	1501	1410.00	72438000	1663	1414.10	79870818	1834			
1406.00	65531274	1504	1410.10	72614996	1667	1414.20	80056650	1838			

CoP/CTUIR Joint Water Project

Nagle Property Impound
Size/Capacity Configuration

STAGE STORAGE TABLE

TRAPEZOIDAL BASIN ID No. Config.5
Description: Nagle Property Impound
Length: 940.00 ft. Width: 940.00 ft.
Side Slope 1: 4 Side Slope 3: 4
Side Slope 2: 4 Side Slope 4: 4
Infiltration Rate: 0.00 min/inch

STAGE	<----STORAGE---->		STAGE	<----STORAGE---->		STAGE	<----STORAGE---->		STAGE	<----STORAGE---->	
(ft)	---cf---	--Ac-Ft-	(ft)	---cf---	--Ac-Ft-	(ft)	---cf---	--Ac-Ft-	(ft)	---cf---	--Ac-Ft-
1348.00	0.0000	0.0000	1351.80	3467439	79.601	1355.60	7159080	164.35	1359.40	11081945	254.41
1348.10	88435	2.0302	1351.90	3561685	81.765	1355.70	7259320	166.65	1359.50	11188365	256.85
1348.20	177021	4.0638	1352.00	3656085	83.932	1355.80	7359721	168.96	1359.60	11294950	259.30
1348.30	265757	6.1009	1352.10	3750642	86.103	1355.90	7460281	171.26	1359.70	11401700	261.75
1348.40	354645	8.1415	1352.20	3845353	88.277	1356.00	7561003	173.58	1359.80	11508616	264.20
1348.50	443683	10.186	1352.30	3940221	90.455	1356.10	7661885	175.89	1359.90	11615697	266.66
1348.60	532872	12.233	1352.40	4035244	92.636	1356.20	7762927	178.21	1360.00	11722944	269.12
1348.70	622212	14.284	1352.50	4130424	94.821	1356.30	7864131	180.54	1360.10	11830356	271.59
1348.80	711704	16.338	1352.60	4225760	97.010	1356.40	7965496	182.86	1360.20	11937935	274.06
1348.90	801347	18.396	1352.70	4321252	99.202	1356.50	8067021	185.19	1360.30	12045679	276.53
1349.00	891141	20.458	1352.80	4416900	101.40	1356.60	8168708	187.53	1360.40	12153590	279.01
1349.10	981088	22.523	1352.90	4512705	103.60	1356.70	8270557	189.87	1360.50	12261667	281.49
1349.20	1071186	24.591	1353.00	4608667	105.80	1356.80	8372567	192.21	1360.60	12369910	283.97
1349.30	1161436	26.663	1353.10	4704785	108.01	1356.90	8474739	194.55	1360.70	12478320	286.46
1349.40	1251838	28.738	1353.20	4801060	110.22	1357.00	8577072	196.90	1360.80	12586896	288.96
1349.50	1342392	30.817	1353.30	4897493	112.43	1357.10	8679567	199.26	1360.90	12695639	291.45
1349.60	1433099	32.899	1353.40	4994082	114.65	1357.20	8782225	201.61	1361.00	12804549	293.95
1349.70	1523958	34.985	1353.50	5090829	116.87	1357.30	8885044	203.97	1361.10	12913626	296.46
1349.80	1614969	37.075	1353.60	5187734	119.09	1357.40	8988026	206.34	1361.20	13022871	298.96
1349.90	1706134	39.167	1353.70	5284796	121.32	1357.50	9091171	208.70	1361.30	13132282	301.48
1350.00	1797451	41.264	1353.80	5382015	123.55	1357.60	9194478	211.08	1361.40	13241861	303.99
1350.10	1888921	43.364	1353.90	5479393	125.79	1357.70	9297947	213.45	1361.50	13351608	306.51
1350.20	1980544	45.467	1354.00	5576928	128.03	1357.80	9401580	215.83	1361.60	13461522	309.03
1350.30	2072320	47.574	1354.10	5674621	130.27	1357.90	9505375	218.21	1361.70	13571604	311.56
1350.40	2164250	49.684	1354.20	5772473	132.52	1358.00	9609333	220.60	1361.80	13681854	314.09
1350.50	2256333	51.798	1354.30	5870483	134.77	1358.10	9713455	222.99	1361.90	13792272	316.63
1350.60	2348570	53.916	1354.40	5968652	137.02	1358.20	9817740	225.38	1362.00	13902859	319.17
1350.70	2440961	56.037	1354.50	6066979	139.28	1358.30	9922188	227.78	1362.10	14013613	321.71
1350.80	2533505	58.161	1354.60	6165464	141.54	1358.40	10026800	230.18	1362.20	14124536	324.25
1350.90	2626203	60.289	1354.70	6264109	143.80	1358.50	10131576	232.59	1362.30	14235628	326.81
1351.00	2719056	62.421	1354.80	6362913	146.07	1358.60	10236515	235.00	1362.40	14346888	329.36
1351.10	2812063	64.556	1354.90	6461875	148.34	1358.70	10341619	237.41	1362.50	14458317	331.92
1351.20	2905224	66.695	1355.00	6560997	150.62	1358.80	10446887	239.83	1362.60	14569915	334.48
1351.30	2998539	68.837	1355.10	6660279	152.90	1358.90	10552318	242.25	1362.70	14681683	337.05
1351.40	3092010	70.983	1355.20	6759719	155.18	1359.00	10657915	244.67	1362.80	14793619	339.61
1351.50	3185635	73.132	1355.30	6859320	157.47	1359.10	10763675	247.10	1362.90	14905725	342.19
1351.60	3279415	75.285	1355.40	6959080	159.76	1359.20	10869601	249.53	1363.00	15018000	344.77
1351.70	3373349	77.441	1355.50	7059000	162.05	1359.30	10975691	251.97	1363.10	15130445	347.35

CoP/CTUIR Joint Water Project

Nagle Property Impound
Size/Capacity Configuration

STAGE STORAGE TABLE

STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-	STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-	STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-	STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-
1363.20	15243059	349.93	1367.80	20609018	473.12	1372.40	26346852	604.84	1377.00	32469019	745.39
1363.30	15355844	352.52	1367.90	20729755	475.89	1372.50	26475811	607.80	1377.10	32606471	748.54
1363.40	15468798	355.11	1368.00	20850667	478.67	1372.60	26604951	610.77	1377.20	32744111	751.70
1363.50	15581923	357.71	1368.10	20971755	481.45	1372.70	26734273	613.73	1377.30	32881938	754.87
1363.60	15695217	360.31	1368.20	21093019	484.23	1372.80	26863778	616.71	1377.40	33019954	758.03
1363.70	15808682	362.92	1368.30	21214459	487.02	1372.90	26993464	619.68	1377.50	33158157	761.21
1363.80	15922318	365.53	1368.40	21336076	489.81	1373.00	27123333	622.67	1377.60	33296549	764.38
1363.90	16036124	368.14	1368.50	21457869	492.60	1373.10	27253384	625.65	1377.70	33435129	767.56
1364.00	16150101	370.76	1368.60	21579839	495.40	1373.20	27383618	628.64	1377.80	33573897	770.75
1364.10	16264249	373.38	1368.70	21701986	498.21	1373.30	27514035	631.64	1377.90	33712854	773.94
1364.20	16378568	376.00	1368.80	21824309	501.02	1373.40	27644634	634.63	1378.00	33852000	777.13
1364.30	16493058	378.63	1368.90	21946810	503.83	1373.50	27775416	637.64	1378.10	33991334	780.33
1364.40	16607719	381.26	1369.00	22069488	506.65	1373.60	27906381	640.64	1378.20	34130858	783.54
1364.50	16722552	383.90	1369.10	22192343	509.47	1373.70	28037529	643.65	1378.30	34270570	786.74
1364.60	16837556	386.54	1369.20	22315375	512.29	1373.80	28168861	646.67	1378.40	34410472	789.96
1364.70	16952732	389.18	1369.30	22438585	515.12	1373.90	28300376	649.69	1378.50	34550563	793.17
1364.80	17068080	391.83	1369.40	22561973	517.95	1374.00	28432075	652.71	1378.60	34690843	796.39
1364.90	17183599	394.48	1369.50	22685539	520.79	1374.10	28563957	655.74	1378.70	34831313	799.62
1365.00	17299291	397.14	1369.60	22809282	523.63	1374.20	28696023	658.77	1378.80	34971972	802.85
1365.10	17415154	399.80	1369.70	22933203	526.47	1374.30	28828273	661.81	1378.90	35112822	806.08
1365.20	17531190	402.46	1369.80	23057303	529.32	1374.40	28960707	664.85	1379.00	35253861	809.32
1365.30	17647399	405.13	1369.90	23181581	532.18	1374.50	29093325	667.89	1379.10	35395091	812.56
1365.40	17763780	407.80	1370.00	23306037	535.03	1374.60	29226128	670.94	1379.20	35536510	815.81
1365.50	17880333	410.48	1370.10	23430672	537.89	1374.70	29359115	673.99	1379.30	35678120	819.06
1365.60	17997060	413.16	1370.20	23555486	540.76	1374.80	29492286	677.05	1379.40	35819921	822.31
1365.70	18113959	415.84	1370.30	23680478	543.63	1374.90	29625643	680.11	1379.50	35961912	825.57
1365.80	18231031	418.53	1370.40	23805649	546.50	1375.00	29759184	683.18	1379.60	36104094	828.84
1365.90	18348277	421.22	1370.50	23931000	549.38	1375.10	29892910	686.25	1379.70	36246466	832.10
1366.00	18465696	423.91	1370.60	24056530	552.26	1375.20	30026821	689.32	1379.80	36389030	835.38
1366.10	18583288	426.61	1370.70	24182238	555.15	1375.30	30160918	692.40	1379.90	36531785	838.65
1366.20	18701054	429.32	1370.80	24308127	558.04	1375.40	30295199	695.48	1380.00	36674730	841.94
1366.30	18818994	432.02	1370.90	24434195	560.93	1375.50	30429667	698.57	1380.10	36817868	845.22
1366.40	18937107	434.74	1371.00	24560443	563.83	1375.60	30564319	701.66	1380.20	36961197	848.51
1366.50	19055395	437.45	1371.10	24686870	566.73	1375.70	30699158	704.76	1380.30	37104717	851.81
1366.60	19173856	440.17	1371.20	24813478	569.64	1375.80	30834182	707.86	1380.40	37248429	855.11
1366.70	19292492	442.89	1371.30	24940265	572.55	1375.90	30969393	710.96	1380.50	37392333	858.41
1366.80	19411302	445.62	1371.40	25067233	575.46	1376.00	31104789	714.07	1380.60	37536429	861.72
1366.90	19530286	448.35	1371.50	25194381	578.38	1376.10	31240372	717.18	1380.70	37680717	865.03
1367.00	19649445	451.09	1371.60	25321710	581.31	1376.20	31376141	720.30	1380.80	37825198	868.35
1367.10	19768779	453.83	1371.70	25449219	584.23	1376.30	31512097	723.42	1380.90	37969871	871.67
1367.20	19888288	456.57	1371.80	25576909	587.17	1376.40	31648239	726.54	1381.00	38114736	874.99
1367.30	20007971	459.32	1371.90	25704780	590.10	1376.50	31784568	729.67	1381.10	38259794	878.32
1367.40	20127830	462.07	1372.00	25832832	593.04	1376.60	31921084	732.81	1381.20	38405044	881.66
1367.50	20247864	464.83	1372.10	25961065	595.98	1376.70	32057787	735.95	1381.30	38550488	885.00
1367.60	20368073	467.59	1372.20	26089479	598.93	1376.80	32194677	739.09	1381.40	38696125	888.34
1367.70	20488458	470.35	1372.30	26218075	601.88	1376.90	32331754	742.23	1381.50	38841954	891.69

CoP/CTUIR Joint Water Project

Nagle Property Impound
Size/Capacity Configuration

STAGE STORAGE TABLE

STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-	STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-	STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-	STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-
1381.60	38987978	895.04	1386.20	45916188	1054	1390.80	53266109	1223	1395.40	61050199	1402
1381.70	39134194	898.40	1386.30	46071440	1058	1390.90	53430666	1227	1395.50	61224333	1406
1381.80	39280604	901.76	1386.40	46226891	1061	1391.00	53595429	1230	1395.60	61398679	1410
1381.90	39427208	905.12	1386.50	46382541	1065	1391.10	53760397	1234	1395.70	61573236	1414
1382.00	39574005	908.49	1386.60	46538391	1068	1391.20	53925571	1238	1395.80	61748004	1418
1382.10	39720997	911.87	1386.70	46694441	1072	1391.30	54090951	1242	1395.90	61922984	1422
1382.20	39868182	915.25	1386.80	46850691	1076	1391.40	54256536	1246	1396.00	62098176	1426
1382.30	40015562	918.63	1386.90	47007142	1079	1391.50	54422328	1249	1396.10	62273579	1430
1382.40	40163135	922.02	1387.00	47163792	1083	1391.60	54588325	1253	1396.20	62449195	1434
1382.50	40310904	925.41	1387.10	47320642	1086	1391.70	54754529	1257	1396.30	62625022	1438
1382.60	40458867	928.81	1387.20	47477693	1090	1391.80	54920939	1261	1396.40	62801062	1442
1382.70	40607024	932.21	1387.30	47634945	1094	1391.90	55087555	1265	1396.50	62977314	1446
1382.80	40755377	935.61	1387.40	47792397	1097	1392.00	55254378	1268	1396.60	63153779	1450
1382.90	40903924	939.02	1387.50	47950050	1101	1392.10	55421408	1272	1396.70	63330456	1454
1383.00	41052666	942.44	1387.60	48107905	1104	1392.20	55588645	1276	1396.80	63507346	1458
1383.10	41201604	945.86	1387.70	48265960	1108	1392.30	55756088	1280	1396.90	63684449	1462
1383.20	41350737	949.28	1387.80	48424216	1112	1392.40	55923739	1284	1397.00	63861765	1466
1383.30	41500065	952.71	1387.90	48582674	1115	1392.50	56091597	1288	1397.10	64039294	1470
1383.40	41649589	956.14	1388.00	48741333	1119	1392.60	56259662	1292	1397.20	64217036	1474
1383.50	41799309	959.58	1388.10	48900194	1123	1392.70	56427935	1295	1397.30	64394992	1478
1383.60	41949225	963.02	1388.20	49059256	1126	1392.80	56596416	1299	1397.40	64573161	1482
1383.70	42099336	966.47	1388.30	49218521	1130	1392.90	56765104	1303	1397.50	64751544	1486
1383.80	42249644	969.92	1388.40	49377987	1134	1393.00	56934000	1307	1397.60	64930140	1491
1383.90	42400148	973.37	1388.50	49537656	1137	1393.10	57103104	1311	1397.70	65108951	1495
1384.00	42550848	976.83	1388.60	49697526	1141	1393.20	57272416	1315	1397.80	65287975	1499
1384.10	42701744	980.30	1388.70	49857600	1145	1393.30	57441936	1319	1397.90	65467214	1503
1384.20	42852838	983.77	1388.80	50017875	1148	1393.40	57611665	1323	1398.00	65646666	1507
1384.30	43004128	987.24	1388.90	50178353	1152	1393.50	57781602	1326	1398.10	65826334	1511
1384.40	43155615	990.72	1389.00	50339034	1156	1393.60	57951748	1330	1398.20	66006215	1515
1384.50	43307298	994.20	1389.10	50499918	1159	1393.70	58122103	1334	1398.30	66186312	1519
1384.60	43459179	997.69	1389.20	50661005	1163	1393.80	58292667	1338	1398.40	66366623	1524
1384.70	43611258	1001	1389.30	50822295	1167	1393.90	58463439	1342	1398.50	66547149	1528
1384.80	43763533	1005	1389.40	50983788	1170	1394.00	58634421	1346	1398.60	66727890	1532
1384.90	43916006	1008	1389.50	51145485	1174	1394.10	58805612	1350	1398.70	66908846	1536
1385.00	44068677	1012	1389.60	51307385	1178	1394.20	58977013	1354	1398.80	67090018	1540
1385.10	44221546	1015	1389.70	51469489	1182	1394.30	59148623	1358	1398.90	67271405	1544
1385.20	44374612	1019	1389.80	51631797	1185	1394.40	59320442	1362	1399.00	67453008	1549
1385.30	44527876	1022	1389.90	51794308	1189	1394.50	59492472	1366	1399.10	67634826	1553
1385.40	44681339	1026	1390.00	51957024	1193	1394.60	59664711	1370	1399.20	67816860	1557
1385.50	44835000	1029	1390.10	52119943	1197	1394.70	59837161	1374	1399.30	67999110	1561
1385.60	44988859	1033	1390.20	52283067	1200	1394.80	60009820	1378	1399.40	68181576	1565
1385.70	45142917	1036	1390.30	52446396	1204	1394.90	60182690	1382	1399.50	68364258	1569
1385.80	45297173	1040	1390.40	52609929	1208	1395.00	60355770	1386	1399.60	68547157	1574
1385.90	45451628	1043	1390.50	52773666	1212	1395.10	60529061	1390	1399.70	68730272	1578
1386.00	45606282	1047	1390.60	52937609	1215	1395.20	60702563	1394	1399.80	68913604	1582
1386.10	45761136	1051	1390.70	53101756	1219	1395.30	60876275	1398	1399.90	69097152	1586

CoP/CTUIR Joint Water Project

Nagle Property Impound

Size/Capacity Configuration

STAGE STORAGE TABLE

STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-	STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-	STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-	STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-
1400.00	69280917	1590	1402.60	74135338	1702	1405.20	79138674	1817	1407.80	84293174	1935
1400.10	69464899	1595	1402.70	74325006	1706	1405.30	79334114	1821	1407.90	84494473	1940
1400.20	69649098	1599	1402.80	74514894	1711	1405.40	79529778	1826	1408.00	84696000	1944
1400.30	69833515	1603	1402.90	74705003	1715	1405.50	79725666	1830	1408.10	84897753	1949
1400.40	70018148	1607	1403.00	74895333	1719	1405.60	79921778	1835	1408.20	85099734	1954
1400.50	70203000	1612	1403.10	75085883	1724	1405.70	80118114	1839	1408.30	85301943	1958
1400.60	70388068	1616	1403.20	75276655	1728	1405.80	80314675	1844	1408.40	85504379	1963
1400.70	70573355	1620	1403.30	75467647	1732	1405.90	80511460	1848	1408.50	85707042	1968
1400.80	70758859	1624	1403.40	75658861	1737	1406.00	80708469	1853	1408.60	85909934	1972
1400.90	70944582	1629	1403.50	75850296	1741	1406.10	80905703	1857	1408.70	86113053	1977
1401.00	71130522	1633	1403.60	76041952	1746	1406.20	81103162	1862	1408.80	86316401	1982
1401.10	71316681	1637	1403.70	76233830	1750	1406.30	81300845	1866	1408.90	86519977	1986
1401.20	71503058	1641	1403.80	76425929	1754	1406.40	81498754	1871	1409.00	86723781	1991
1401.30	71689654	1646	1403.90	76618251	1759	1406.50	81696888	1876	1409.10	86927814	1996
1401.40	71876468	1650	1404.00	76810794	1763	1406.60	81895247	1880	1409.20	87132075	2000
1401.50	72063501	1654	1404.10	77003560	1768	1406.70	82093831	1885	1409.30	87336565	2005
1401.60	72250753	1659	1404.20	77196547	1772	1406.80	82292641	1889	1409.40	87541284	2010
1401.70	72438224	1663	1404.30	77389757	1777	1406.90	82491677	1894	1409.50	87746232	2014
1401.80	72625914	1667	1404.40	77583190	1781	1407.00	82690938	1898	1409.60	87951409	2019
1401.90	72813823	1672	1404.50	77776845	1786	1407.10	82890426	1903	1409.70	88156815	2024
1402.00	73001952	1676	1404.60	77970723	1790	1407.20	83090139	1907	1409.80	88362450	2029
1402.10	73190300	1680	1404.70	78164823	1794	1407.30	83290079	1912	1409.90	88568315	2033
1402.20	73378868	1685	1404.80	78359147	1799	1407.40	83490245	1917	1410.00	88774410	2038
1402.30	73567655	1689	1404.90	78553694	1803	1407.50	83690637	1921	1410.00	88774411	2038
1402.40	73756663	1693	1405.00	78748464	1808	1407.60	83891256	1926			
1402.50	73945890	1698	1405.10	78943457	1812	1407.70	84092101	1930			

CoP/CTUIR Joint Water Project

Nagle Property Impound
Size/Capacity Configuration

STAGE STORAGE TABLE

TRAPEZOIDAL BASIN ID No. Config.6
Description: Nagle Property Impound
Length: 1050.00 ft. Width: 1050.00 ft.
Side Slope 1: 4 Side Slope 3: 4
Side Slope 2: 4 Side Slope 4: 4
Infiltration Rate: 0.00 min/inch

STAGE	<----STORAGE---->		STAGE	<----STORAGE---->		STAGE	<----STORAGE---->		STAGE	<----STORAGE---->	
(ft)	---cf---	--Ac-Ft-	(ft)	---cf---	--Ac-Ft-	(ft)	---cf---	--Ac-Ft-	(ft)	---cf---	--Ac-Ft-
1356.00	0.0000	0.0000	1359.80	4311967	98.989	1363.60	8873549	203.71	1367.40	13691770	314.32
1356.10	110334	2.5329	1359.90	4428779	101.67	1363.70	8997025	206.54	1367.50	13822095	317.31
1356.20	220836	5.0697	1360.00	4545765	104.36	1363.80	9120680	209.38	1367.60	13952603	320.31
1356.30	331507	7.6103	1360.10	4662924	107.05	1363.90	9244512	212.22	1367.70	14083294	323.31
1356.40	442345	10.155	1360.20	4780257	109.74	1364.00	9368523	215.07	1367.80	14214167	326.31
1356.50	553353	12.703	1360.30	4897762	112.44	1364.10	9492711	217.92	1367.90	14345224	329.32
1356.60	664529	15.255	1360.40	5015441	115.14	1364.20	9617078	220.78	1368.00	14476464	332.33
1356.70	775873	17.812	1360.50	5133294	117.84	1364.30	9741624	223.64	1368.10	14607887	335.35
1356.80	887387	20.372	1360.60	5251320	120.55	1364.40	9866348	226.50	1368.20	14739494	338.37
1356.90	999070	22.935	1360.70	5369521	123.27	1364.50	9991251	229.37	1368.30	14871284	341.40
1357.00	1110921	25.503	1360.80	5487895	125.98	1364.60	10116333	232.24	1368.40	15003259	344.43
1357.10	1222942	28.075	1360.90	5606444	128.71	1364.70	10241594	235.11	1368.50	15135417	347.46
1357.20	1335133	30.650	1361.00	5725167	131.43	1364.80	10367034	237.99	1368.60	15267759	350.50
1357.30	1447493	33.230	1361.10	5844064	134.16	1364.90	10492653	240.88	1368.70	15400285	353.54
1357.40	1560023	35.813	1361.20	5963136	136.89	1365.00	10618452	243.77	1368.80	15532995	356.59
1357.50	1672722	38.400	1361.30	6082382	139.63	1365.10	10744430	246.66	1368.90	15665890	359.64
1357.60	1785591	40.992	1361.40	6201803	142.37	1365.20	10870588	249.55	1369.00	15798969	362.69
1357.70	1898631	43.587	1361.50	6321399	145.12	1365.30	10996926	252.45	1369.10	15932233	365.75
1357.80	2011840	46.186	1361.60	6441170	147.87	1365.40	11123443	255.36	1369.20	16065682	368.82
1357.90	2125220	48.788	1361.70	6561117	150.62	1365.50	11250141	258.27	1369.30	16199316	371.89
1358.00	2238771	51.395	1361.80	6681238	153.38	1365.60	11377018	261.18	1369.40	16333134	374.96
1358.10	2352492	54.006	1361.90	6801535	156.14	1365.70	11504076	264.10	1369.50	16467138	378.03
1358.20	2466383	56.620	1362.00	6922008	158.91	1365.80	11631315	267.02	1369.60	16601327	381.11
1358.30	2580446	59.239	1362.10	7042656	161.68	1365.90	11758734	269.94	1369.70	16735701	384.20
1358.40	2694679	61.861	1362.20	7163480	164.45	1366.00	11886333	272.87	1369.80	16870261	387.29
1358.50	2809083	64.488	1362.30	7284480	167.23	1366.10	12014114	275.81	1369.90	17005007	390.38
1358.60	2923659	67.118	1362.40	7405656	170.01	1366.20	12142075	278.74	1370.00	17139939	393.48
1358.70	3038406	69.752	1362.50	7527009	172.80	1366.30	12270217	281.69	1370.10	17275056	396.58
1358.80	3153324	72.390	1362.60	7648537	175.59	1366.40	12398541	284.63	1370.20	17410359	399.69
1358.90	3268414	75.032	1362.70	7770242	178.38	1366.50	12527046	287.58	1370.30	17545849	402.80
1359.00	3383676	77.679	1362.80	7892124	181.18	1366.60	12655732	290.54	1370.40	17681525	405.91
1359.10	3499110	80.329	1362.90	8014182	183.98	1366.70	12784600	293.49	1370.50	17817387	409.03
1359.20	3614715	82.982	1363.00	8136417	186.79	1366.80	12913650	296.46	1370.60	17953436	412.15
1359.30	3730493	85.640	1363.10	8258829	189.60	1366.90	13042881	299.42	1370.70	18089672	415.28
1359.40	3846442	88.302	1363.20	8381419	192.41	1367.00	13172295	302.39	1370.80	18226094	418.41
1359.50	3962565	90.968	1363.30	8504185	195.23	1367.10	13301890	305.37	1370.90	18362704	421.55
1359.60	4078859	93.638	1363.40	8627129	198.05	1367.20	13431668	308.35	1371.00	18499500	424.69
1359.70	4195327	96.311	1363.50	8750250	200.88	1367.30	13561628	311.33	1371.10	18636484	427.83

CoP/CTUIR Joint Water Project

Nagle Property Impound
Size/Capacity Configuration

STAGE STORAGE TABLE

STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-	STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-	STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-	STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-
1371.20	18773654	430.98	1375.80	25288234	580.54	1380.40	32211929	739.48	1385.00	39557198	908.11
1371.30	18911013	434.14	1375.90	25434353	583.89	1380.50	32367081	743.05	1385.10	39721653	911.88
1371.40	19048559	437.29	1376.00	25580667	587.25	1380.60	32522432	746.61	1385.20	39886314	915.66
1371.50	19186293	440.46	1376.10	25727173	590.61	1380.70	32677983	750.18	1385.30	40051179	919.45
1371.60	19324214	443.62	1376.20	25873874	593.98	1380.80	32833733	753.76	1385.40	40216250	923.24
1371.70	19462324	446.79	1376.30	26020768	597.35	1380.90	32989683	757.34	1385.50	40381527	927.03
1371.80	19600621	449.97	1376.40	26167857	600.73	1381.00	33145833	760.92	1385.60	40547010	930.83
1371.90	19739107	453.15	1376.50	26315139	604.11	1381.10	33302183	764.51	1385.70	40712698	934.63
1372.00	19877781	456.33	1376.60	26462616	607.50	1381.20	33458733	768.11	1385.80	40878592	938.44
1372.10	20016644	459.52	1376.70	26610287	610.89	1381.30	33615484	771.71	1385.90	41044693	942.26
1372.20	20155695	462.71	1376.80	26758153	614.28	1381.40	33772435	775.31	1386.00	41211000	946.07
1372.30	20294935	465.91	1376.90	26906213	617.68	1381.50	33929586	778.92	1386.10	41377513	949.90
1372.40	20434364	469.11	1377.00	27054468	621.09	1381.60	34086938	782.53	1386.20	41544233	953.72
1372.50	20573982	472.31	1377.10	27202918	624.49	1381.70	34244490	786.15	1386.30	41711159	957.56
1372.60	20713789	475.52	1377.20	27351563	627.91	1381.80	34402244	789.77	1386.40	41878292	961.39
1372.70	20853785	478.74	1377.30	27500403	631.32	1381.90	34560199	793.39	1386.50	42045632	965.23
1372.80	20993971	481.96	1377.40	27649438	634.74	1382.00	34718355	797.02	1386.60	42213180	969.08
1372.90	21134346	485.18	1377.50	27798669	638.17	1382.10	34876712	800.66	1386.70	42380934	972.93
1373.00	21274911	488.40	1377.60	27948095	641.60	1382.20	35035270	804.30	1386.80	42548896	976.79
1373.10	21415665	491.64	1377.70	28097717	645.03	1382.30	35194030	807.94	1386.90	42717065	980.65
1373.20	21556609	494.87	1377.80	28247534	648.47	1382.40	35352992	811.59	1387.00	42885441	984.51
1373.30	21697744	498.11	1377.90	28397548	651.92	1382.50	35512155	815.25	1387.10	43054025	988.38
1373.40	21839068	501.36	1378.00	28547757	655.37	1382.60	35671521	818.91	1387.20	43222817	992.26
1373.50	21980583	504.60	1378.10	28698163	658.82	1382.70	35831088	822.57	1387.30	43391817	996.14
1373.60	22122288	507.86	1378.20	28848765	662.28	1382.80	35990858	826.24	1387.40	43561026	1000
1373.70	22264184	511.12	1378.30	28999563	665.74	1382.90	36150829	829.91	1387.50	43730442	1004
1373.80	22406271	514.38	1378.40	29150558	669.20	1383.00	36311004	833.59	1387.60	43900066	1008
1373.90	22548548	517.64	1378.50	29301750	672.68	1383.10	36471381	837.27	1387.70	44069899	1012
1374.00	22691016	520.91	1378.60	29453138	676.15	1383.20	36631960	840.95	1387.80	44239941	1016
1374.10	22833675	524.19	1378.70	29604724	679.63	1383.30	36792743	844.65	1387.90	44410191	1020
1374.20	22976525	527.47	1378.80	29756506	683.12	1383.40	36953728	848.34	1388.00	44580650	1023
1374.30	23119567	530.75	1378.90	29908486	686.60	1383.50	37114917	852.04	1388.10	44751319	1027
1374.40	23262800	534.04	1379.00	30060663	690.10	1383.60	37276308	855.75	1388.20	44922196	1031
1374.50	23406225	537.33	1379.10	30213037	693.60	1383.70	37437903	859.46	1388.30	45093282	1035
1374.60	23549841	540.63	1379.20	30365609	697.10	1383.80	37599701	863.17	1388.40	45264578	1039
1374.70	23693649	543.93	1379.30	30518378	700.61	1383.90	37761703	866.89	1388.50	45436083	1043
1374.80	23837649	547.24	1379.40	30671346	704.12	1384.00	37923909	870.61	1388.60	45607798	1047
1374.90	23981841	550.55	1379.50	30824511	707.63	1384.10	38086319	874.34	1388.70	45779722	1051
1375.00	24126225	553.86	1379.60	30977875	711.15	1384.20	38248932	878.07	1388.80	45951857	1055
1375.10	24270802	557.18	1379.70	31131436	714.68	1384.30	38411750	881.81	1388.90	46124201	1059
1375.20	24415571	560.50	1379.80	31285196	718.21	1384.40	38574772	885.55	1389.00	46296756	1063
1375.30	24560532	563.83	1379.90	31439155	721.74	1384.50	38737998	889.30	1389.10	46469521	1067
1375.40	24705687	567.16	1380.00	31593312	725.28	1384.60	38901428	893.05	1389.20	46642496	1071
1375.50	24851034	570.50	1380.10	31747668	728.83	1384.70	39065064	896.81	1389.30	46815681	1075
1375.60	24996574	573.84	1380.20	31902222	732.37	1384.80	39228904	900.57	1389.40	46989077	1079
1375.70	25142307	577.19	1380.30	32056976	735.93	1384.90	39392949	904.34	1389.50	47162684	1083

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Nagle Property Impound

Size/Capacity Configuration

STAGE STORAGE TABLE

STAGE (ft)	STORAGE ---cf---	--Ac-Ft-	STAGE (ft)	STORAGE ---cf---	--Ac-Ft-	STAGE (ft)	STORAGE ---cf---	--Ac-Ft-	STAGE (ft)	STORAGE ---cf---	--Ac-Ft-
1389.60	47336502	1087	1394.20	55562299	1276	1398.80	64247048	1475	1403.40	73403207	1685
1389.70	47510531	1091	1394.30	55746173	1280	1398.90	64441037	1479	1403.50	73607583	1690
1389.80	47684771	1095	1394.40	55930263	1284	1399.00	64635249	1484	1403.60	73812187	1694
1389.90	47859222	1099	1394.50	56114571	1288	1399.10	64829684	1488	1403.70	74017021	1699
1390.00	48033885	1103	1394.60	56299096	1292	1399.20	65024342	1493	1403.80	74222083	1704
1390.10	48208759	1107	1394.70	56483839	1297	1399.30	65219224	1497	1403.90	74427375	1709
1390.20	48383845	1111	1394.80	56668799	1301	1399.40	65414329	1502	1404.00	74632896	1713
1390.30	48559143	1115	1394.90	56853976	1305	1399.50	65609658	1506	1404.10	74838646	1718
1390.40	48734652	1119	1395.00	57039372	1309	1399.60	65805210	1511	1404.20	75044626	1723
1390.50	48910374	1123	1395.10	57224985	1314	1399.70	66000986	1515	1404.30	75250835	1728
1390.60	49086307	1127	1395.20	57410817	1318	1399.80	66196986	1520	1404.40	75457275	1732
1390.70	49262453	1131	1395.30	57596866	1322	1399.90	66393210	1524	1404.50	75663944	1737
1390.80	49438812	1135	1395.40	57783134	1327	1400.00	66589658	1529	1404.60	75870844	1742
1390.90	49615383	1139	1395.50	57969620	1331	1400.10	66786331	1533	1404.70	76077973	1747
1391.00	49792166	1143	1395.60	58156325	1335	1400.20	66983228	1538	1404.80	76285333	1751
1391.10	49969163	1147	1395.70	58343249	1339	1400.30	67180350	1542	1404.90	76492924	1756
1391.20	50146372	1151	1395.80	58530391	1344	1400.40	67377696	1547	1405.00	76700745	1761
1391.30	50323795	1155	1395.90	58717753	1348	1400.50	67575267	1551	1405.10	76908797	1766
1391.40	50501430	1159	1396.00	58905333	1352	1400.60	67773063	1556	1405.20	77117079	1770
1391.50	50679279	1163	1396.10	59093133	1357	1400.70	67971084	1560	1405.30	77325593	1775
1391.60	50857341	1168	1396.20	59281152	1361	1400.80	68169331	1565	1405.40	77534338	1780
1391.70	51035617	1172	1396.30	59469390	1365	1400.90	68367802	1570	1405.50	77743314	1785
1391.80	51214107	1176	1396.40	59657848	1370	1401.00	68566500	1574	1405.60	77952521	1790
1391.90	51392810	1180	1396.50	59846526	1374	1401.10	68765422	1579	1405.70	78161960	1794
1392.00	51571728	1184	1396.60	60035423	1378	1401.20	68964571	1583	1405.80	78371630	1799
1392.10	51750859	1188	1396.70	60224541	1383	1401.30	69163945	1588	1405.90	78581532	1804
1392.20	51930205	1192	1396.80	60413878	1387	1401.40	69363546	1592	1406.00	78791666	1809
1392.30	52109765	1196	1396.90	60603436	1391	1401.50	69563372	1597	1406.10	79002032	1814
1392.40	52289539	1200	1397.00	60793214	1396	1401.60	69763425	1602	1406.20	79212630	1818
1392.50	52469528	1205	1397.10	60983213	1400	1401.70	69963704	1606	1406.30	79423461	1823
1392.60	52649732	1209	1397.20	61173432	1404	1401.80	70164210	1611	1406.40	79634524	1828
1392.70	52830151	1213	1397.30	61363872	1409	1401.90	70364942	1615	1406.50	79845819	1833
1392.80	53010784	1217	1397.40	61554533	1413	1402.00	70565901	1620	1406.60	80057347	1838
1392.90	53191633	1221	1397.50	61745415	1417	1402.10	70767087	1625	1406.70	80269108	1843
1393.00	53372697	1225	1397.60	61936518	1422	1402.20	70968500	1629	1406.80	80481101	1848
1393.10	53553976	1229	1397.70	62127842	1426	1402.30	71170140	1634	1406.90	80693328	1852
1393.20	53735471	1234	1397.80	62319388	1431	1402.40	71372007	1638	1407.00	80905788	1857
1393.30	53917182	1238	1397.90	62511155	1435	1402.50	71574102	1643	1407.10	81118481	1862
1393.40	54099108	1242	1398.00	62703144	1439	1402.60	71776424	1648	1407.20	81331407	1867
1393.50	54281250	1246	1398.10	62895354	1444	1402.70	71978974	1652	1407.30	81544567	1872
1393.60	54463608	1250	1398.20	63087787	1448	1402.80	72181751	1657	1407.40	81757961	1877
1393.70	54646182	1255	1398.30	63280441	1453	1402.90	72384757	1662	1407.50	81971588	1882
1393.80	54828972	1259	1398.40	63473318	1457	1403.00	72587990	1666	1407.60	82185450	1887
1393.90	55011979	1263	1398.50	63666416	1462	1403.10	72791452	1671	1407.70	82399545	1892
1394.00	55195202	1267	1398.60	63859738	1466	1403.20	72995142	1676	1407.80	82613875	1897
1394.10	55378642	1271	1398.70	64053281	1470	1403.30	73199060	1680	1407.90	82828439	1901

CoP/CTUIR Joint Water Project

Nagle Property Impound
Size/Capacity Configuration

STAGE STORAGE TABLE

STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-	STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-	STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-	STAGE (ft)	<----STORAGE----> ---cf---	--Ac-Ft-
1408.00	83043237	1906	1408.60	84336957	1936	1409.20	85639149	1966	1409.80	86949841	1996
1408.10	83258270	1911	1408.70	84553400	1941	1409.30	85857007	1971	1409.90	87169118	2001
1408.20	83473537	1916	1408.80	84770079	1946	1409.40	86075101	1976	1410.00	87388632	2006
1408.30	83689040	1921	1408.90	84986993	1951	1409.50	86293431	1981	1410.00	87388632	2006
1408.40	83904777	1926	1409.00	85204142	1956	1409.60	86511998	1986			
1408.50	84120750	1931	1409.10	85421528	1961	1409.70	86730801	1991			

APPENDIX V IMPOUND WATER QUALITY STUDY

CTUIR/CoP Joint Water Project – Engineering Feasibility Study
Impound Water Quality Study

Dr. Peter O. Nelson, Oregon State University

Introduction and Background

Three proposed impoundments (storage reservoirs) are considered in this analysis, identified as the West Patawa, East Patawa, and Nagle Property impoundments. The reservoirs are located in the vicinity of Pendleton, Oregon, on tributary draws (except Nagle) of Patawa Creek, a tributary of the Umatilla River. For the purposes of climate conditions, the location of the reservoirs is assumed to be that of the Pendleton Field Station:

Location of Pendleton Field Station- Latitude: 45 Deg. 41 Min. N, Longitude: 118 Deg. 51 Min. W

The following hydrologic characteristics were assumed for the reservoirs:

Rule curve: Pump-fill January – May
Drawdown June – October
Approximate hydraulic residence time: 120-150 days

Watershed runoff: negligible

A summary of reservoir physical characteristics at the three locations is shown in Table 1.

Table 1: Reservoir Physical Characteristics

Reservoir	Surface Elev. (ft)	Max. Depth (ft)	Volume (ac-ft)	Surface Area (sq-ft.x10^6)	Mean Depth (ft)
West Patawa					
	1330	63	1207	2.044	25.7
	1340	73	1739	2.665	28.4
	1350	83	2421	3.508	30.1
	1360	93	3351	4.403	33.2
	1370	103	4520	5.854	33.6
	1380	113	5925	6.306	40.9
East Patawa					
	1350	50	602	1.658	15.8
	1360	60	1079	2.525	18.6
	1370	70	1774	3.872	20.0
	1380	80	2769	6.499	18.6
	1390	90	4018	6.993	25.0
Nagle Property					
	1373	16	1000		
	1387	30	2000		
	1410	53	4000		

Regional climate is assumed to be that at the Pendleton Field station for a period of record from 1961-1990 and is summarized in Table 2.

Table 2: Pendleton Field Station Climate Data Summary

Month	Temperature (°F)			Precipitation Mean (in)	Cloud Cover Fraction	Wind Speed Mean (mph)	Evaporation (in)
	Max.	Mean	Min.				
January	39.7	33.5	27.2	1.51	0.84	7.7	0
February	46.9	39.2	31.6	1.14	0.80	8.1	0
March	54.2	44.8	35.4	1.16	0.73	9.1	3.34
April	61.3	50.3	39.4	1.04	0.68	9.8	5.05
May	70.0	57.9	45.8	0.99	0.61	9.5	6.82
June	79.5	66.2	52.9	0.64	0.54	9.5	8.68
July	87.8	72.9	58.0	0.35	0.31	9.0	11.46
August	86.2	72.0	57.7	0.53	0.34	8.6	10.22
September	76.3	63.1	49.9	0.59	0.40	8.3	6.55
October	63.8	52.4	41.0	0.86			3.61
November	48.9	41.5	34.1	1.58			0
December	40.5	34.2	27.9	1.63			0

Source water for the proposed impoundments is the Umatilla River during the winter-spring months of January – May. Water quality for the Umatilla River during this period is summarized in Table 3. Only recent data during this time period are included due to concern for changes in analytical methods and in particular greater accuracy in nutrient determinations in data from the 1990's.

The reservoir sites under consideration are off-stream sites rather than on-stream sites. Inflow to the reservoirs will be pumped from the Umatilla River during the months of January – May when excess flow is available. Drawdown of the reservoirs will occur from approximately June – September or October. The West Patawa and East Patawa sites are located in the upper elevations of draws that have limited net runoff from ephemeral creeks. For this preliminary study, it is assumed that the reservoirs receive no inputs of water or water quality constituents (nutrients, sediment) from their watersheds.

Table 3: Umatilla River Water Quality Data – January to May Period Only

Umatilla River Water Quality (near Pendleton, Oregon)
Period: January - May

Location	Date	TSS mg/L	Turbidity FTU	NH3-N mg/L	TKN mg/L	NO2+NO3 mg/L	Tot. N mg/L	Tot. P mg/L	N/P Ratio
Highway 11 (RM ~ 57) or	4/29/93			0.02		0.04		0.04	
West Bndy	4/30/96	9	8	0.02	0.2	0.13	0.33	0.09	3.67
(RM ~ 56)	5/1/96	3	5	0.03	0.4	0.13	0.53	0.07	7.57
	5/2/96	2	5	0.02	0.2	0.11	0.31	0.06	5.17
	1/5/98	2	5	0.02	0.2	0.06	0.26	0.04	6.50
	1/20/98	23	15	0.02	0.3	0.2	0.5	0.09	5.56
	1/27/98	31	19	0.02	0.3	0.14	0.44	0.09	4.89
	2/17/98	1	4	0.02	0.2	0.09	0.29	0.04	7.25
	2/24/98	1	3	0.04	0.2	0.08	0.28	0.06	4.67
	3/10/98	4	12	0.03	0.2	0.09	0.29	0.06	4.83
	Average	8.44	8.4	0.02	0.24	0.11	0.36	0.07	5.57
Mission	4/30/96	13	9	0.02	0.3	0.11	0.41	0.07	5.86
Bridge	5/1/96	3	4	0.02	0.3	0.11	0.41	0.06	6.83
	5/2/96	3	4	0.02	0.2	0.12	0.32	0.05	6.40
	3/27/97	36	25	0.03	0.2	0.1	0.3	0.1	3.00
	4/23/97	160	72	0.02	0.6	0.08	0.68	0.33	2.06
	5/7/97	4	3	0.03	0.2	0.06	0.26	0.05	5.20
	5/21/97	4	3	0.03	0.2	0.02	0.22	0.04	5.50
	1/5/98	2	5						
	1/20/98	23	15						
	1/27/98	31	19						
	2/10/98	1	5						
	2/17/98	0.8	4						
	2/24/98	1	3						
	3/3/98	2	7						
	3/10/98	4	12						
	3/17/98	3	6						
	3/23/98	32	18						
	3/31/98	4	5						
	4/6/98	0.8	6						
	4/14/98	0.8	3						
	Average	18.2	12.41	0.03	0.3	0.07	0.37	0.13	3.94

Temperature and Stratification

Thermal stratification in the reservoirs will have important effects on water quality. When thermally stratified, reservoirs are separated into a well-mixed and oxygenated upper layer (epilimnion) and a poorly mixed and deoxygenated lower layer (hypolimnion). The euphotic zone of light penetration and algal growth occurs mainly in the epilimnion, while respiration, carbon assimilation, and deoxygenation occur mainly in the hypolimnion. Thus, water quality can vary greatly from top to bottom in the reservoir. Reservoir physical characteristics, operation, and the influence of external factors, such as insolation and wind-induced mixing, affect the extent of thermal stratification.

Several assessment approaches can be used to estimate the thermal stratification regime of the proposed reservoirs. Because of the difficulty in quantifying the detailed factors that affect stratification, the extent and duration of thermal stratification can best be predicted by comparison to model calculations for a standard set of reservoir configurations for selected representative geographical locations. As a final check, comparison is made to model simulations of temperature profiles for two proposed sidestream reservoirs on the Umatilla River in an earlier study and to McKay Reservoir, which is in and adjacent drainage to the Umatilla River and about the same depth but about ten times the volume of the proposed reservoirs.

To estimate the extent and duration of thermal stratification, comparison is made by similarity to model calculations of thermal profiles over depth and time for representative geometries and climatological conditions (Mills, et al., 1985). For this purpose, parameter values must be estimated for comparison to those used in the thermal gradient plots. For geographic locale, the most similar location to Pendleton that is included in the model calculations is Billings, Montana (Lat: 45.8°N, Long: 108.5°W). Being at similar latitudes, and with similar cloud cover fractions, insolation should be quite similar for these two locations. However, because Billings has mean monthly temperatures that are typically 10-15 °F colder than those of Pendleton, comparison was also made with model calculations for Salt Lake City, Utah (Lat: 40.8°N, Long: 111.9°W), which although about 5° Latitude south of Pendleton has similar mean monthly temperatures but slightly lower fractional cloud cover.

Reservoir characteristics were assumed for comparison to model thermal profiles for two cases that most closely match the proposed impoundments, maximum pool depth = 100 ft and maximum pool depth = 75 ft. Parameter used for the 100 ft case are as follows: maximum depth, 110 ft; volume, 2.6×10^8 ft^3; mean residence time, 150 days; mixing, low (based on mean wind speed for Pendleton Field Station, Table 2). Parameter used for the 75 ft case are as follows: maximum depth, 75 ft; volume, 7.6×10^7 ft^3; mean residence time, 120 days; mixing, low.

By comparison to model thermal profiles, the reservoir is likely to stratify from May through September. The epilimnion will be initially about 6-8 ft deep in May at a temperature of about 12 °C with a thermocline down to a depth of about 25-ft, reaching a hypolimnion temperature near 4 °C. During the summer (June – August), epilimnion temperatures will increase to about 22 °C, and the thermocline will extend to a depth of about 20-40 ft, reaching a hypolimnion temperature of about 10-12 °C, depending on reservoir drawdown. The epilimnion begins rapidly cooling during September, with overturn and complete mixing occurring in late September or early October at an isothermal temperature of about 12-14 °C. Predicted temperatures will vary depending on the rule curve of operation for the reservoir, being affected by both filling during the winter-spring period and drawdown during the summer-fall period.

These predicted temperatures are in good agreement with those projected for two proposed side-stream reservoirs in an earlier study (Umatilla Basin Project, Vol. 2, Bureau of Reclamation – Region 1, 1970).

Temperature profile data for McKay Reservoir are also in good general agreement with these projections, although McKay reservoir temperatures average about 1-2 °C higher than these projections.

Sediment Accumulation

The reservoir sites under consideration are off-stream sites rather than on-stream sites, receiving inflow from pumped Umatilla River water during the months of January – May. As such, larger sediment fractions transported by the river in the gravel size range and larger are assumed to be excluded by an inlet structure at the pump station. Only the fine suspended sediment fractions are assumed to be transported in the reservoir inflow, the same fractions that are determined by suspended solids or turbidity measurements. In the absence of detailed particle size distribution data or of reservoir inflow-outflow physical locations, the fraction of sediment trapped by the reservoir can be estimated by the ratio of the reservoir capacity to inflow rate (Lindsey, Kohler, and Paulhus, 1958). This is effectively the hydraulic residence time of the reservoir expressed in years, which has been estimated (above) to be 150 days or 0.4 years for the deepest reservoir and about 120 days or 0.33 years for the 75 ft. deep reservoir. Both of these residence times result in a predicted sediment trapping efficiency of 95% for the proposed reservoirs.

The mass of sediment transported to the reservoirs is estimated using water quality data for the Umatilla River during the months of January – May. Mass of sediment inflow is computed by the product of mean suspended solids concentration and mean flow rate. In the absence of a reservoir rule curve for operation, pumped inflow from the Umatilla River is assumed to be evenly distributed over the January-May filling period. A value of 18 mg/L TSS is assumed for the incoming suspended sediment from the Umatilla River (Table 3). The cumulative flow for the filling period is taken to be the maximum reservoir volume (5925 ac-ft). The accumulated annual volume of trapped sediment depends on the specific gravity of the sediment particles and the porosity of the accumulated sediment on the reservoir bottom. The primary origin of suspended sediment particles in the Umatilla River during the January – May period assumed to be soil erosion. Thus, particles will be predominantly inorganic in nature (clay, silt, and sand) with a mean specific gravity of 2.7. After accumulation and consolidation on the reservoir bottom, a mean porosity of 50% is assumed for the sediments.

Calculation of trapped sediment volume per year based on the above assumptions is 0.003 ac-ft. Obviously, this is a negligible volume for the reservoir, leading to the conclusion that sediment accumulation from inflow suspended sediment from the Umatilla River will not be an operating problem for the reservoir. Furthermore, since about 95 % of the inflow suspended sediment is predicted to settle out, background turbidity and TSS values will be very low (turbidity 1-2 NTU, TSS 1-2 mg/L).

Nutrients and Algal Growth

Algal populations and primary production in reservoirs is controlled by the availability of nutrients required for growth. Most commonly, nitrogen and phosphorus are the nutrients that limit growth by being present in least concentration relative to requirements of algal cells. The average formula of algal cells is $C_{106}H_{263}O_{110}N_{16}P$. Thus, the molar N/P ratio is 16/1 and the mass ratio is 7.2/1. Theoretically, algal growth in waters with N/P mass ratios greater than 7.2/1 will be limited by phosphorus availability and in waters with N/P mass ratios less than 7.2/1 will be nitrogen-limited. In practice, waters with N/P mass ratios less than 5/1 are considered nitrogen limiting, those with N/P mass ratios greater than 10/1 are considered phosphorus limiting, and those with N/P mass ratios between 5/1 and 10/1 are limited by both nutrients. In many highly enriched eutrophic lakes that are initially nitrogen-limited, blue-green algae predominate that are capable of fixing elemental nitrogen from the atmosphere. Thus, the worst-case

analysis for algal growth can be made by assuming that phosphorus is limiting. For the proposed reservoirs, inflow water quality is determined by that of the Umatilla River at the point of withdrawal (approximately river mile 57) during the months of January – May. The contribution of nutrients from the watersheds of the reservoirs is assumed to be negligible.

For lakes and impoundments, concentrations of total nitrogen above about 0.3 mg/L and total phosphorus above about 0.015 mg/L are considered excessive, above which nuisance algal blooms may be experienced. Data for concentrations of various forms of nitrogen and phosphorus are available from a number of individual studies and monitoring reports spanning a period of nearly 40 years. Only data sets for which total nitrogen and total phosphorus concentrations were directly determined or can be calculated are used here. Data from two sampling sites on the river are summarized here. One site is a composite of two nearby stations, the West Boundary to the Umatilla Indian at river mile 56, and the point where State Highway 11 bridge crosses the river at river mile 57. The second site is at Mission Bridge, at approximately river mile 61. At both sites, mean total nitrogen (0.36 mg/L) and total phosphorus (0.07 mg/L) concentrations are well in excess of levels that promote excessive algal growth (Table 3, above). In addition, N/P ratios indicate that nitrogen is the limiting nutrient for algal growth or that both nitrogen and phosphorus are limiting (Table 3).

Also important in assessing the nutrient enrichment level and trophic state of the proposed reservoirs are their relative mass loading rates for nutrients. As stated above, even in cases where nitrogen appears to be the limiting nutrient, phosphorus is assumed limiting as a worst-case analysis since nitrogen can be fixed from the atmosphere in highly enriched (eutrophic) lakes or impoundments. Analysis of phosphorus loading and its affect on water quality is based on the Vollenweider relationship. The trophic state of a lake or reservoir depends on the relationship between phosphorus loading ($g/m^2/yr$) and the ratio of the mean reservoir depth to hydraulic residence time. For the West Patawa reservoir, phosphorus loading of 0.88 g/m^2-yr is estimated with a ratio of depth to hydraulic residence time of 30.3 m/yr. Based on the Vollenweider relationship and diagram (Mills et al., 1985), the reservoir is classified as mesotrophic, or transitional between oligotrophic (nutrient poor, low algal growth) and eutrophic (nutrient rich, excessive algal growth). A similar classification results from application of the Vollenweider analysis to the other two reservoir sites.

Oxygen Demand and Dissolved Oxygen

Oxygen demand will result from two processes operant in the reservoir. Oxygen-demanding materials will be present in the inflow water from the Umatilla River and are measured as biochemical oxygen demand, or BOD. In addition, as algae grow and die in the reservoir, algal cells are consumed by bacteria in the process known as respiration in the bottom layers of water column, or hypolimnion. BOD values reported for the Umatilla River at the Highway 11 station ranged from 0.1 to 1.8 mg/L over the period of 1993-1997 (year-around values). This indicates that oxygen demand in the inflow water from the Umatilla will have little or no effect on the oxygen regime of the reservoir, as dissolved oxygen in the water (assumed near saturation) and natural reaeration will easily provide sufficient oxygen to meet this demand. Hypolimnetic oxygen demand from algal growth will cause some oxygen depletion during the period of temperature stratification from June – September. A comparison was therefore made with water quality data collected for McKay Reservoir, located nearby to the proposed impoundments. McKay Reservoir has a similar maximum depth (approx. 82-ft.) and has similar but somewhat greater nutrient levels than those predicted for the proposed impoundments. Minimum dissolved oxygen levels for McKay occur late during the period of stratification in August or September, with values typically between 4.3-5.0 mg/L, or about 45-50% of saturation. Thus, by comparison, severe oxygen depletion and anaerobic conditions are not predicted for the proposed impoundments as a result of nutrient enrichment and excessive algal growth. Taste and odor problems may be of concern late in the summer as alga

degradation product concentrate in the hypolimnion layer prior to overturn in late September or October. However, the lack of anaerobic conditions will make this problem less severe.

Effects of Reservoir Depth and Surface Area on Water Quality

Reservoir physical characteristics are summarized in Table 1 for each proposed reservoir site. Several possible maximum depths with their associated volumes, surface areas, and mean depths are included. In general, reservoir water quality will depend primarily on the water quality of the inflow water from the Umatilla River. Inflow water turbidity, nutrient concentrations, and oxygen demand (BOD, COD) are of greatest concern. Secondary effects are caused by changes in water quality during storage within the reservoirs. These include the effects of algal growth, which are related to nutrient levels, and oxygen depletion, which are related to inflow oxygen demand and bacterial respiration of alga cells. Changes in reservoir maximum depth and surface area will have very little influence on these effects. Using the West Patawa site as an example, maximum depths for proposed reservoir configurations range from about 63-113 ft. Period of thermal stratification, maximum surface temperature, and depth of the epilimnion and euphotic zone will change minimally. Thus, the negative effects of algal growth on water quality will be largely unchanged with changes in reservoir depth or surface area. Reservoir cumulative evaporative loss from May to October will be about 70% of pan evaporation (Table 2), or about 3 ft. This represents about 3-5 % of reservoir depth and 8-12% of reservoir volume, depending on initial reservoir depth. Neither this depth change nor the volume change and resulting increased concentration of dissolved solids will greatly influence water quality.

Conclusions and Recommendations

Three proposed reservoir sites for the joint City of Pendleton – Confederated Tribes of the Umatilla Indian Reservation project were evaluated in terms of water quality suitability as a municipal water supply. Overall, no major water quality limitations are anticipated for the reservoirs, which are to receive pumped inflow from the Umatilla River during the period of excess flow annually from approximately January – May. The reservoirs are predicted to be thermally stratified during the period of approximately May – September. Maximum surface temperatures will be about 72 °F in August, with the stratified bottom layer remaining near 50 °F, depending on drawdown characteristics of the reservoir. The major water quality concern will be algal growth due to relatively high levels of nutrients (nitrogen and phosphorus) in Umatilla River water. This nutrient enrichment is predicted to cause a mesotrophic condition of moderate to high algal growth. Algal production is not predicted to be high enough to cause severe oxygen depletion and anaerobic conditions in the reservoir hypolimnion layers. However, moderate taste and odor problems could develop late in the summer from the build-up of algal cell degradation products. Siltation and reservoir filling are not predicted to be a problem for the reservoirs. Effects on water quality with changes in reservoir maximum depth are expected to be minimal. All proposed reservoir sites are suitable in terms of acceptable water quality for a municipal water supply.

APPENDIX VI PUMPING/PIPING HYDRAULIC ANALYSIS

CoP Intake to Site A: 30" delivery pipe
Worksheet for Pressure Pipe

Project Description	
Project File	c:\haestad\fmw\cop-ctui.fm2
Worksheet	CoP Intake to Site A: 30" delivery pipe
Flow Element	Pressure Pipe
Method	Hazen-Williams Formula
Solve For	Discharge

Input Data	
Pressure at 1	125.00 psi
Pressure at 2	5.00 psi
Elevation at 1	1,120.00 ft
Elevation at 2	1,370.00 ft
Length	10,600.00 ft
C Coefficient	113.0
Diameter	30.00 in

Results		
Discharge	9,657.9	gal/min
Headloss	26.79	ft
Energy Grade at 1	1,408.48	ft
Energy Grade at 2	1,381.70	ft
Hydraulic Grade at 1	1,408.32	ft
Hydraulic Grade at 2	1,381.53	ft
Flow Area	4.91	ft^2
Wetted Perimeter	7.85	ft
Velocity	4.38	ft/s
Velocity Head	0.30	ft
Friction Slope	0.002527	ft/ft

9,657.9 GPM = 21.5 CFS

Horsepower (HP) required = GPM x TDH/3,960 x pump eff.

$HP_{reqd.}$ = 9,657.9 x (26.8 + (1,370 – 1,120))/3,960 x 0.75

$HP_{reqd.}$ = 900

CoP Intake to Site A: 36" delivery pipe
Worksheet for Pressure Pipe

Project Description	
Project File	c:\haestad\fmw\cop-ctui.fm2
Worksheet	CoP Intake to Site A: 36" delivery pipe
Flow Element	Pressure Pipe
Method	Hazen-Williams Formula
Solve For	Discharge

Input Data	
Pressure at 1	125.00 psi
Pressure at 2	5.00 psi
Elevation at 1	1,120.00 ft
Elevation at 2	1,370.00 ft
Length	10,600.00 ft
C Coefficient	113.0
Diameter	36.00 in

Results		
Discharge	15,600.2	gal/min
Headloss	26.79	ft
Energy Grade at 1	1,408.88	ft
Energy Grade at 2	1,382.09	ft
Hydraulic Grade at 1	1,408.32	ft
Hydraulic Grade at 2	1,381.53	ft
Flow Area	7.07	ft^2
Wetted Perimeter	9.42	ft
Velocity	4.92	ft/s
Velocity Head	0.38	ft
Friction Slope	0.002527	ft/ft

15,600.2 GPM = 34.8 CFS

Horsepower (HP) required = GPM x TDH/3,960 x pump eff.

$HP_{reqd.}$ = 15,600.2 x (26.8 + (1,370 – 1,120))/3,960 x 0.75

$HP_{reqd.}$ = 1,454

CoP Intake to Site A: 42" delivery pipe
Worksheet for Pressure Pipe

Project Description	
Project File	c:\haestad\fmw\cop-ctui.fm2
Worksheet	CoP Intake to Site A: 42" delivery pipe
Flow Element	Pressure Pipe
Method	Hazen-Williams Formula
Solve For	Discharge

Input Data	
Pressure at 1	125.00 psi
Pressure at 2	5.00 psi
Elevation at 1	1,120.00 ft
Elevation at 2	1,370.00 ft
Length	10,600.00 ft
C Coefficient	113.0
Diameter	42.00 in

Results		
Discharge	23,399.1	gal/min
Headloss	26.79	ft
Energy Grade at 1	1,408.70	ft
Energy Grade at 2	1,381.91	ft
Hydraulic Grade at 1	1,408.32	ft
Hydraulic Grade at 2	1,381.53	ft
Flow Area	9.62	ft^2
Wetted Perimeter	11.00	ft
Velocity	5.42	ft/s
Velocity Head	0.46	ft
Friction Slope	0.002527	ft/ft

23,399.1 GPM = 52.1 CFS

Horsepower (HP) required = GPM x TDH/3,960 x pump eff.

$HP_{reqd.}$ = 23,399.1 x (26.8 + (1,370 – 1,120))/3,960 x 0.75

$HP_{reqd.}$ = 2,180

CoP Intake to Site B: 30" delivery pipe
Worksheet for Pressure Pipe

Project Description	
Project File	c:\haestad\fmw\cop-ctui.fm2
Worksheet	CoP Intake to Site B: 30" delivery pipe
Flow Element	Pressure Pipe
Method	Hazen-Williams Formula
Solve For	Discharge

Input Data	
Pressure at 1	130.00 psi
Pressure at 2	5.00 psi
Elevation at 1	1,120.00 ft
Elevation at 2	1,370.00 ft
Length	16,200.00 ft
C Coefficient	113.0
Diameter	30.00 in

Results		
Discharge	9,319.1	gal/min
Headloss	38.32	ft
Energy Grade at 1	1,420.04	ft
Energy Grade at 2	1,381.72	ft
Hydraulic Grade at 1	1,419.85	ft
Hydraulic Grade at 2	1,381.53	ft
Flow Area	4.91	ft^2
Wetted Perimeter	7.85	ft
Velocity	4.23	ft/s
Velocity Head	0.28	ft
Friction Slope	0.002366	ft/ft

9,319.1 GPM = 20.8 CFS

Horsepower (HP) required = GPM x TDH/3,960 x pump eff.

$HP_{reqd.}$ = 9,319.1 x (38.3 + (1,370 – 1,120))/3,960 x 0.75

$HP_{reqd.}$ = 904

CoP Intake to Site B: 36" delivery pipe
Worksheet for Pressure Pipe

Project Description	
Project File	c:\haestad\fmw\cop-ctui.fm2
Worksheet	CoP Intake to Site B: 36" delivery pipe
Flow Element	Pressure Pipe
Method	Hazen-Williams Formula
Solve For	Discharge

Input Data	
Pressure at 1	130.00 psi
Pressure at 2	5.00 psi
Elevation at 1	1,120.00 ft
Elevation at 2	1,370.00 ft
Length	16,200.00 ft
C Coefficient	113.0
Diameter	36.00 in

Results		
Discharge	15,052.9	gal/min
Headloss	38.32	ft
Energy Grade at 1	1,420.28	ft
Energy Grade at 2	1,381.96	ft
Hydraulic Grade at 1	1,419.85	ft
Hydraulic Grade at 2	1,381.53	ft
Flow Area	7.07	ft^2
Wetted Perimeter	9.42	ft
Velocity	4.74	ft/s
Velocity Head	0.35	ft
Friction Slope	0.002366	ft/ft

15,052.9 GPM = 33.5 CFS

Horsepower (HP) required = GPM x TDH/3,960 x pump eff.

$HP_{reqd.}$ = 15,052.9 x (38.3 + (1,370 – 1,120))/3,960 x 0.75

$HP_{reqd.}$ = 1,461

CoP Intake to Site B: 42" delivery pipe
Worksheet for Pressure Pipe

Project Description	
Project File	c:\haestad\fmw\cop-ctui.fm2
Worksheet	CoP Intake to Site B: 42" delivery pipe
Flow Element	Pressure Pipe
Method	Hazen-Williams Formula
Solve For	Discharge

Input Data	
Pressure at 1	130.00 psi
Pressure at 2	5.00 psi
Elevation at 1	1,120.00 ft
Elevation at 2	1,370.00 ft
Length	16,200.00 ft
C Coefficient	113.0
Diameter	42.00 in

Results		
Discharge	22,578.3	gal/min
Headloss	38.32	ft
Energy Grade at 1	1,420.20	ft
Energy Grade at 2	1,381.88	ft
Hydraulic Grade at 1	1,419.85	ft
Hydraulic Grade at 2	1,381.53	ft
Flow Area	9.62	ft^2
Wetted Perimeter	11.00	ft
Velocity	5.23	ft/s
Velocity Head	0.42	ft
Friction Slope	0.002366	ft/ft

22,578.3 GPM = 50.3 CFS

Horsepower (HP) required = GPM x TDH/3,960 x pump eff.

$HP_{reqd.}$ = 22,578.3 x (38.3 + (1,370 – 1,120))/3,960 x 0.75

$HP_{reqd.}$ = 2,192

CoP Intake to Site C: 30" delivery pipe
Worksheet for Pressure Pipe

Project Description	
Project File	c:\haestad\fmw\cop-ctui.fm2
Worksheet	CoP Intake to Site C: 30" delivery pipe
Flow Element	Pressure Pipe
Method	Hazen-Williams Formula
Solve For	Discharge

Input Data	
Pressure at 1	150.00 psi
Pressure at 2	5.00 psi
Elevation at 1	1,120.00 ft
Elevation at 2	1,410.00 ft
Length	20,300.00 ft
C Coefficient	113.0
Diameter	30.00 in

Results		
Discharge	8,938.7	gal/min
Headloss	44.45	ft
Energy Grade at 1	1,466.06	ft
Energy Grade at 2	1,421.60	ft
Hydraulic Grade at 1	1,465.99	ft
Hydraulic Grade at 2	1,421.53	ft
Flow Area	4.91	ft^2
Wetted Perimeter	7.85	ft
Velocity	4.06	ft/s
Velocity Head	0.26	ft
Friction Slope	0.002190	ft/ft

8,938.7 GPM = 19.9 CFS

Horsepower (HP) required = GPM x TDH/3,960 x pump eff.

$HP_{reqd.} = 8,938.7 \times (44.5 + (1,410 - 1,120))/3,960 \times 0.75$

$HP_{reqd.} = 1,007$

CoP Intake to Site C: 36" delivery pipe
Worksheet for Pressure Pipe

Project Description	
Project File	c:\haestad\fmw\cop-ctui.fm2
Worksheet	CoP Intake to Site C: 36" delivery pipe
Flow Element	Pressure Pipe
Method	Hazen-Williams Formula
Solve For	Discharge

Input Data	
Pressure at 1	150.00 psi
Pressure at 2	5.00 psi
Elevation at 1	1,120.00 ft
Elevation at 2	1,410.00 ft
Length	20,300.00 ft
C Coefficient	113.0
Diameter	36.00 in

Results		
Discharge	14,438.4	gal/min
Headloss	44.45	ft
Energy Grade at 1	1,466.24	ft
Energy Grade at 2	1,421.79	ft
Hydraulic Grade at 1	1,465.99	ft
Hydraulic Grade at 2	1,421.53	ft
Flow Area	7.07	ft^2
Wetted Perimeter	9.42	ft
Velocity	4.55	ft/s
Velocity Head	0.32	ft
Friction Slope	0.002190	ft/ft

14,438.4 GPM = 32.2 CFS

Horsepower (HP) required = GPM x TDH/3,960 x pump eff.

$HP_{reqd.}$ = 14,438.4 x (44.5 + (1,410 – 1,120))/3,960 x 0.75

$HP_{reqd.}$ = 1,626

CoP Intake to Site C: 42" delivery pipe
Worksheet for Pressure Pipe

Project Description	
Project File	c:\haestad\fmw\cop-ctui.fm2
Worksheet	CoP Intake to Site C: 42" delivery pipe
Flow Element	Pressure Pipe
Method	Hazen-Williams Formula
Solve For	Discharge

Input Data	
Pressure at 1	150.00 psi
Pressure at 2	5.00 psi
Elevation at 1	1,120.00 ft
Elevation at 2	1,410.00 ft
Length	20,300.00 ft
C Coefficient	113.0
Diameter	42.00 in

Results		
Discharge	21,656.5	gal/min
Headloss	44.45	ft
Energy Grade at 1	1,466.31	ft
Energy Grade at 2	1,421.85	ft
Hydraulic Grade at 1	1,465.99	ft
Hydraulic Grade at 2	1,421.53	ft
Flow Area	9.62	ft^2
Wetted Perimeter	11.00	ft
Velocity	5.02	ft/s
Velocity Head	0.39	ft
Friction Slope	0.002190	ft/ft

21,656.5 GPM = 48.3 CFS

Horsepower (HP) required = GPM x TDH/3,960 x pump eff.

$HP_{reqd.}$ = 21,656.5 x (44.5 + (1,410 – 1,120))/3,960 x 0.75

$HP_{reqd.}$ = 2,439

APPENDIX VII OAR/WRD REGULATIONS/ CHECKLIST

OAR Division 3:	Timelines for Processing Applications - Guidelines
OAR Division 20:	Appropriation and Use of Surface Water – Dams
WRD:	Safety of Dam Checklist

Oregon Administrative Rules
1999 Compilation

WATER RESOURCES DEPARTMENT

DIVISION 3

TIMELINES FOR PROCESSING APPLICATIONS -- GUIDELINES

690-003-0000

Applications Subject to Processing Timelines

Water Resources Department "permit" applications subject to Chapter 3, Second Special Session 1982 Oregon Laws (ORS 285.150):

(1) Groundwater Application (ORS 537.615).

(2) Surface Water Application (ORS 537.130, 537.140, and 537.240).

(3) Reservoir Application (ORS 537.130, 537.140 and ORS 537.240 to 537.300):

(a) Small dam, not requiring plans and specifications by licensed engineer;

(b) Large dam, requiring plans and speci-fications pursuant to OAR 690-020-0035.

(4) Hydroelectric License Application (ORS 543.010 to 543.630):

(a) Minor Project (OAR 690-050-0050 to 690-050-0060);

(b) Major Project (OAR 690-050-0070 to 690-050-0075).

(5) Water Right Transfer Application (ORS 540.510 to 540.530):

(a) Change in Place of Use;

(b) Change in Point of Diversion, less than 1/4 mile and no intervening diversion point;

(c) Change in Point of Diversion, 1/4 mile or more and/or intervening diversion point;

(d) Change in Use Theretofore Made.

(6) Landowner Permit for Well Constructed on Landowner's Property (ORS 537.753(4)).

(7) Instream Water Right Applications (ORS 537.336 to 537.343).

NOTES:

-1- Applications for "permits" Items (1), (2), (3)(a), (4)(a), (5)(a) and (b), (6) and (7) are normally subject to approval or denial within 60 days from the date of filing of the completedapplication.

-2- Applications for "permits" Item (3)(b) are not normally subject to approval or denial within 60 days

from date of filing of the completed application due to required site inspection and subsequent detailed engineering analysis of plans and specifications for construction of the reservoir.

-3- Applications for "permits" Items (4)(b), (5)(c) and (d) are subject to statutory provisions for public notice, waiting periods and hearing opportunities for public participation in the review process which delay approval or denial beyond 60 days from the date of filing of a completed application.

Stat. Auth.: ORS 183, ORS 536.027, ORS 536.029 & ORS 540

Stats. Implemented:

Hist.: WRD 6-1982, f. & ef. 6-2-82; WRD 11-1986, f. & ef. 9-30-86; WRD 8-1992, f. & cert. ef. 6-24-92, Renumbered from 690-001-0050

690-003-0010

Processing of Permit Applications

All applications shall be acknowledged in writing to the applicant or the applicant's agent of record within ten working days of the date of filing. Written acknowledgement ofapplications for "permit" Items (3)(b), (4)(b) and (5)(c) and (d) shall include a summary of procedural steps to be followed in the processing of the application and the estimated time schedule.

Stat. Auth.: ORS 183, ORS 536.027 & ORS 536.029

Stats. Implemented:

Hist.: WRD 6-1982, f. & ef. 6-2-82; WRD 8-1992, f. & cert. ef. 6-24-92, Renumbered from 690-001-0060

690-003-0020

Review Procedures for Permit Applications

The estimated time schedule for the application review procedures for any application for "permit" shall be determined on the basis of the required statutory procedures for that application, the then current workload, and the projected staff capability

Stat. Auth.: ORS 183, ORS 536.027 & ORS 536.029

Stats. Implemented:

Hist.: WRD 6-1982, f. & ef. 6-2-82; WRD 8-1992, f. & cert. ef. 6-24-92, Renumbered from 690-001-0070

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Oregon Administrative Rules 1999 Compilation

WATER RESOURCES DEPARTMENT

DIVISION 20

APPROPRIATION AND USE OF SURFACE WATER

Dams

690-020-0021

General Statement

The following Oregon Administrative Rules (OAR), 690-020-0022 through 690-020-0040, apply to construction of dams. For administrative purposes dams have been classified as "small" and "dams over the statutory limits". Information concerning small dams is found in OAR 690-020-0029, and information concerning dams over the statutory limits is contained in OAR 690-020-0035. Small dams are those that are either under ten feet in height or store less than 3,000,000 gallons (9.2 acre-feet). OAR 690-020-0040 is concerned with enforcementprocedures.

Stat. Auth.: ORS 540.350 - ORS 540.400

Stats. Implemented: ORS 183 & ORS 540

Hist.: WRD 12-1986, f. & ef. 10-3-86; WRD 12-1994, f. & cert. ef. 11-7-94

690-020-0022

Statutory Authority and Definitions

(1) Statutory authority for these rules is: ORS 537.130, 537.190, 537.211, 537.260, 537.410 through 537.450, 540.330 through 540.400.

(2) The statutes in section (1) of this rule primarily provide for the protection of life and property, and for protection of other water rights. The following definitions are provided for theapplicant's reference:

(a) Abutment: A natural valley or canyon side against which the dam is built;

(b) Acre-foot: The equivalent volume of one acre covered with one foot of water (325,900 gallons);

(c) Conduit: A closed conveyance used to release water through a dam.

(d) Cutoff Collar: A thin collar placed at uniform intervals along an outlet conduit to retard water seepage;

(e) Cutoff Trench: A trench excavated beneath the dam foundation and backfilled with impermeable material to retard water seepage;

(f) Dam Crest: The top of the dam;

(g) Embankment: An engineered earth fill;

(h) Emergency Spillway: An overflow structure constructed to bypass flood water and prevent overtopping the dam crest;

(i) Foundation: The ground surface upon which a dam is constructed;

(j) Freeboard: The vertical distance between the designed high-water level in the reservoir and the dam crest; and

(k) Gate: A permanent device for regulating water flow.

Stat. Auth.: ORS 183 & ORS 540

Stats. Implemented: ORS 183 & ORS 540

Hist.: WRD 12-1986, f. & ef. 10-3-86

690-020-0025

General Requirements for all Dams

(1) The Water Resources Director may require any information or data in addition to that outlined herein which the Water Resources Director finds necessary for determining the safetyof the proposed structure.

(2) Whenever possible, precipitation or rainfall and runoff records shall be submitted. If records are not available for the basin in which the dam is located, the hydrological/hydraulic criteria used in the design shall be submitted.

(3) The Water Resources Director may include as part of any permit to construct a reservoir limitations and conditions that pertain to construction, operation, maintenance, and theprotection of lives and property. These limitations and conditions become, by reference, part of the certificate and remain in effect throughout the life of the water right.

(4) Approved plans and specifications for construction are, by reference, considered limitations and conditions placed on the water right permit and water right certificate. The Water Resources Director retains the authority to place additional limitations and conditions on the water right relative to operation and maintenance.

(5) Dams constructed or operated in violation of limitations and conditions included in the permit or certificate are subject to restricted use and permit cancellation procedures. The certificate affirms the applicant's right to store water subject to the limitations and conditions therein.

(6) An outlet conduit with a minimum diameter of 8" must be installed in any instream reservoir to permit drainage of the reservoir and for passage of flow to downstream prior rights ifnecessary. The Director may waive this requirement if the Director determines that the conduit is not needed for dam safety and will not be needed to pass flow for the benefit of other water rights, minimum perennial streamflows, or if the Director determines an adequate alternative for passing flow is provided. Adequate alternatives must be capable of passing flow insufficient quantity to satisfy downstream needs, and can include pumps, by-pass channels and siphons. Conduit material should be chosen based on design and site condition requirements. Acceptable conduit materials include reinforced concrete cylinder pipe; cast-in-place, reinforced concrete; zinc-coated, fiber-treated, bituminous-coated corrugated steel; coal tar enamel-coated welded steel; ductile iron; and cast iron. All joints should be water tight. The conduit valve should be installed at the upstream end and should be industry-manufactured with specifications consistent to the applied usage. Special provisions should be made for pressure conduits gated on the downstream end.

Stat. Auth.: ORS 540.350 - ORS 540.400

Stats. Implemented: ORS 183, ORS 536 & ORS 543

Hist.: WRD 3, f. & ef. 2-18-77; WRD 12-1986, f. & ef. 10-3-86; WRD 12-1994, f. & cert. ef. 11-7-94

690-020-0029

Small Dams, Recommended Minimum Standards

The following information is presented for the applicant's assistance in constructing small earthfill dams less than ten feet in height or impounding less than 3,000,000 gallons (9.2 acre feet) (see **Exhibit 1**):

(1) The crest width of the dam should be not less than 8 feet.

(2) The upstream slope of the dam should be no steeper than 3:1.

(3) The downstream slope of the dam should be no steeper than 2:1.

(4) The spillway channel should be constructed around the dam, not over the top of the fill. The spillway is normally excavated in natural material and, if necessary, lined to prevent erosion. The spillway should be large enough to pass the 50-year flood flow without overtopping the dam. Assistance is available from this office or the watermaster in sizing the spillway. Flow passing through the spillway should be returned to the creek channel at a sufficient distance downstream to prevent erosion of the fill.

(5) All brush, stumps, roots, and organic matter should be cleared from the area to be occupied by the dam. All such material should also be removed from the borrow area.

(6) A minimum of two cutoff collars should be constructed on the outlet conduit. These cutoff collars are normally constructed of concrete with a minimum thickness of 6 inches and should extend from the outside of the conduit a minimum of 24 inches in all directions. Prefabricated asphalt-dipped metal cutoff collars are acceptable, provided a watertight joint is obtained between conduit and collar.

(7) Embankment material should be spread paralleled with the dam axis in layers not exceeding eight inches in thickness and adequately compacted with sheepfoot roller or other similar equipment.

[ED. NOTE: The Exhibit referenced in this rule is not printed in the OAR Compilation. Copies are available from the agency.]

Stat. Auth.: ORS 183 & ORS 540

Stats. Implemented: ORS 183 & ORS 540

Hist.: WRD 12-1986, f. & ef. 10-3-86

690-020-0035

Dams Over the Statutory Limits; Minimum Engineering Design Requirements

All maps, plans, and specifications for the construction, enlargement, repair, or alteration of all dams which are, or will be, 10 feet or more in height and will impound 3,000,000 gallons (9.2 acre-feet) or more, must be prepared by a professional engineer licensed to practice in the State of Oregon.

(2) Before initiating design, the engineer shall obtain design criteria from the Department.

(3) No newly constructed dam that is 10 feet or more in height and impounds 3,000,000 gallons (9.2 acre-feet) or more, shall be permitted to store water until written approval is received from the Water Resources Department. Approval will be given after construction has been completed and is certified by the supervising engineer to have been constructed in accordance with the approved plans and specifications.

(4) Design documents shall include the following:

(a) Plans:

(A) Plans for dams submitted for approval must accurately portray the work to be accomplished and be of sufficient detail to adequately define all features of the project. Plans must be submitted on good-quality mylar or vellum and must be neatly and accurately drawn to a scale sufficiently large, with an adequate number of views, for the drawing to be readily interpreted;

(B) Several sheets may be used to eliminate the necessity of large bulky drawings. No map or plan should be larger than 24 x 36 inches. The following information will be required:

(i) A contour map of the reservoir site which will show the location of the dam by quarter-quarter section, township, range and tax lot; and the name and location of the stream flowingthrough the reservoir. Government survey lines must be indicated on this map, along with a survey tie to the dam axis from a government land corner. Area and capacity curves and/or tables of the proposed reservoir must be shown;

(ii) A map of the drainage basin showing the location of the dam and reservoir and the streams within the drainage area. This map may be prepared from existing reliable topographicalmaps and it must include: the number of square miles of drainage area; a brief description of the area; the percentage of bare and timbered lands; and general characteristics of the watershed, whether precipitous, rolling, or comparatively flat;

(iii) A topographic map of the dam site with contour intervals of not to exceed 5 feet. A plan of the dam should be superimposed on this map showing the location of spillways, outletconduits, and cutoff walls;

(iv) A profile of the dam site taken on the axis of the dam and a profile of the spillway along its axis. The profile should also show the location of the outlet conduit and spillway. A logshowing the classification of materials encountered below the surface as shown by test pits or borings should be included;

(v) A cross section of the dam at maximum section showing complete details and dimensions;

(vi) Plans showing sections of the outlet conduit, control works, and spillways. These sections should be in sufficient number and detail to make definite all features of the structure.

(b) Specifications. All plans for dams must be accompanied by specifications:

(A) The specifications shall describe in detail the methods to be followed in performing each class of work and shall set forth the requirements for the various types of material to beused in the permanent construction;

(B) The specifications must contain a provision for supervision by the engineer during construction and for inspection by the Director of the Water Resources Department at any time during the construction period;

(C) The specifications must also contain a provision to the effect that plans or specifications shall not be altered or changed without the written approval of the Director of the WaterResources Department or the Director's authorized representative.

(5) Construction: Construction should be supervised by an engineer licensed to practice in Oregon. As a minimum the following notices and construction reports shall be submitted tothe Department:

(a) Notice of beginning of construction;

(b) Notice of intent to begin placement of fill materials;

(c) Completion report including test results, "as-built" drawings, and certificate of completion in accordance with approved plans and specifications.

Stat. Auth.: ORS 540.350 - ORS 540.400

Stats. Implemented: ORS 183, ORS 536 & ORS 540

Hist.: WRD 3, f. & ef. 2-18-77; WRD 12-1986, f. & ef. 10-3-86; WRD 12-1994, f. & cert. ef. 11-7-94

690-020-0039

Enforcement Procedures

The Water Resources Director will maintain a program of inspecting existing hydraulic structures. When any structure is found to be in violation of the terms and conditions of thepermit or certificate or directly threatens life or property, or when any structure is found where lack of maintenance or unauthorized alterations could lead to a direct threat to life or property, the department shall notify the owner in writing of the

violation and the action necessary to bring the structure up to design, operation, or maintenance standards. Failure by the owner to perform the required action may result inproceedings for one or more of the following:

(1) Notice and opportunity for a contested case hearing as provided for in ORS 540.350(5).

(2) Cancellation of the permit.

(3) Posting of the structure to prevent storage or to limit operation until the owner has complied with the requested action required to fulfill conditions of the permit or certificate.

(4) Instituting legal action by the District Attorney or Attorney General to have the facility declared a public nuisance.

(5) Issuance of an order to prevent storage or to breach the embankment as provided for inORS 540.370.

(6) Any other enforcement action permitted by law.

Stat. Auth.: ORS 183 & ORS 540

Stats. Implemented: ORS 183 & ORS 540

Hist.: WRD 12-1986, f. & ef. 10-3-86

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OREGON DEPARTMENT OF WATER RESOURCES
SAFETY OF DAMS

MINIMUM REQUIREMENTS FOR EXAMINATION AND APPROVAL OF PLANS AND SPECIFICATIONS FOR DAM AND RESERVOIR CONSTRUCITON GREATER THAN, OR EQUAL TO, 10 FEET HEIGHT AND 9.2 ACRE-FEET STORAGE (ORS 540.400)

I. Vicinity Map

a. Location of dam and reservoir in relation to township, range and quarter-quarter section, together with a survey tie from the dam to a known government land corner.
b. Watershed map that delineates the drainage area above the dam with tabulated area extent.
c. Access roads, land features, population centers.

II. Contour Map of Dam and Reservoir (Include Excavation)

a. Plan of dam and reservoir area on 2-foot maximum intervals.
b. Include area-capacity curve or stage-storage table.
c. Show locations of outlet and spillway by station; if applicable, also show location of toe drains, log boom, fish by-pass, and instrumentation.
d. Borrow area or quarries, utilities and property lines.
e. Location of foundation investigations (borings, test pits, trenches, etc).

III. Profile on Centerline of Dam

a. Existing ground surface and thickness of strippings.
b. Approximate grade one of cutoff trench.
c. Type of foundation materials
d. Crest elevation of dam, plus camber.
e. Locations of outlet conduit, emergency spillway, toe drains, and fish by-pass, if applicable.

IV. Cross Section of Dam at Maximum Section

a. Upstream and downstream slopes.
b. Dam crest and base elevations.
c. Dam crest and base widths.
d. Spillway crest elevation.
e. Pre-existing or natural ground surface.
f. Cutoff trench showing depth, width, side slopes.
g. Elevation of normal water surface.
h. Elevation of maximum water surface at design flood.
i. Foundation materials and interior zoning or filters.
j. Erosion control for upstream and downstream slopes.
k. Invert elevations of outlet conduit, toes drains, etc.

IV. Profile of Emergency Spillway

a. Profile of existing ground on centerline.
b. Profile of proposed grade on centerline.
c. Crest and base elevation, and elevation at all stations where channel dimensions change.

V. Cross Section of Emergency Spillway

a. Natural ground line and proposed grade line at all stations where channel dimensions change.
b. Depth, width and side slopes at all stations where channel dimensions change.
c. Erosion control features (riprap, concrete, etc.).
d. Detail illustration of flow control mechanism (flashboards, gates, fuseplug, etc.).

VI. Outlet Conduit or Primary Spillway

a. Cross section showing size and type.
b. Longitudinal section showing location of cutoff collars.
c. Drawdown curve or flow rating information.

VII. Outlet Works Detail

a. Detail of gates or valves; if manufactured list name, model and serial number.
b. Detail illustration of trash rack and fish screen.
c. Detail illustration of anchor, pedestals, stem, and lift.

VIII. Technical Data

a. All elevations referenced to established benchmark.
b. Hydrologic report or calculations verifying adequacy of emergency spillway for design flood (100-year minimum).
c. Geotechnical report or summary of foundation investigation to include geology, boring logs, laboratory test results, stability analysis or other design report, if applicable.
d. Complete set of specifications or bid package.
e. Operations and maintenance manual.

IX. Emergency Action Plan (High Hazard Structures Only)

a. Inundation map illustrating sudden failure conditions for sunny day and worst case (storm) scenarios.
b. Notification flowchart.
c. Warning systems.
d. Evacuation procedures.

APPENDIX VIII SITE PROPOSAL CALCULATIONS and MAPS

(prepared by CoP/CTUIR for preliminary study)

CoP/CTUIR Joint Water Project

Goad Road Site Proposal

Assumptions for use of existing facilities (ie - CoP gravity line):

1) Well 7 is will be utilized by both communties at 100 AF each.
2) 10-inch intertie cost is shared by both communities 50/50 (CoP will receive Well 7 water through intertie).
3) WTP/Intake cost is shared by % capacity basis:
   a) CoP purchasing 4.5 mgd (90%)
   b) CTUIR purchasing 0.5 mgd (10%)
   c) 1 mgd backwash unit purchased on 90/10 basis (Total delivered water @ 5.4 mgd: CoP @ 4.81 mgd & CTUIR @ 0.54 mgd).
4) Flow assumptions are based on 5 feet/second velocity (conservative estimate).
5) Existing gravity line will be utilized east of WTP for raw water.
6) Raw water delivery line cost is shared by % stored basis:
   a) CoP to store 3,000 acre-ft (75%)
   b) CTUIR to store 1,000 acre-ft (25%)
7) Upgrade for sections of finished delivery line from WTP to CoP is not considered.

Present Construction Considerations:	Capacity (mgd)	Piping Length (LF)	Unit Cost	Total Cost	CoP & CTUIR Cost %	CoP Cost	CTUIR Cost
WTP w/5 mgd capacity and 1 mgd backwash	5.4		$7.5 m	$7,500,000	90/10	$6,750,000	$750,000
Intake structure and pump gallery	32.0		$0.5 m	$500,000	90/10	$450,000	$50,000
24" raw delivery line - Intake/WTP	10.0	2,500	$100/LF	$250,000	90/10	$225,000	$25,000
42" raw delivery line upgrade - Intake/WTP	32.0	2,500	$35/LF	$87,500	75/25	$65,625	$21,875
42" raw delivery line - WTP/CoP Gravity Line	32.0	1,000	$135/LF	$135,000	75/25	$101,250	$33,750
24" finished delivery line - WTP/CoP Gravity Line	10.2	1,000	$100/LF	$100,000	100/0	$100,000	
16" finished delivery line - WTP/common point	4.6	2,000	$40/LF	$80,000	50/50	$40,000	$40,000
12" finished delivery line - common point/CoP	2.5	1,200	$25/LF	$30,000	100/0	$30,000	
10" finished delivery line - common point/CTUIR	1.8	17,800	$18/LF	$320,400	50/50	$160,200	$160,200
6" finished delivery line - Well 7/CTUIR 16" main	0.6	4,800	$14/LF	$67,200	50/50	$33,600	$33,600
BP Station & appurtances for two direction flow - intertie line	0.5		$0.1 m	$100,000	10/90	$10,000	$90,000
Spring property - 127 to 176.5 acres							
Total				$9,170,100		$7,965,675	$1,204,425

Future Exansion Considerations:				
30" raw delivery line parallel to existing gravity: additional	16			
West Patawa Site - raw delivery would have total capacity of 32 mgd		7,000	$115/LF	$805,000
East Patawa Site - raw delivery would have total capacity of 32 mgd		11,000	$115/LF	$1,265,000
24" finished delivery line parallel to existing WTP/CoP delivery line:	10.2	5,500	$100/LF	$550,000

CoP/CTUIR Joint Water Project

Reservation Site Proposal - Option A - West Patawa

Assumptions for use of existing facilities (ie - CoP gravity line):

1) Well 7 is will be utilized by both communties at 100 AF each.
2) 10-inch finished delivery line will convey Well 7 water to CoP.
3) WTP/Intake cost is shared by % capacity basis:
   a) CoP purchasing 4.5 mgd (90%)
   b) CTUIR purchasing 0.5 mgd (10%)
   c) 1 mgd backwash unit purchased on 90/10 basis (Total delivered water @ 5.4 mgd: CoP @ 4.81 mgd & CTUIR @ 0.54 mgd).
4) Flow assumptions are based on 5 feet/second velocity (conservative estimate).
5) Existing gravity line will be utilized east of WTP for raw water.
6) Raw water delivery line cost is shared by % stored basis:
   a) CoP to store 3,000 acre-ft (75%)
   b) CTUIR to store 1,000 acre-ft (25%)
7) Upgrade for sections of existing finished delivery line from WTP to CoP is not considered.

Present Construction Considerations:	Capacity (mgd)	Piping Length (LF)	Unit Cost	Total Cost	CoP & CTUIR Cost %	CoP Cost	CTUIR Cost
WTP w/5 mgd capacity and 1 mgd backwash	5.4		$7.5 m	$7,500,000	90/10	$6,750,000	$750,000
Intake structure and pump gallery	32.0		$0.5 m	$500,000	90/10	$450,000	$50,000
24" raw delivery line - Intake to existing Gravity Line	10.0	8,000	$100/LF	$800,000	90/10	$720,000	$80,000
42" raw delivery line upgrade - Intake to existing Gravity Line	32.0	8,000	$35/LF	$280,000	75/25	$210,000	$70,000
42" raw delivery line - replace Gravity Line to 30" section	32.0	5,500	$135/LF	$742,500	75/25	$556,900	$185,600
30" finished delivery line - WTP/Gravity Line	16.0	500	$115/LF	$57,500	100/0	$57,500	
10" finished delivery line - WTP/CTUIR	1.8	14,500	$18/LF	$261,000	50/50	$130,500	$130,500
6" finished delivery line - Well 7/CTUIR 16" main	0.6	4,800	$14/LF	$67,200	50/50	$33,600	$33,600
Spring property - 127 to 176.5 acres							
Total				$10,208,200		$8,908,500	$1,299,700

Future Exansion Considerations:				
30" raw delivery line parallel to existing 30" gravity line: additional	16	8,500	$115/LF	$977,500
24" finished delivery line parallel to existing 24" CoP delivery line: Note: existing 24" capacity @ 10.2 mgd	10.2	8,000	$100/LF	$800,000

CoP/CTUIR Joint Water Project

Reservation Site Proposal - Option B - Shallow Impound @ Nagle Property

Assumptions for use of existing facilities (ie - CoP gravity line):

1) Well 7 is will be utilized by both communties at 100 AF each.
2) 10-inch finished delivery line will convey Well 7 water to CoP.
3) WTP/Intake cost is shared by % capacity basis:
   a) CoP purchasing 4.5 mgd (90%)
   b) CTUIR purchasing 0.5 mgd (10%)
   c) 1 mgd backwash unit purchased on 90/10 basis (Total delivered water @ 5.4 mgd: CoP @ 4.81 mgd & CTUIR @ 0.54 mgd).
4) Flow assumptions are based on 5 feet/second velocity (conservative estimate).
5) Existing gravity line will be utilized east of WTP for raw water.
6) Raw water delivery line cost is shared by % stored basis:
   a) CoP to store 3,000 acre-ft (75%)
   b) CTUIR to store 1,000 acre-ft (25%)
7) Upgrade for sections of existing finished delivery line from WTP to CoP is not considered.

Present Construction Considerations:	Capacity (mgd)	Piping Length (LF)	Unit Cost	Total Cost	CoP & CTUIR Cost %	CoP Cost	CTUIR Cost
WTP w/5 mgd capacity and 1 mgd backwash	5.4		$7.5 m	$7,500,000	90/10	$6,750,000	$750,000
Intake structure and pump gallery	32.0		$0.5 m	$500,000	90/10	$450,000	$50,000
24" raw delivery line - Intake to existing Gravity Line	10.0	8,000	$100/LF	$800,000	90/10	$720,000	$80,000
42" raw delivery line upgrade - Intake to existing Gravity Line	32.0	8,000	$35/LF	$280,000	75/25	$210,000	$70,000
42" raw delivery line - replace Gravity Line to 30" section	32.0	3,000	$135/LF	$405,000	75/25	$303,750	$101,250
30" finished delivery line - WTP/existing 30" Gravity Line	16.0	2,500	$115/LF	$287,500	100/0	$287,500	
10" finished delivery line - WTP/CTUIR	1.8	4,500	$18/LF	$81,000	50/50	$40,500	$40,500
6" finished delivery line - Well 7/CTUIR 16" main	0.6	4,800	$14/LF	$67,200	50/50	$33,600	$33,600
Spring property - 127 to 176.5 acres							
Total				$9,920,700		$8,795,350	$1,125,350

Future Exansion Considerations:				
30" raw delivery line to West Patawa site:	16	8,500	$115/LF	$977,500
30" raw delivery line to East Patawa site:	16	5,500	$115/LF	$632,500
24" finished delivery line parallel to existing 24" CoP delivery line:	10.2	8,000	$100/LF	$800,000
Note: existing 24" capacity @ 10.2 mgd				

CoP/CTUIR Joint Water Project

Reservation Site Proposal - CTUIR WTP Option

Assumptions for use of existing facilities (ie - CoP gravity line):

1) Well 7 use by CoP is not addressed. *
2) CTUIR has its own intake at Hwy 331 bridge.
3) CoP/CTUIR intake & raw water delivery cost is shared by % capacity basis:
   a) CoP storing 3,000 acre-ft (75%)
   b) CTUIR storing 1,000 acre-ft (25%)
3) Flow assumptions are based on 5 feet/second velocity (conservative estimate).
4) Existing gravity line will be utilized east of CoP WTP for raw water.

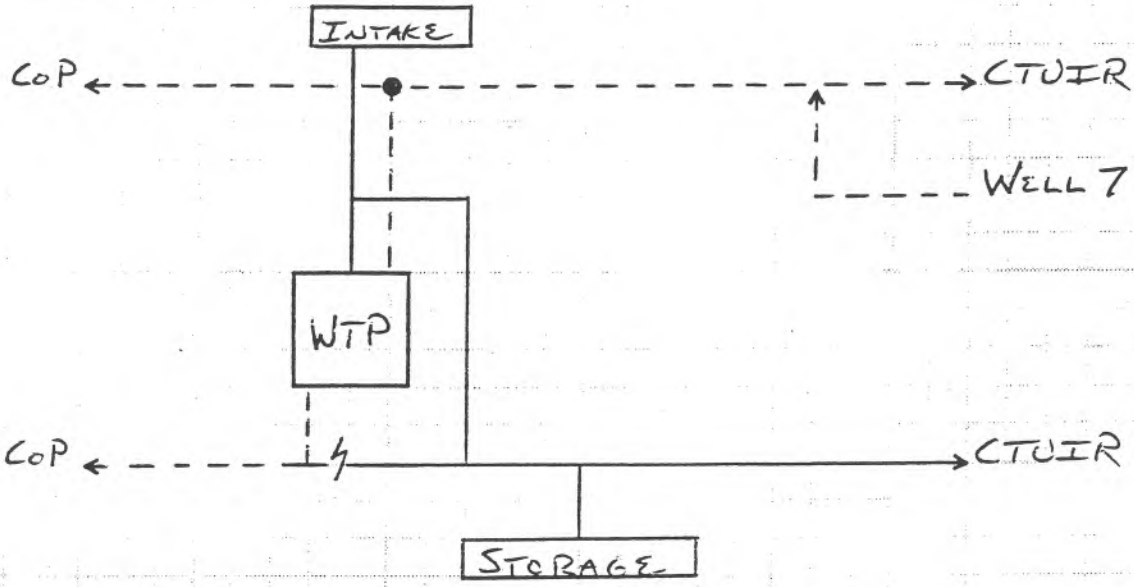
Present Construction Considerations:	Capacity (mgd)	Piping Length (LF)	Unit Cost	Total Cost	CoP & CTUIR Cost %	CoP Cost	CTUIR Cost
CTUIR WTP w/0.5 mgd capacity **	0.5		$0.8 m	$800,000	0/100		$800,000
Intake structure and pump gallary	1.0		$0.1 m	$100,000	0/100		$100,000
10" raw delivery line - Intake/WTP		1500	$18/LF	$27,000	0/100		$27,000
CoP WTP w/4 mgd capacity and 1 mgd backwash	4.4		$6.5 m	$6,500,000	100/0	$6,500,000	
Intake structure and pump gallary	32.0		$0.5m	$500,000	75/25	$375,000	$125,000
42" raw delivery line - Intake/WTP	32.0	2,500	$135/LF	$337,500	75/25	$253,100	$84,400
42" raw delivery line - WTP/CoP Gravity Line	32.0	1,000	$135/LF	$135,000	75/25	$101,200	$33,800
24" finished delivery line - WTP/CoP Gravity Line	10.2	1,000	$100/LF	$100,000	100/0	$100,000	
Spring property - 127 to 176.5 acres							
Total				$8,499,500		$7,329,300	$1,170,200

NOTES:

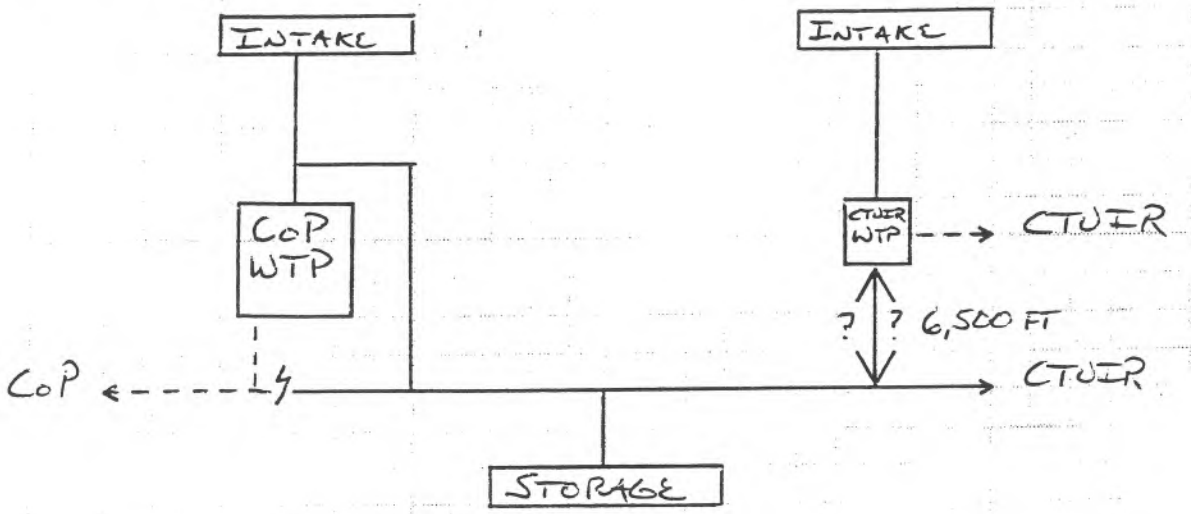
* Well 7 has potential to be delivered to the CoP through the gravity line until raw water is brought to the CTUIR resort area. Then delivery of well water to the CoP would have to be addressed in a different manner.

** The CTUIR WTP facility would be designed to be expandable to 1.0 mgd capacity. The CoP WTP is designed to be expandable to 10 mgd.

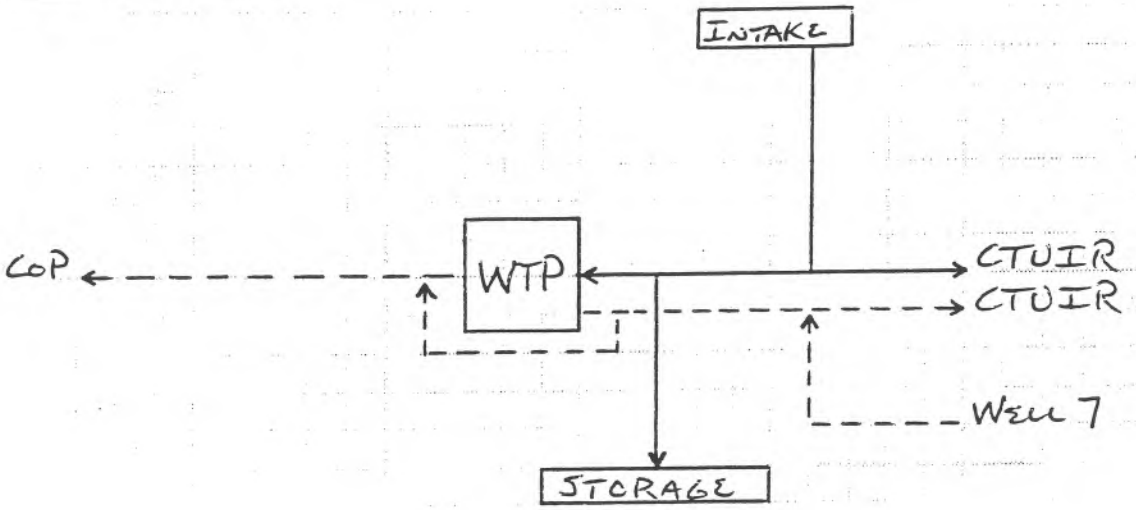
GOAD SITE



CTUIR WTP / CoP WTP



RESERVATION SITE



CoP/CTUIR Joint Water Project

Goad Road Site Proposal

Intake Site

WTP Site

Intertie Water Line

Intertie Water Line

CoP Gravity Line (existing)

CoP Gravity Line (existing)

Existing Intertie

CoP Well 7

Resort Area
Golf Course
West Lake

West Patawa Impound

Base		1,260 elev.
1,000 AF	325 MG	1,325 elev.
4,000 AF	1,300 MG	1,365 elev.
4,700 AF	1,530 MG	1,370 elev.

East Patawa Impound

Base		1,290 elev.
1,000 AF	325 MG	1,360 elev.
3,000 AF	978 MG	1,370 elev.

Shallow Impound

500 AF	163 MG	12.5 acres @ 40 ft depth
1,000 AF	325 MG	25 acres @ 40 ft depth
4,000 AF	1,300 MG	67 acres @ 60 ft depth

CoP/CTUIR Joint Water Project

Reservation Site Proposal:

A) WTP @ West Patawa Impound Site

B) WTP @ Shallow Impound Site on Nagle Property

Intake Site

WTP Site A

WTP Site B

CoP Gravity Line (existing)

CoP Gravity Line (existing)

CoP Well

Existing Intertie

Resort Area
Golf Course
West Lake

West Patawa Impound

Base		1,260 elev.
1,000 AF	325 MG	1,325 elev.
4,000 AF	1,300 MG	1,365 elev.
4,700 AF	1,530 MG	1,370 elev.

East Patawa Impound

Base		1,290 elev.
1,000 AF	325 MG	1,360 elev.
3,000 AF	978 MG	1,370 elev.

Shallow Impound

500 AF	163 MG	12.5 acres @ 40 ft depth
1,000 AF	325 MG	25 acres @ 40 ft depth
4,000 AF	1,300 MG	67 acres @ 60 ft depth

CTUIR Water Treatment Plant

Hwy 331, North of Mission Intersection

Intake Site

WTP Site

APPENDIX IX INTERGOVERNMENTAL AGREEMENT – CONSULTANT'S SCOPE OF WORK (ATTACHMENT A)

INTERGOVERNMENTAL AGREEMENT

The City of Pendleton (City) and the Confederated Tribes of the Umatilla Indian Reservation (Tribes) agree as follows:

1. The Tribes shall contract with a consultant to deliver the product (the Study) detailed in Attachment A, Consultant's Scope of Work.

2. The Tribes and the City shall use their best efforts to insure that the Consultant delivers the verification of portion of the Study (paragraphs 11, 19, 20, 21, and 22) by March 1, 1999, and the final Study to the Tribes and the City no later than April 30, 1999.

3. The City shall pay to the Tribes in a timely manner, upon delivery of invoice(s), no more than $19,500 total.

4. The Tribes shall pay the Consultant no more than $39,000 for the Study.

5. If the Consultant agrees to complete the Study for less than $39,000, the Tribes and the City shall each pay fifty percent of the total costs of the Study.

6. If the Study reveals economic or engineering advantages to placement of a joint treatment plant at a site other than South Hill/Goad Road, Pendleton, the Tribes and the City shall meet to determine the need for and scope of a more detailed and comprehensive study of treatment plant location.

7. The City and the Tribes shall have full access to all information and materials used by the Consultant in completing the Study, and shall inform each other in a timely manner of any information or materials they provide to the Consultant.

8. The City and the Tribes may terminate this Agreement at any time, for any reason, without prejudice to any obligations or liabilities of either party already accrued prior to such termination.

9. The Tribes and the City may amend any terms of this Agreement, including any or all Attachments, at any time by mutual consent. Such amendment(s) shall be in writing and shall be signed by both parties prior to such amendment(s)becoming effective.

10. Any reports, information or data given to or prepared or assembled by the City and Tribes under this Agreement which the either the Tribes or City request to be kept confidential shall not be made available to any individual or organization by the City or Tribes or by any Consultant retained under this Agreement unless required to under public records laws.

11. All work, reports, data, plans and other materials assembled or created by any Consultant under this Agreement shall be the exclusive joint property of the Tribes and

the City. The City or Tribes shall obtain the other party's consent before attempting to publish, disclose, distribute, and otherwise use, in whole or part, any work, reports, data, plans, or materials prepared by the Consultant under this Agreement.

12. Contractor shall assume all responsibility for the acts, errors or omissions of itself and its agents hereunder and shall indemnify and hold harmless the CTUIR from and against all damages, liability, claims, expenses, including reasonable attorney's fees, and causes of action that may arise in whole or part out of or result from its acts, errors or omissions and those of its agents and others for whose acts it may be liable for activities related to this Agreement.

13. The City and Tribes shall not attempt to hold the other responsible for the negligent or intentional acts or omissions of its own employees, officers, subcontractors, or agents under this Agreement. Neither party is required to indemnify or defend the other for any liability arising out of the wrongful action of its employees or agents.

Antone Minthorn, Chair, Board of Trustees
Confederated Tribes of the Umatilla Indian Reservation

Date

Larry Lehman, City Manager
City of Pendleton

2/16/99
Date

ATTACHMENT A

CONSULTANT'S SCOPE OF WORK

The Tribes shall contract with the Consultant to deliver the Study which shall examine the following:

1) the estimated costs of construction for a water supply impoundment, at specified sites, including delivery systems to and from the City's gravity water transmission line, in order to provide specific quantities of water at set qualities and temperatures; and

2) whether the most economical location of a joint treatment plant, intake and delivery system is on the south hill in Pendleton based on certain criteria and specific assumptions detailed below in comparison to a treatment plant located just west of a proposed impound site on the Reservation. See attached "Site Proposal" calculations and maps.

3) the costs to the Tribes' alone of developing a separate treatment plant and intake for Tribal use only for treated water delivery and for raw water delivery of 1000 acre-feet to the Nagle impound site. See the attached "Site Proposal" calculations and maps.

Basic Parameters.

1. The water source will be the Umatilla River high flows.

2. Refer to the information provided in the W&H Pacific Feasibility Report of August 1996 and the Wallulis City Master Water Plan of May 1995.

3. The analysis will be based upon the CTUIR and the City providing available data on the water quality of the Umatilla River for study.

4. The scope of this Study does not include soil sampling, data gathering or laboratory analysis. If data is unavailable for some water quality parameters, Consultant shall make assumptions based on the best evidence available.

5. Use existing piping to the degree possible, including the delivery pipe for the City's on-reservation spring water supply.

6. The impoundment sites are a) West Patawa, b) East Patawa, and c) Nagle.

   a. The West Patawa Site shall be analyzed to provide a useable storage of impounded water at 1) 1000 acre-feet, and 2) a maximum size for the site based on existing topography.

b. The East Patawa Site shall be analyzed to provide a useable storage of impounded water at 1) 1000 acre-feet, and 2) a maximum size for the site based on existing topography.

c. The Nagle Site shall be analyzed to provide a useable storage of impounded water at 1) 500 acre-feet, 2) 1000 acre-feet, and 3) 4000 acre-feet.

7. Water quality issues to be investigated for the impoundment sites should include, but not be limited to, temperature, algae growth, turbidity, total organic carbon, siltation, and evaporation in relation to the depth of the site.

8. Amount of treated water to be delivered to the City from the Treatment plant is 5 mgd, and to the Tribes is 0.5 mgd.

9. The specific impacts of aerial spraying and impacts of particulate matter from traffic on I-84 are beyond the scope of this study. However, some general observations may be made.

10. Use the attached "Site Proposal" calculations and maps drafted by City and Tribal staff as the beginning basis for review.

Impoundments

11. Address the limits to water quantity and rate of pumping imposed by a 30 inch, 36 inch and 42 inch diameter pipeline in order to fill the impounds and calculate the reasonable maximum rate of flow through the above referenced pipe sizes.

12. Determine the relationship of stored Umatilla River water quality related to the depth of the impoundment and associated water surface area. The Consultant shall make recommendations on the depth and surface area of such an impoundment relative to water quality for a municipal water supply.

13. Estimate the costs of construction, maintenance and operation of the selected impoundment sites, including costs of delivery system to and from the gravity line. Address costs issues involving dam regulations for both construction and maintenance.

14. Estimate the costs of providing treated water to the Tribes and the City under each impoundment scenario.

15. Estimate the costs of providing raw water to the Tribes' golf course under each impoundment scenario.

16. Determine ability to expand, if necessary, the capacity of the facility to meet long-term municipal needs of the City and the Tribes, including costs of later expansion by increasing the height of the dam or berm.

17. Verify the maximum storage capacity that is economically available from all impound sites.

Treatment Plant

18. Estimate the cost of a treatment plant, intake and develivery system, including the most economical intake location, located near Mission Market, sized to deliver 0.5 mgd of treated water to the Tribes only and 1000 acre-feet of raw water to the Nagle impound site.

19. Verify the calculated costs of the joint treatment plant, intake and delivery systems. See attached "Site Proposal" calculations and maps. Determine if any advantages to siting treatment plant in vicinity of intake.

20. Address the assumptions underlying the "Site Proposal" calculations and maps, verifying and providing comments.

21. Comment briefly on the location of the treatment plant in relationship to potential future use of McKay Reservoir water and future development of an artificial storage and recovery project.

22. Comment on advantages and disadvantages of a treated water intertie along Mission Highway between the City and Tribes' water systems.

23. Prepare three schematic diagrams showing the impoundment site, treatment plant site, intake site, pipelines including the intertie where appropriate, for each of the following:

a) a schematic showing both intake sites, all three treatment plant sites, and all three impound sites and the delivery systems, including the intertie;

b) a schematic showing the intake/treatment plant at the most economical location and all three impound sites with delivery systems, including the intertie; and

c) a schematic showing the intake/treatment plant at Mission for a tribal system only, with delivery to the Nagel impound site from the Mission intake site, but with no intertie.