Demonstration Project for

Callahan Water District

Treatment Plant Engineer's Report

Technical Assistance for Disadvantaged Water and Wastewater Providers

North Coast Resource Partnership

California Department of Water Resources

December 2014

North Coast Resource Partnership
California Department of Water Resources

Technical Assistance for Disadvantaged Water and Wastewater Providers

Demonstration Project for the

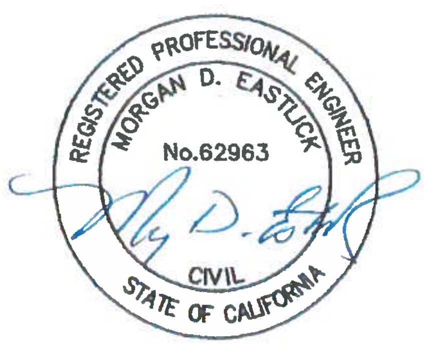
Callahan Water District

October, 2014

Prepared by:

E & S Engineers & Surveyors, Inc.

Dba: Bray & Associates Civil Engineering & Land Surveying
329 West Miner Street
Yreka, CA 96097



Author	Review by Author's Firm	Review by GHD	GHD Project Director Approval
Morgan D. Eastlick	Brian L. Smith	P. Rogers	R. Crow

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1. Introduction

The Callahan Water District (District) owns and operates a small water system No. 4700503 serving the community of Callahan located in rural Siskiyou County, California. The system has 35 active connections and serves a population of approximately 70. The system is supplied by surface water from nearby Boulder Creek. The raw water is directed into a supply pipeline from the intake at Boulder Creek some two and a half miles away from the treatment facility. Raw water is conveyed through a buried steel pipeline that was constructed in the 1930's when the system was initially constructed. The supply pipeline consists of the approximately 500 lineal feet of 6" and 6,700 lineal feet of 4" to the McKeen Divide. The supply line is then reduced to 2" diameter at McKeen Divide and consists of 5,600 lineal feet of 2" pipe followed by 400 lineal feet of 4" diameter pipe to where it enters the treatment facility.

The District location is presented in Figure 1. The District's treatment facility was installed in 1984. Funding for the treatment facility was made possible through a grant from State of California Department of Water Resources under the Safe Drinking Water Bond Act of 1976 and a private loan. The treatment facility is an In-Line Filtration Plant in which the water supply enters the treatment building after passing through a pressure reducing valve which reduces pressure to at or below 100 psi for protection of the treatment equipment. Raw water is injected with polymer to aid the filtration process through flocculation, followed by chlorine injection for disinfection. The water is then filtered through two self-contained vertical filters located inside the wood framed 16' x 18' treatment building. The filters are pressure sand filters packed with graded layered media to remove turbidity or particulate matter from the raw water. Treated water in excess of user demands is directed to storage reservoirs for use in the filter backwash process as well as storage for the system.

The system distribution is served by a 2" steel line which conveys the treated water to users in the community. The users are currently charged a flat rate for water service which is currently set at $35 per month.

1.1 Purpose of this report

The purpose of this engineer's report is to evaluate alternatives to bring the District's surface water treatment plant into compliance with current State of California standards. In addition, this report, where appropriate assists the District in determining future goals, and helps demonstrates the use of the Small Community Toolbox, developed for assisting small districts manage their systems. The Small Community Toolbox can be downloaded from the North Coast Resource Partnerships' website.

1.2 Scope and limitations

The Callahan Water District report was initiated in response to a letter sent out by California Department of Public Health (CDPH, now State Water Recourses Control Board Division of Drinking Water) Klamath District Engineer, Tony Wiedemann, P.E. entitled In-Line Filtration Plants and Revised Surface Water Treatment Regulations (See Appendix A). The letter outlined that the State of California adopted the EPA's Long Term 1 and 2 Enhanced Surface Water Treatment Rules which became effective July 1, 2013. The new rules adopted do not allow for the use of In-Line Filtration plants like Callahan's to continue to operate because of the reduced turbidity standards that were adopted. The letter outlines three different options to comply with the new regulations. This report addresses the three options laid out by the state, outlines recommendations for a project that will bring the system into compliance, and makes recommendations for future planning to assist the district in evaluating and maintaining their system.

This report: has been prepared by Bray & Associates Civil Engineering & Land Surveying and reviewed by GHD for the North Coast Resource Partnership. The Callahan Water District has signed a participation agreement relating to the demonstration project that is the subject of this report. It should be emphasized that this report is to be used as an example of how tools and processes can be used to help further infrastructure improvement projects for a variety of communities throughout the North Coast region. Further planning, analysis, engineering, and permitting may be required.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. This report has been prepared based on information provided by others, which has not been independently verified or checked.

Any cost estimates presented in this report or through related Toolbox elements are for conceptual purposes only. Actual prices, costs and other variables may be different at the time of the actual project and thus, project costs may change. Actual costs will depend on final project configuration and requirements. There is no warranty or guarantee that the project as currently conceived can or will be undertaken at a cost which is the same or less than costs that may be inferred from this report.

1.3 Assumptions

It is assumed that the Callahan Water District has water from Boulder Creek available for use by the District. This assumption is based on the history of the system. The District has been using water from Boulder Creek since its inception without the absence of adequate flows from Boulder Creek.

It is also assumed that well water is not a viable option for water supply for the district. This assumption is based on the fact that two previous attempts were made to drill for well water to service the district and water was not found on either attempt.

U.S. Highway
Major Road
Local Roads
Stream
River

Paper Size 8.5" x 11" (ANSI A)
0 500 1,000 1,500 2,000
Feet
Map Projection: Mercator Auxiliary Sphere
Horizontal Datum: WGS 1984
Grid: WGS 1984 Web Mercator Auxiliary Sphere

N

GHD

Callahan Water District
Technical Assistance

Job Number	8410996
Revision	A
Date	25 Jul 2014

Vicinity Map

Figure 1

718 Third Street Eureka CA 95501 USA T 707 443 8326 F 707 444 8330 E eureka@ghd.com W www.ghd.com

\\ekasvr3\projects\01081 HumboldtCounty DPW\8410996 NCRP Water-WW Assistance\08-GIS\Maps\Figures\F1_Vicinity_Callahan_WD.mxd

Data source: ESRI Street Map; NAIP aerial 1m. Created by:porogers

2. Use of the Small Community Toolbox

This Small Community Toolbox provides resources and references that allow small communities to approach the management of local water and wastewater infrastructure in a systematic fashion. The Toolbox is not a substitute for professional assistance with operations, management, engineering and legal issues. Rather it is intended to help small utilities develop a “first order” understanding of what their options are, how they should begin to budget, and how to get help.

The Small Community Toolbox is organized around the concept of the Utility Management Cycle illustrated in Figure 1.

Figure 2.1: Utility Management Cycle

Individual tools have been prepared for each of the elements of the Utility Management Cycle which are summarized in Table 2.1

Table 2.1: Small Community Toolbox Elements

Utility Management Cycle Element	Toolbox Element	What it is and How it can be Used
Utility Management Cycle Element 1: *Organize and Plan for Success*	1.1: Community Networking Directory:	A contacts database of willing participants interested in collaboration for advice and assistance.
	1.2: Governance Summaries:	An overview of options, benefits, and steps required to form various types of service entities.
	1.3: GIS Layers:	Census, legislative, and other public data to help agencies access information needed for applications.
Utility Management Cycle Element 2: *Match Needs to Economical Technologies*	2.1: Technology Overviews:	Overviews of common issues, technologies, and evaluation factors to help select alternatives.
	2.2: General Cost Estimating Charts:	Cost estimating charts to help develop order of magnitude estimates for various types and sizes of infrastructure to begin scoping overall funding strategies.
Utility Management Cycle Element 3: *Create Viable Financing Strategies*	3.1: Funding Program Summaries:	A one-stop information shop about funding programs suited to small community infrastructure projects.
	3.2: Capital Recovery Tables:	Lookup tables to translate the portion of total project costs not paid by grant into annual debt service requirements met through a revenue mechanism.
	3.3: Financing District Summaries:	Summary of strategy options for generating revenue to pay the annual debt service.
	3.4: Cash Flow Considerations:	Assists entities in understanding the funds needed to move a project through planning, design, and construction
Utility Management Cycle Element 4: *Prepare Preliminary Design, Studies, and Applications*	4.1: Consolidated Preliminary Engineering Report Template:	Consolidated report outline, with model tables that will meet the needs commonly used funding programs.
	4.2: CEQA/NEPA Exemptions and Checklists:	Summary of CEQA/NEPA exemptions and checklists to aid in meeting State and Federal environmental requirements and funding program requirements.
	4.3: Common Permit Triggers:	Summary chart of typical project components that often trigger different types of permits.
Utility Management Cycle Element 5: *Complete Final Design and Construction*	5.1: Guidance for Hiring Professionals:	As a project moves from initial planning towards implementation, detailed, community-specific designs are required and communities will need to retain professional support.
	5.2: Public Bidding Process Overview:	Understanding how the public bidding process works, how to set up a successful project bid, and how the low bid contractor is selected
Utility Management Cycle Element 6: *Operate and Manage System*	6.1: Technical, Managerial, and Financial (TMF) Resources:	Tools to help agencies be organized and managed to improve overall operations and funding competitiveness.
	6.2: Regulatory Resources:	Sources to provide information to the utility operator on various federal and state regulations.
	6.3: Rate Setting Guidance:	Linking the costs of projects to the need to rate increases and methods to set and change rates
	6.4: Capital Improvement Planning Resources:	Part of the on-going Utility Management Cycle of planning for future system improvements

The Small Community Tool Box was used a few times for this report and it is expected that as the Callahan Water District moves forward with meeting these new SWT regulations the tool box will be used to further their project. The Small Community Toolbox summaries should be referenced for additional information regarding the tools and their use. It is anticipated that this tool box will be a helpful tool to many service districts in the future as they maintain and upgrade their water and wastewater systems.

3. Treatment Plant Evaluation

As stated earlier in the report, the CDPH letter requires that the District evaluate their treatment facility with respect to the newly adopted surface drinking water standards. CDPH outlines three options for bringing the plant into compliance as follows:

Option 1:	Demonstrate that the existing plant can comply with the new regulations
Option 2:	Upgrade the existing in-line filter plant by adding a flocculation step upstream of the plant
Option 3:	Replace the existing filter plant with an approved filtration technology

3.1 Demonstration Study for the Existing Filtration Plant

This option would require a demonstration study to show that the existing treatment plant can comply with the new regulations without any upgrades. The demonstration study would include continuous turbidity monitoring of the combined filter effluent from the plant. Recorded turbidity from the filtered water would have to meet or be below 0.1 NTU in 95% of the measurements each month in accordance with the State's Cryptosporidium Action Plan. If successful the District's permit would be amended to a lower more strict level of performance. Additionally a particle study may have to be done for the plant, demonstrating that the filter plant can achieve 99% reduction of particles in the Cryptosporidium size range of two to five microns. The monitoring would have to be done through various seasons and weather changes over a 12 month period. Incoming and outgoing water would have to be tested to record the particle reduction through the plant.

Initially, this presents as a good option, however given the requirements, it is very unlikely Callahan's filtration plant will be able to meet these standards. Storm periods tend to increase turbidity and make the turbidity standards impossible to meet with in-line filtration plants. In the event the existing plant did meet these demonstration requirements the plant would be that the District is held to more stringent turbidity limits than those for direct filtration plants.

In short, the District would be spending a lot of time, money and effort to provide the filter plant with a more strict turbidity level than those Districts that went with one of the other options. It is our opinion that this option is not a viable option for the Callahan Water District.

3.2 Upgrade plant through addition of Flocculation Step

Under this option the existing plant would be upgraded to meet direct filtration requirements. The Callahan Water Treatment Plant is an In-Line filtration plant where coagulants are added in line just ahead of the pressure sand filters. Particulates are then filtered out in the pressurized sand filters. When coagulants are introduced this close to the filter process there is limited mixing that occurs and very limited detention time for the flocculation process to occur prior to filtration. This plant could be upgraded from an In-Line Filtration plant to a Direct Filtration Plant by adding the flocculation step.

In order to add a flocculation step to the existing plant we must be able to inject the chemical further upstream of the filters. There are a couple of different ways this could be accomplished for the District's plant.

3.2.1 Upgrade plant through addition of a Flocculation Tank

The first of which is to construct a flocculation tank with mixers. This approach would mean the construction of an appropriately sized flocculation tank and mechanical mixers to mix in the coagulant. Not only is this an expensive item to add, but by adding this step the system has to be depressurized. Depressurizing the system at the plant would mean a pump would have to be added back in to pressurize the filters and pump the treated water up to the reservoirs, which also adds capital, electrical and operational expenses.

3.2.2 Upgrade plant through addition of Static Mixer with pipeline flocculation

Another option is to add an appropriately sized static mixer inline ahead of the existing filters. The District had their existing filters recoated and new media installed about seven years ago and indicated that the filters were in relatively good condition. This option would maintain the system pressures while adequately mixing chemicals. However, chemical mixing is just one of the factors involved in the flocculation process. The process also takes contact time in order to "grow" the floc particles. There is approximately 400 lineal feet of 4" diameter pipe ahead of the treatment facility, which equates to about 400 feet x 0.65 Gal/Ft = 260 gallons of storage available in the pipeline for flocculation. The peak flow through the plant is approximately 70 gpm so this would be approximately 4 minutes detention time for the flocculation process. This is a relatively short detention time for flocculation tank type standards, however in this case the static mixer is a very efficient piece of equipment for mixing in chemicals, whereas typical rectangular flocculation basins are not so efficient. The 400 lineal feet of pipe is actually an existing flocculation vessel. The typical standards for Gt for flow through flocculators is 10,000 to 100,000. The Gt value is a measure of molecule collisions occurring in the vessel and is related to the velocity gradient and the Reynolds number of the pipe flow condition. Bray & Associates has performed a calculation for the existing 400 lineal feet of 4" diameter pipe and determined that the Gt value for this section of pipe is approximately 29,500 which is within the acceptable range for flow through flocculation vessels.

Both of these methods would up-grade the plant to a Direct Filtration Plant and bring the plant into compliance with current surface drinking water standards, however the latter is a much more cost effective approach.

3.3 Replace the Water Treatment Plant

Option number three would be to replace the existing treatment plant with a new upgraded filter plant. There are several different filter technologies currently in use for treatment of surface water for drinking water. The EPA published the Small System Compliance Technology List for the Surface Water Treatment Rule for use by small water systems operators and engineers to assist them in the selection of treatment plant options. The listed options available for filters under the Surface Water Treatment Rule SWTR are Conventional Filtration, Direct Filtration, Slow Sand Filtration, and Diatomaceous earth filtration.

- Conventional Filtration

Conventional filtration includes the pre-treatment steps of chemical coagulation, rapid mixing, and flocculation. Floc is then removed by sedimentation or floatation. After clarification the water is then filtered through some sort of media filter.

- Direct Filtration

Direct filtration also includes pre-treatment of chemical coagulation followed by rapid mixing. Direct filtration does not include the clarification step. Pre-treated water is sent directly through a media filter. These types of filtration plants are very cost effective for gravity systems because there are no pumping costs associated with them, however direct filtration systems require low turbidity raw water.

- Slow Sand Filtration

Slow sand filters are simple and easily used by small systems. These filters utilize “shmutzdecke” by biodegradation and other biological processes rather than just relying on simple filtration. The advantage to slow sand filters is that they require less maintenance and backwashing. The operation of the filter is also independent of the operator, however when slow sand filters do require cleaning they also require a “ripening period” in which the plant is to be off line filtering to waste, which generally takes up to two days.

- Diatomaceous Earth Filtration

Diatomaceous earth filters have a layer of DE supported on a filter element. The pre-coat layer is subject to cracking and must be supplemented by continuous-body feed of diatomite to maintain porosity of the filter. Marinating the filter cake can be tricky and has limited the use of these filters.

The filter treatment technologies not listed in the SWTR are membrane processes such as Reverse Osmosis Filtration (RO), Nanofiltration (NF), Ultrafiltration (UF) and Microfiltration (MF). These types of systems require membrane monitoring and alarms in case of membrane failures. Pilot systems maybe required by the State for use of these technologies in order to determine if they are a workable filter option.

The Callahan Water System is a gravity system with adequate pressures to utilize pressure type media filters and still feed backwash storage tanks without the use of any pumps. The operational costs associated with existing system are about as minimal as can be expected for a water system because the only electrical costs are those associated with chemical feeds and testing. This raw water has very low turbidity as well. Both of these system characteristics point toward a direct filtration plant.

As stated earlier a direct filtration plant pre-treats water through the use of chemical injection followed by some form of rapid mixing. The raw water is then sent directly to the filter vessels. Filter effluent is then disinfected and sent to the system distribution system. The existing system already utilizes pressure filters and chemical injection, however the chemical injection occurs right in front of the filters with no intentional mixing effort. Replacing the filter plant with a new direct filtration plant would include replacing existing equipment with new more up to date equipment. In order to make this decision one must evaluate the existing equipment and determine its remaining usable life.

4. Conclusions & Recommendations

4.1 Conclusions

Option 1 – Demonstrating that the existing filter plant will meet the new regulations

This option would be time consuming and costly. There is a very good chance the system would not meet the requirements. If the system did meet the requirements the system would be held to higher standards than if the system were upgraded.

Option 2 – Upgrade the existing In-Line Filtration Plant to a Direct Filtration System

This option is the most cost effective option and existing filter vessels have a decent life expectancy. Tool box Element 2.2 was utilized to prepare a budget range of $50,000 to $75,000 for this option. See Appendix B for a breakdown of this estimate. In this case, a static mixer would be placed in line 400 feet in front of the filter plant. The chemical injection point would be placed in the static mixer and then the 400 lineal feet of raw water supply pipe would become the flow through flocculation vessel for the system.

Option 3 – Replace the filter plant with an approved technology filter plant

This option would be applicable if it was determined that the existing filter vessels are short lived or not a viable technology for new treatment standards. Tool box Element 2.2 was also utilized to prepare a budget range of $400,000 to $600,000 for this option. See Appendix B for a breakdown of this estimate. This estimate was based on the installation cost of the existing treatment plant in 1984 with inflation adjustments based on the Customer Price Index (CPI).

4.2 Recommendations

It is recommended that the Callahan Water District apply for a planning & design grant/loan through the Safe Drinking Water State Revolving Fund (SDWSRF). The planning & design grant/loan would fund a more detailed evaluation of Options 2 and 3 above to select a preferred option, the design of the new or updated direct filter plant (bringing the plant into compliance), rate structure review, necessary system audit requirements, and a list of future recommended capital replacement projects.

5. References

1) S Casey Jones, A.M.ASCE, Fotis Sotiropoulus, M.ASCE, Appiah Amirtharajah F. ASCE. 2002 Journal of Environmental Engineering, May, 2002

2) United States Environmental Protection Agency- Office of Water. 1997 *Small Systems Compliance Technology List for the Surface Treatment Rule.* Publication 815-R-97-002 August, 1997

3) United States Environmental Protection Agency- Office of Water. 2005 *Technologies and Costs Documentation for the Final Long Term 2 Enhanced Surface Water Treatment Rule and Final Stages.* Publication 815-R-05-013 December, 2005

4) United States Environmental Protection Agency- Office of Water. 2004 *Long Term 1 Enhanced Surface Water Treatment Rule Turbidity Provisions Technical Guidance Manual.* Publication 816-R-04-007 August, 2004

Appendices

Appendix A – CDPH Letter - In-Line Filtration Plants and the Revised Surface Water Treatment Regulations

State of California—Health and Human Services Agency
California Department of Public Health

CDPH

RON CHAPMAN, MD, MPH
Director & State Health Officer

EDMUND G. BROWN JR.
Governor

November 15, 2013

Callahan Water District
P.O. Box 1524
Callahan, CA 96014

Attention: Shirley Gilmore, District Secretary

In-Line Filtration Plants and the Revised Surface Water Treatment Regulations

Please be aware that new rules have been adopted that have caused your current surface water filtration plant to be out of compliance. These new rules affect drinking water systems that use *in-line filtration*. *In-line filtration* is a technology in which a coagulant is injected into the raw water supply immediately upstream of the filter(s), without a flocculation process. Our records show your water system uses *in-line filtration*.

As you may know, the State recently adopted EPA's Long Term 1 and 2 Enhanced Surface Water Treatment Rules. They became effective on July 1, 2013, and have been incorporated into the State's Surface Water Treatment Regulations (SWT Regulations). These rules improve public health protection through control of the protozoan Cryptosporidium.

The SWT Regulations specify approved filtration technologies and also allow our Department to approve alternative filtration technologies. *In-line filtration* is not an approved filtration technology. When the original SWT Regulations were adopted in 1991, we were able to grandfather many *in-line filtration* plants as an approved alternative filtration technology as long as they demonstrated that they could meet the same turbidity performance standards (0.5 NTU) as required for direct filtration.

With the new rules, however, the grandfathering of *in-line filtration* plants is not possible. This is because past particle count studies at *in-line filtration* plants indicate that many of these plants cannot provide the required reduction in Cryptosporidium-sized particles, even when they are in compliance with the stricter turbidity standards (0.3 NTU) required by the new rules.

Therefore, you must evaluate your *in-line filtration* plant to determine if it can comply with the new rules or you will need to upgrade to an approved technology, such as, direct filtration. You basically have three options.

3

1. **Demonstrate that your current filtration plant can comply with the new rules by conducting one of the following:**

   - A demonstration study showing that your *in-line filter* plant can achieve an effluent turbidity of 0.1 NTU in 95% of the measurements each month in compliance with the State's Cryptosporidium Action Plan. Continuous turbidity monitoring of the combined filter effluent is required. Your certified operator should conduct the demonstration study. If you believe this performance is possible with your existing filtration facilities, then we encourage you to give it a try. If after a couple of months it is obvious your facilities cannot reliably achieve this, then you can explore other options. If successfully demonstrated, then our office would amend your permit to include the stricter performance criteria. The other performance requirements of the SWTR would remain the same; or ←

   - A particle count study of the filter plant's influent and effluent to demonstrate that it can consistently achieve a 99 percent reduction of particles in the Cryptosporidium size range of two to five microns. The study will also establish a performance standard for effluent turbidity, which would likely be less than the current 0.3 NTU standard for direct filtration but cannot be greater. Sufficient data must be collected to provide a valid statistical analysis and during different seasons to reflect the normal changes in water quality. This study will most likely require the assistance of a civil engineer experienced with water treatment. If you currently have difficulty meeting the 0.3 NTU turbidity performance standard then this option may not be worth your effort. ← CE

   Both studies must be 12 months long to capture all seasons and all expected water quality conditions. A study protocol outlining the methodology to be used to demonstrate compliance must be coordinated with our office. The protocol should include, but not be limited to, descriptions of sampling points, frequency of measurements, and calibration and verification procedures for all instruments used for process control and measurements during the study. ←

   If you chose this option, we recommend you begin your study as soon as possible to take advantage of wet-weather conditions that provide the greatest challenge to the performance of most filtration plants.

2. **Upgrade your plant to a direct filtration plant, which is an approved filtration technology, by adding a flocculation step upstream of the filters.** In general, upgrading to direct filtration is fairly simple. In some cases you may be able to use existing facilities to accomplish this. Some systems with an appropriate diameter and length of raw water pipeline before the filters can practice pipeline flocculation. Other systems have added contact tanks or roughing filters to create a flocculation step. In most cases, the design of the flocculation step will require assistance from a civil engineer experienced with water treatment to ensure that it adheres to acceptable design criteria. The design must be approved by our office before its installation. One advantage to upgrading to direct filtration is that the turbidity performance standard is 0.3 NTU. CE

3. **Replace your filter plant with an approved filtration technology or State approved alternative filtration technology.** If your filter plant is old, deteriorated, and near the end of its useful life, then this may be your best option. This option requires the assistance of a civil engineer. Financial assistance in the form of loans, and possibly grants, may be

available through the Safe Drinking Water State Revolving Fund. Contact our office if you want more information on financial assistance.

Please contact our office by the end of the year with your proposed plan and schedule for achieving compliance with the new rules of the revised SWT Regulations. Your existing filter plant is out of compliance with the SWT Regulations until you either demonstrate compliance with the new rules or upgrade to an approved technology. Feel free to contact any of the engineers at our office to discuss your options.

If you believe our assessment of your filtration technology is in error or if you have recently modified your filter plant to what you believe is an approved filtration technology, please contact our office.

You can get a copy of the current SWT Regulations from the following website address: www.cdph.ca.gov/certlic/drinkingwater/Pages/Lawbook.aspx Then click on the link entitled, Drinking Water-Related Regulations, selecting either the PDF format or WORD format. The SWT Regulations begin at Section 64650 and end at Section 64666. The Cryptosporidium Action Plan may be obtained from the following website address under the heading "Cryptosporidium": http://www.cdph.ca.gov/certlic/drinkingwater/Pages/Publications.aspx ←

If you have any questions, please contact me at (530) 224-4872 or the staff engineer from this office that you have worked with in the past.

Tony Wiedemann

Tony Wiedemann, P.E.
Klamath District Engineer
DRINKING WATER FIELD
OPERATIONS BRANCH

System No. 4700503

Appendix B – Project Cost Estimates

Callahan Water District - Existing Plant Upgrade

Major Equipment and Construction Items

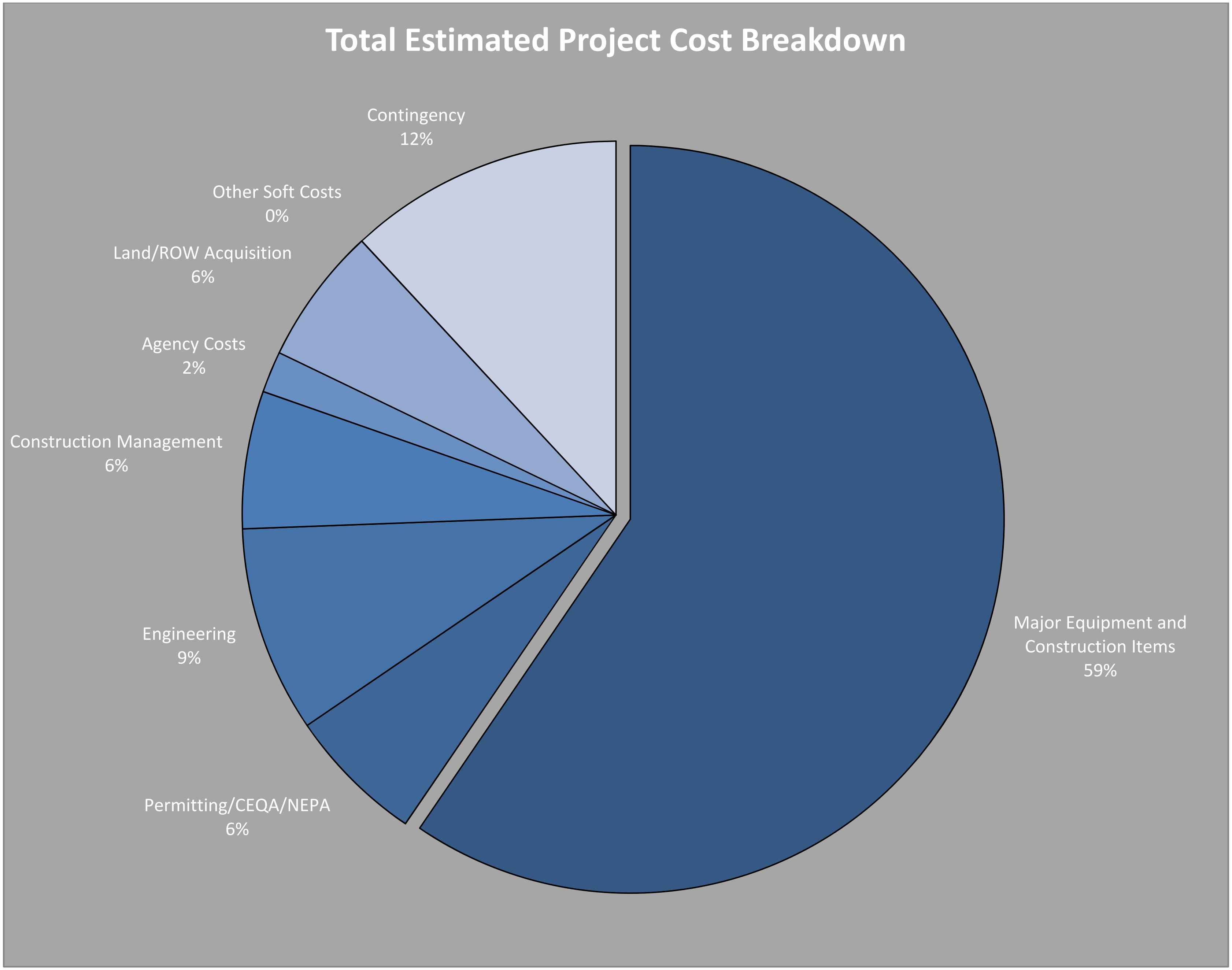
Unit Items	Quantity	Unit Cost	Total	Typical Ranges
Static Mixer	1	$ 10,000.00	$10,000	*Includes costs for purchase, tax, shipping, and installation. Inplace cost is typically 150-300% of purchase price.*
Turbidity Meter	1	$ 10,000.00	$10,000	
			$0	
		$ -	$0	
		$ -	$0	
Subtotal 1			**$20,000**	
Other Construction Items	**Cost Estimate**		**Total**	**Typical Ranges**
Electrical	15%	of subtotal 1	$3,000	*5-125% of subtotal 1*
Instrumentation	10%	of subtotal 1	$2,000	*3-15% of subtotal 1*
Site Work	10%	of subtotal 1	$2,000	*5-15% of subtotal 1*
Mobilization/ Demolition	10%	of subtotal 1	$2,000	*5-20% of subtotal 1*
Other	0%	of subtotal 1	$0	*Variable*
Subtotal 2	45%	of subtotal 1	**$9,000**	

Non Construction Implementation Costs (Soft Costs)

Permitting/CEQA/NEPA	10%	of (subtotal 1 + 2)	$2,900	*5-20% of (subtotal 1 + 2)*
Engineering	15%	of (subtotal 1 + 2)	$4,350	*10-20% of (subtotal 1 + 2)*
Construction Management	10%	of (subtotal 1 + 2)	$2,900	*5-15% of (subtotal 1 + 2)*
Agency Costs	3%	of (subtotal 1 + 2)	$870	*1-5% of (subtotal 1 + 2)*
Land/ROW Acquisition	10%	of (subtotal 1 + 2)	$2,900	*Variable*
Other Soft Costs	0%	of (subtotal 1 + 2)	$0	*Variable*
Contingency	20%	of (subtotal 1 + 2)	$5,800	*20-50% of (subtotal 1 + 2)*
Subtotal 3	68%	of (subtotal 1 + 2)	**$19,720**	

Cost Summary

Total Construction Estimate (w/o Contingency)	100%	of subtotal 1+2	**$29,000**	*90-140% of subtotal 2*
Total Estimated Project Costs	100%	of (subtotal 1 + 2 + 3)	**$48,720**	*70-150% of (subtotal 1 + 2 + 3)*
For Initial Funding Application	150%	of Total Estimated Project Costs	**$73,080**	*150-300% of (subtotal 1 + 2 + 3)*


Total Estimated Project Cost Breakdown
Contingency
12%
Other Soft Costs
0%
Land/ROW Acquisition
6%
Agency Costs
2%
Construction Management
6%
Engineering
9%
Permitting/CEQA/NEPA
6%
Major Equipment and
Construction Items
59%

Callahan Water District - New Treatment Plant

Major Equipment and Construction Items

Unit Items	Quantity	Unit Cost	Total	Typical Ranges
New Treatment Plant	1	$ 165,000.00	$165,000	*Includes costs for purchase, tax, shipping, and installation. Inplace cost is typically 150-300% of purchase price.*
			$0	
			$0	
		$ -	$0	
		$ -	$0	
Subtotal 1			**$165,000**	

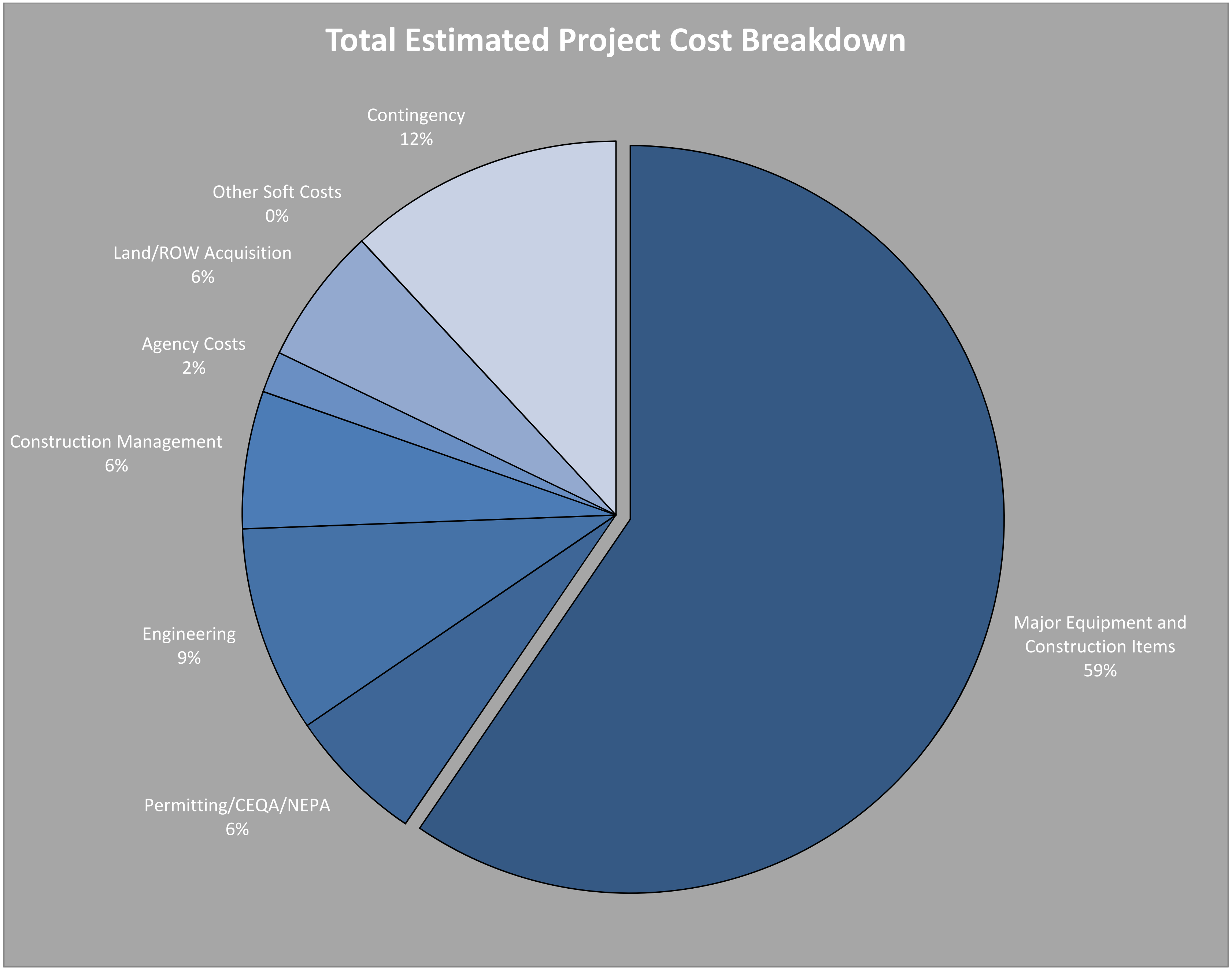
Other Construction Items		Cost Estimate	Total	Typical Ranges
Electrical	15%	of subtotal 1	$24,750	*5-125% of subtotal 1*
Instrumentation	10%	of subtotal 1	$16,500	*3-15% of subtotal 1*
Site Work	10%	of subtotal 1	$16,500	*5-15% of subtotal 1*
Mobilization/ Demolition	10%	of subtotal 1	$16,500	*5-20% of subtotal 1*
Other	0%	of subtotal 1	$0	*Variable*
Subtotal 2	45%	of subtotal 1	**$74,250**	

Non Construction Implementation Costs (Soft Costs)

Permitting/CEQA/NEPA	10%	of (subtotal 1 + 2)	$23,925	*5-20% of (subtotal 1 + 2)*
Engineering	15%	of (subtotal 1 + 2)	$35,888	*10-20% of (subtotal 1 + 2)*
Construction Management	10%	of (subtotal 1 + 2)	$23,925	*5-15% of (subtotal 1 + 2)*
Agency Costs	3%	of (subtotal 1 + 2)	$7,178	*1-5% of (subtotal 1 + 2)*
Land/ROW Acquisition	10%	of (subtotal 1 + 2)	$23,925	*Variable*
Other Soft Costs	0%	of (subtotal 1 + 2)	$0	*Variable*
Contingency	20%	of (subtotal 1 + 2)	$47,850	*20-50% of (subtotal 1 + 2)*
Subtotal 3	68%	of (subtotal 1 + 2)	**$162,690**	

Cost Summary

Total Construction Estimate (w/o Contingency)	100%	of subtotal 1+2	**$239,250**	*90-140% of subtotal 2*
Total Estimated Project Costs	100%	of (subtotal 1 + 2 + 3)	**$401,940**	*70-150% of (subtotal 1 + 2 + 3)*
For Initial Funding Application	150%	of Total Estimated Project Costs	**$602,910**	*150-300% of (subtotal 1 + 2 + 3)*


Total Estimated Project Cost Breakdown
Contingency
12%
Other Soft Costs
0%
Land/ROW Acquisition
6%
Agency Costs
2%
Construction Management
6%
Engineering
9%
Permitting/CEQA/NEPA
6%
Major Equipment and
Construction Items
59%