CITY OF MORRO BAY
WATER RECLAMATION FACILITY
CITIZEN ADVISORY COMMITTEE (WRFCAC)
AGENDA

The City of Morro Bay is dedicated to the preservation and enhancement of the quality of life. The City shall be committed to this purpose and will provide a level of municipal service and safety consistent with and responsive to the needs of the public.

Special Meeting
Wednesday, December 3, 2014
Community Center Studio - 3:00 P.M.
1001 Kennedy Way, Morro Bay, CA

Barbara Spagnola	Bill Woodson	Dale Guerra
John Diodati	Mary (Ginny) Garelick	Paul Donnelly
Valerie Levulett	Planning Commission Member: Richard Sadowski	Public Works Advisory Board Member: Steven Shively

ESTABLISH QUORUM AND CALL TO ORDER
MOMENT OF SILENCE/PLEDGE OF ALLEGIANCE
ANNOUNCEMENTS/PRESENTATIONS

PUBLIC COMMENT PERIOD
Members of the audience wishing to address the Board on City business matters other than scheduled items may do so at this time. To increase the effectiveness of the Public Comment Period, the following rules shall be followed:

- When recognized by the Chair, please come forward to the podium and state your name and address for the record. Board meetings are audio and video recorded and this information is voluntary and desired for the preparation of minutes.
- Comments are to be limited to three minutes.
- All remarks shall be addressed to the Board, as a whole, and not to any individual member thereof.
- The Board respectfully requests that you refrain from making slanderous, profane or personal remarks against any elected official, commission and/or staff.
- Please refrain from public displays or outbursts such as unsolicited applause, comments or cheering.
- Any disruptive activities that substantially interfere with the ability of the Board to carry out its meeting will not be permitted and offenders will be requested to leave the meeting.
- Your participation in Board meetings is welcome and your courtesy will be appreciated.

In compliance with the Americans with Disabilities Act, if you need special assistance to participate in this meeting, please contact the Public Services Department at (805) 772-6264. Notification 24 hours prior to the meeting will enable the City to make reasonable arrangements to ensure accessibility to this meeting.

A. CONSENT CALENDAR

A-1 Approval of minutes from the Water Reclamation Facility Citizen Advisory Committee meeting of November 5, 2014
Staff Recommendation: Approve minutes as submitted.

B. OLD BUSINESS

B-1 Presentation of City of Morro Bay New Water Reclamation Facility Project Comparative Site Analysis (*continued*): Regional CMC Facility vs. Rancho Colina *(Focus will be the CMC WWTP Analysis by Carollo Engineers and MKN Associates Engineering analysis of the Rancho Colina Site*)
(Reports will be available on website and via email by 5:00 p.m. 12-1-2014)

B-2 WRFCAC Sub-Committee Updates and Recommendations
Finance, Environmental and Engineering Sub-Committees to present their analyses and findings to the entire committee. *(Sub-Committee Reports Attached)*
Recommendation: Receive and consider updates.

C. NEW BUSINESS

C-1 Committee discussion and consideration of a recommendation to the City Council for site preference decision. *(No Staff Report; Member comments are included)*
Recommendation: Provide comments or recommendations that will be forwarded or presented to City Council for their consideration for final site preference selection, including but not limited to any recommendations on water supply benefit, reclamation/reuse, treatment technology, financing strategies and other project aspects.

D. **COMMITTEE MEMBER CLOSING COMMENTS**

E. **ADJOURNMENT**

Adjourn to the Water Reclamation Facility Citizen Advisory Committee meeting at the **Community Center Multipurpose Room, 1001 Kennedy Way**, on December 10, 2014, at 3:00 p.m.

This agenda is subject to amendment up to 72 hours prior to the date and time set for the meeting. Please refer to the agenda posted at the Public Services Department, 955 Shasta Avenue, for any revisions or call the department at 772-6264 for further information.

Materials related to an item on this Agenda are available for public inspection during normal business hours in the Public Services Department, at Mill's/ASAP, 495 Morro Bay Boulevard, or the Morro Bay Library, 695 Harbor, Morro Bay, CA 93442, or online at www.morro-bay.ca.us/wrfcac . Materials related to an item on this Agenda submitted to the Committee after publication of the Agenda packet are available for inspection at the Public Services Department during normal business hours or at the scheduled meeting.

AGENDA ITEM: A-1

DATE: December 3, 2014

ACTION: ____________________

CITY OF MORRO BAY
WATER RECLAMATION FACILITY
CITIZEN ADVISORY COMMITTEE (WRFCAC)

SYNOPSIS MINUTES

Regular Meeting – November 5, 2014

PRESENT:	John Diodati	Mary (Ginny) Garelick
	Barbara Spagnola	Dale Guerra
	Valerie Levulett	Paul Donnelly
	Bill Woodson	Richard Sadowski

ABSENT: Steven Shively

STAFF:	Rob Livick	Public Services Director
	Bruce Keogh	Wastewater Treatment Manager
	Rick Sauerwein	Capitol Projects Manager
	Kay Merrill	Administrative Utilities Technician

CONSULTANTS: John Rickenbach and Mike Nunley

ESTABLISH QUORUM AND CALL TO ORDER

John Diodati called the meeting to order at 3:00pm and stated all Committee Members were present except for Steven Shively and the Committee has a quorum. John Diodati asked for a moment of silence and asked staff if there were any announcements or presentations; Rob Livick replied there were none.

PUBLIC COMMENT

John Diodati opened Public Comment period.

Nancy Castle announced the Historical Society will be meeting on Sunday, November 9, 2014 at 4:30pm in the Training Room at the Fire Department and invited Committee Members, staff and the public to attend.

John Diodati closed Public Comment.

A. CONSENT CALENDAR

A-1 MINUTES OF OCTOBER 22, 2014 WRFCAC MEETING

MOTION: Bill Woodson moved to approve the minutes. Mary (Ginny) Garelick seconded the motion and the motion passed unanimously. (8-0).

B. OLD BUSINESS - To be heard after New Business

C. NEW BUSINESS

C-1 Presentation by Bill Woodson, “Morro Bay Water” – Exhibit

Bill Woodson stated the role of the WRFCAC is to advise the City Council on reclaiming Morro Bay’s wastewater.

He presented the following:

- Should Morro Bay continue to rely on State water or do we reclaim?
- The State Water Bond passed for $7.5 billion and $750 million is allocated for recycling.
- Should Morro Bay recycle water or not?
- How much will Morro Bay residents pay for water in the future?
- Does reclaimed water reduce those costs?
- There are four sources of water: State Water, Morro Creek Wells, Chorro Creek Wells and the Desalination Plant.
- Options for reclaimed water.
- What are the minimum permit requirements for the WWTP?
- What is the return investment on tertiary?
- How do the different options impact the cost for water?

Bill Woodson requested the Committee to ask staff to develop a chart showing costs or savings for each option.

John Diodati asked if there were any questions or comments regarding the presentation.

Rob Livick clarified the minimum WWTP permit requirements depends on where the water is discharged.

John Rickenbach stated information from Carollo will be available in draft form by November 18, 2014 which will assist the cost analysis. It is up to City Council if they want to make a site decision without the cost analysis.

Rob Livick stated a chart can be made and the City has the basic water costs.

John Rickenbach clarified we all share the same goal of making assumptions as realistic as possible.

John Diodati stated as the Advisory Committee they will advise City Council as to what the best course of action is. Whether it is to a specific site or additional direction, recommendation to the City Council to not select a site in November until the next report is in and then the Committee can make a recommendation to City Council.

Rob Livick stated in the City’s Local Coastal Plan (LCP) the City is committed to providing reclaimed water.

Discussion continued between the Committee and staff regarding amount of reclaimed water and ag use for the LCP.

C-2 Presentation of City of Morro Bay New Water Reclamation Facility Project Comparative Site Analysis: Regional CMC Facility vs. Rancho Colina

John Rickenbach presented the Site Analysis.

In May, 2014, City Council provided direction that Rancho Colina was the preferred site and asked the consultants to look at the regional facility option which is the CMC site.

John Rickenbach stated the key questions and comments are:

- What are the regional benefits of the sites?
- Cost comparisons to be determined pending completion of the Carollo Report.
- What are the water supply benefits?
- How much will the water fees be for AG?
- What are the logistical constraints?
- What are the physical site constraints?
- What are the environmental constraints for CCC and/or general public?
- What are the permitting constraints?
- Is the 5 year goal obtainable?
- What is the City's role in construction at CMC?
- What type of funding is available?
- Final recommendation

The Committee and staff discussed the key questions presented by the consultant.

John Diodati stated the Committee cannot make a recommendation until the Carollo report is submitted and reviewed.

MOTION: John Diodati moved that the Committee direct the chair to draft a letter to the City Council indicating that the Advisory Committee has made the following recommendations:

- City Council does not make a decision at the November 12, 2014 meeting regarding site selection.
- Committee directs staff to finalize reports and make a presentation to the Advisory Committee at a tentatively scheduled meeting the first Wednesday of December, which is December 3, 2014,and any such decision by the City Council should happen after the new Council members have been seated and are in office.
- The Advisory Committee will follow-up with a subsequent recommendation prior to the December 12, 2014 meeting.

Bill Woodson seconded the motion, and the motion carried unanimously. (8-0).

B. OLD BUSINESS

B-1 Sub-Committee Updates

Barbara Spagnola stated the Finance Sub-Committee has reviewed three of the four reports and has three recommendations:

- Postpone making a decision
- Review funding options
- Review Contract Negotiations and terms

John Rickenbach suggested that this Committee get a memo to staff that includes errors, technical issues and questions to the Council regarding the reports.

John Diodati suggested to send errors, technical issues and questions directly to John Rickenbach.

Rob Livick stated it would be best for the Sub-Committees to forward their questions directly to him and Rob will forward them to John Rickenbach or to an appropriate consultant.

John Diodati stated the Sub-Committees should meet amongst themselves and provide comments at the December 3, 2014 meeting.

Rob Livick agreed and can assist the Sub-Committees in providing places for the Committees to meet.

D. COMMITTEE MEMBER CLOSING COMMENTS

Bill Woodson stated since Prop 1 passed and has allocated a $750 billion water bond for California, he suggested the Sub-Committees discuss financing as there may be changes due to the passing of Prop 1.

E. ADJOURNMENT

The meeting adjourned at 4:47pm to a special WRFCAC meeting at a location to be determined, on Wednesday December 3, 2014 at 3:00pm.

____

John Diodati, Chairperson

ATTEST:

____

Rob Livick, Secretary

CITY OF MORRO BAY

CAPACITY EVALUATION OF THE CALIFORNIA MEN'S COLONY WASTEWATER TREATMENT PLANT

TECHNICAL MEMORANDUM

DRAFT
December 2014

This document is released for the purpose of information exchange review and planning only under the authority of Eric T. Casares, December 1, 2014, CA, 73351.

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CITY OF MORRO BAY

CAPACITY EVALUATION OF THE CALIFORNIA MEN'S COLONY WASTEWATER TREATMENT PLANT

TECHNICAL MEMORANDUM

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Technical Memorandum

CAPACITY EVALUATION OF THE CALIFORNIA MEN'S COLONY WASTEWATER TREATMENT PLANT

1.0 PURPOSE AND INTRODUCTION

The California Men's Colony (CMC) Wastewater Treatment Plant (WWTP) treats the entire flow from the CMC along with flows from several surrounding areas including the California Men's Colony East Facility, California Men's Colony West Facility, County of San Luis Obispo (County Jail, Juvenile Services, and County Education and Engineering, Maintenance and Support Services Facilities), Camp San Luis Obispo (California National Guard Base), and Cuesta College. Each of these organizations has a contractual agreement with CMC and agreed to capacity of the WWTP, which will be discussed in a later section of this report.

There is current interest in developing a regional WWTP to provide services to not only the existing service area but also to the communities of Morro Bay (City) and the Cayucos Sanitary District (CSD). This area is collectively referred to as MBCSD throughout this report. The purpose of this report is to reassess the capacity of each process component of the existing CMC WWTP and determine the upgrades necessary to provide adequate capacity for the existing service area and the flows and loads anticipated from the combined MBCSD service area.

2.0 BACKGROUND

This section provides the background for the report and summarizes the terminology used throughout the report, the regulatory considerations for the CMC facility, a description of the existing facility, a summary of available data for the CMC facility, along with a summary of the design flows and loads for both the CMC facility and the MBCSD.

2.1 Definitions and Terminology

This section provides a summary of the terminology used in this report.

- Aerobic solids residence time (aSRT)/total solids residence time (SRT)
- Ammonia (NH_3)
- Average annual (AA)
- Average dry weather (ADW)
- Biochemical oxygen demand (BOD)
- California Men's Colony (CMC)

- Concrete mortar lining (CML)
- Cubic feet per hour (cfh)
- Ductile iron pipe (DIP)
- Filter Feed Pump Station (FFPS)
- Foot per second (fps)
- Gallons per minute (gpm)
- Gallons per minute per square foot (gpm/sf)
- Horsepower (hp)
- Hydraulic retention time (HRT)
- Microfiltration (MF)
- Million gallons per day (MGD)
- Milligrams per liter (mg/L)
- Milliliters per gram (mL/g)
- Millimeter (mm)
- Maximum month (MM)
- Mixed liquor suspended solids (MLSS)
- ORP (Oxidation-reduction potential)
- Peak hour dry weather (PHDW)
- Peak hour wet weather (PHWW)
- Pounds per day (ppd)
- Polyvinyl chloride (PVC)
- Raw wastewater pumping station (RWWPS)
- Return activated sludge (RAS)
- Reverse osmosis (RO)
- Total dissolved solids (TDS)
- Total Kjeldahl Nitrogen (TKN)
- Total suspended solids (TSS)

- Waste activated sludge (WAS)
- Welded steel pipe (WSP)
- Wastewater treatment plant (WWTP)
- Variable frequency drive (VFD)

2.2 Regulatory Considerations

The effluent from the CMC WWTP is discharged to Chorro Creek and is regulated by the Central Coast Regional Water Quality Control Board under NPDES permit number CA0047856. The NPDES permit limitations for biochemical oxygen demand (BOD), total suspended solids (TSS), turbidity, nutrients and total dissolved solids (TDS) are summarized below in Table 1. As is shown in Table 1, the effluent concentration limits are typical for all constituents except for total nitrogen, which has a maximum daily limit of 10 milligrams per liter (mg/L).

Since this analysis is evaluating the feasibility of the CMC WWTP accepting additional flow from MBCSD, it has been assumed that the existing mass load limits would be increased such that the effective concentration limit from the combined flow equals the prescribed concentration limits.

Table 1 NPDES Permit Effluent Limitations
Capacity Evaluation of the California Men's Colony WWTP
City of Morro Bay

		Effluent Limitations		
Parameter	**Units**	**Average Monthly**	**Average Weekly**	**Maximum Daily**
BOD	mg/L	10	30	50
	ppd	100	300	500
TSS	mg/L	10	30	50
	ppd	100	300	500
Turbidity	NTU	10	--	20
Total Nitrogen (as N)	mg/L	--	--	10
	ppd	--	--	100
Nitrite	mg/L	--	--	1.0
TDS(1)	mg/L	500		

Notes:
(1) TDS limit based on a surface water limitation. For this analysis, it was assumed that no dilution credits would be allowed, therefore the surface water limit is the effluent limit.
(2) ppd = pounds per day

2.3 Existing Facilities Description

The WWTP treatment process consists of preliminary treatment including mechanical bar screens and aerated grit removal, secondary treatment with oxidation ditch technology and secondary clarifiers, tertiary treatment with continuous backwash filters, disinfection with a recently constructed in-channel ultraviolet (UV) disinfection system, solids storage in an existing anaerobic sludge digester, and dewatering with centrifuges.

2.4 Summary of Available Data for the CMC Facility

CMC provided daily data for the years 2010 through 2014. The influent data provided included flow, and BOD and TSS concentrations. The effluent data provided included BOD, TSS, total nitrogen, and ammonia concentrations. The facility does not measure influent ammonia or total nitrogen concentrations.

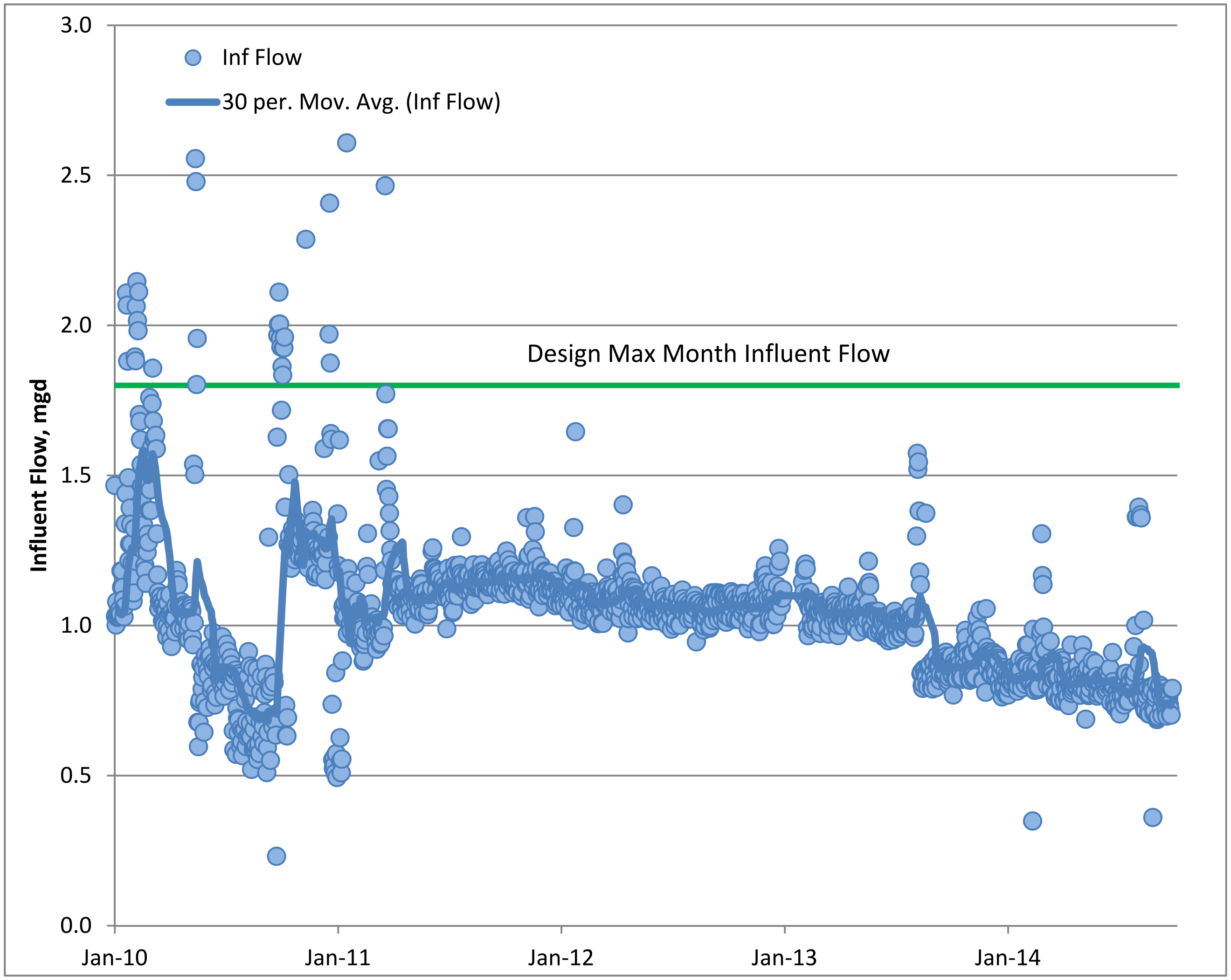
Figure 1 and Figure 2, along with Table 2, summarize the influent flow and BOD and TSS loads at the CMC facility for the years 2010 through 2013. The data presented in Figure 2 and Table 3 excludes outlier influent concentrations, which were calculated as any concentration exceeding two standard deviations above the mean. As is shown in Table 1 and Figure 1, the average annual (AA) and maximum month (MM) flows have generally decreased from 2010 through 2013. As shown in Table 1 and Figure 2, the AA and MM BOD and TSS loads have varied significantly, with the highest AA and MM loads occurring in 2012.

Figure 3 summarizes the effluent total nitrogen concentrations for the treatment plant.

Table 2 Influent Flow and Loads
Capacity Evaluation of the California Men's Colony WWTP
City of Morro Bay

	Flow, MGD		BOD(1), mg/L		TSS(1), mg/L	
Year	**AA(2)**	**MM(3)**	**AA**	**MM**	**AA**	**MM**
2010	1.10	1.54	3,800	7,100	4,300	7,500
2011	1.13	1.21	4,700	6,100	4,600	6,200
2012	1.08	1.13	4,500	10,700	5,100	9,100
2013	0.97	1.07	3,600	5,700	5,200	8,100

Notes:
(1) Data excludes outliers, which were determined to be values exceeding two standard deviations above the mean.
(2) AA = Average annual
(3) MM = Maximum month



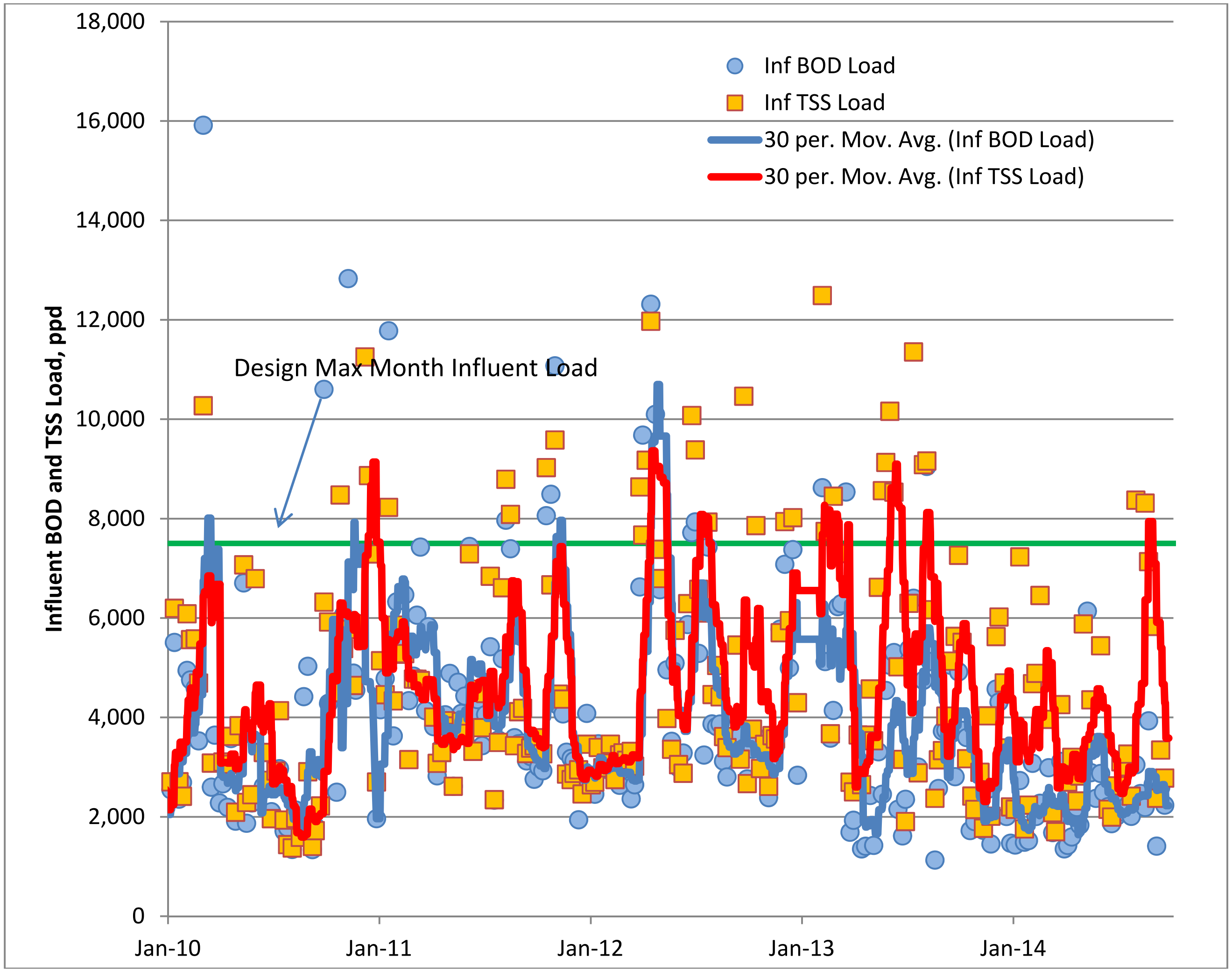
MONTHLY INFLUENT FLOW

FIGURE 1

CITY OF MORRO BAY

CAPACITY EVALUATION OF THE CALIFORNIA MEN'S COLONY WWTP

carollo

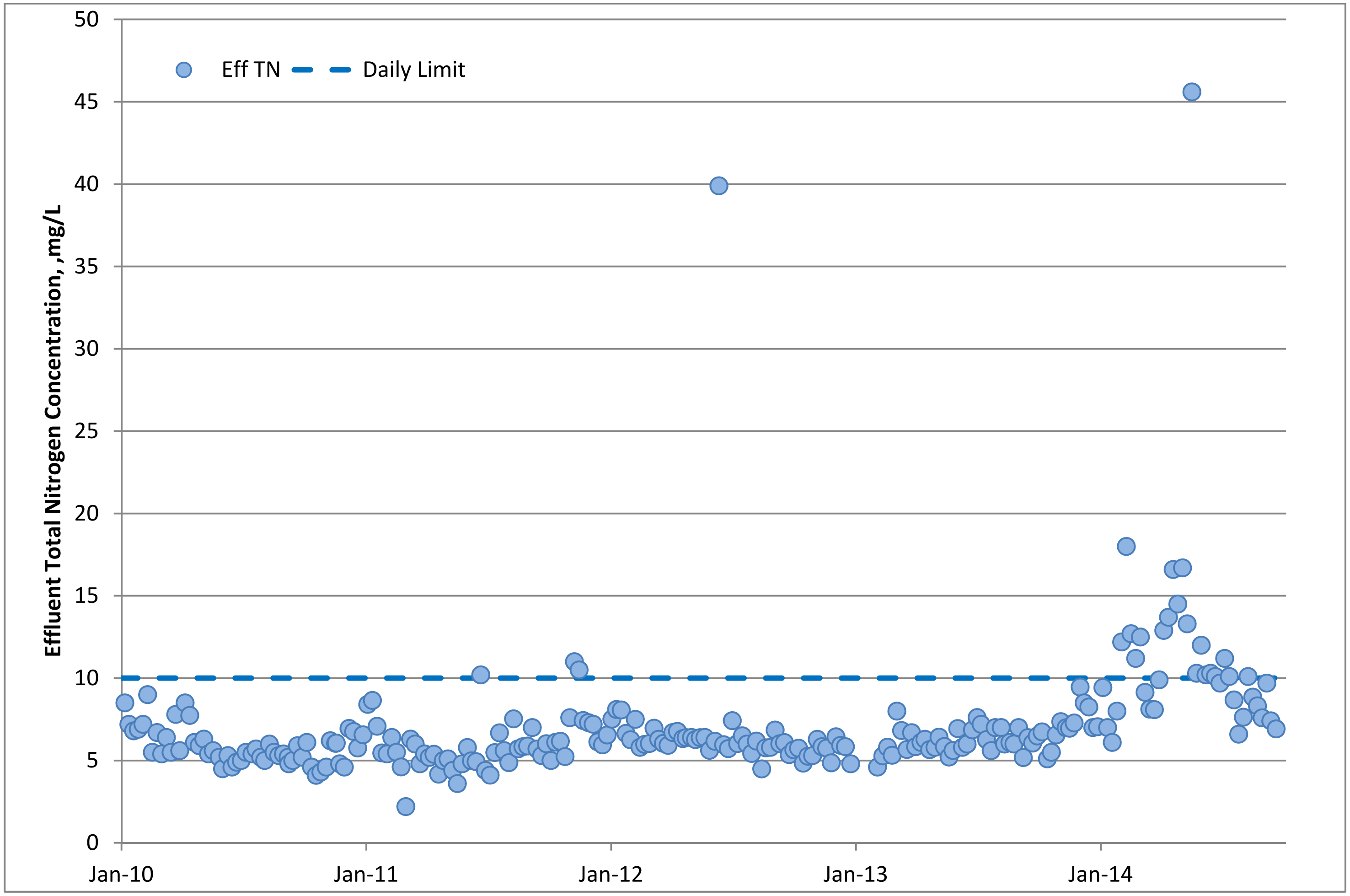


MONTHLY INFLUENT BOD AND TSS LOAD

FIGURE 2

CITY OF MORRO BAY

CAPACITY EVALUATION OF THE CALIFORNIA MEN'S COLONY WWTP



EFFLUENT TOTAL NITROGEN CONCENTRATIONS

FIGURE 3

CITY OF MORRO BAY
CAPACITY EVALUATION OF THE CALIFORNIA MEN'S COLONY WWTP

carollo

No data has been provided on operating conditions at the treatment plant including wastewater temperature, solids retention time (SRT), mixed liquor suspended solids (MLSS), sludge volume index (SVI), and waste activated sludge (WAS) flows or loads. A phone conversation with CMC on November 3, 2014 indicated that the plant typically operates with both oxidation ditches and both secondary clarifiers in service. The digester that was planned to be used for WAS storage has not been cleaned, and therefore the plant does not store their WAS prior to dewatering. Additionally, CMC provided the following typical values:

- Minimum monthly wastewater temperature is approximately 19 degrees Centigrade (°C)
- SVI averages approximately 130 milliliters per gram (mL/g)
- MLSS concentrations average between 3,600 and 3,800 mg/L
- Wasting occurs approximately three times per week at a concentration of around 7,000 mg/L for an average daily WAS volume of 60,000 gallons per (gpd)

2.5 Design Flows and Loads

This section summarizes the design flows and loads for the CMC and MBCSD service areas.

2.5.1 Existing CMC Service Area

Table 3 summarizes the CMC service area influent flow and loads from the 2001 design.

Table 3 Design CMC Influent Flow and Loads
Capacity Evaluation of the California Men's Colony WWTP
City of Morro Bay

Parameter	ADW(1)	AA	MM	PHDW(2)	PHWW(3)
Flow, MGD	1.2	1.3	1.8	2.4	5.2
BOD, ppd		5,400	7,500		
TSS, ppd		5,400			
Ammonia, ppd		450			

Notes:
(1) ADW = Average dry weather
(2) PHDW = Peak hour dry weather
(3) PHWW = Peak hour wet weather

2.5.1.1 Summary of Known Existing Service Contracts

Based on information obtained from the County of San Luis Obispo (County), the agreements in place between CMC and other entities served by the WWTP are summarized in Table 4.

Table 4 Existing Service Contracts
Capacity Evaluation of the California Men's Colony WWTP
City of Morro Bay

Party	Date	Capacity Commitment (gpd)
San Luis Obispo Community College District(1)	1971	80,000
California Army National Guard, Camp San Luis Obispo (CSLO)(2)	1999	125,000
County of San Luis Obispo(3)	2000	215,000

Notes:
(1) Based on 80 percent of potable water commitment of 100,000 gpd.
(2) Based on 80 percent of potable water commitment of 140 acre-feet per year.
(3) Based on 240 acre-feet per year.

At this time, it is not known if other agreements to provide wastewater service are in place. Additionally, adequate flow data is not available to determine what amount of the above capacity commitments are currently being served by the WWTP.

2.5.2 Combined City of Morro Bay and Cayucos Sanitary District

Table 5 summarizes the influent flow and loads for the MBCSD based on information from Amendment 2 (MWH, July 2011).

Table 5 Design City Influent Flow and Loads
Capacity Evaluation of the California Men's Colony WWTP
City of Morro Bay

Parameter	ADW	AA	MM	PHDW	PHWW
Flow, MGD		1.5	2.9		8.0
BOD, ppd		3,500	5,500(1)		
TSS, ppd		3,800	6,300(1)		
TKN, ppd		600	940		

Notes:
(1) Peak season dry weather

3.0 PROCESS CAPACITY EVALUATION METHODOLOGY

This section summarizes the methods used to evaluate the process capacity of each unit process.

3.1 "Whole-Plant" Process Simulation

As is shown in Figure 2, the CMC influent MM BOD and TSS loads have exceeded the 2001 design criteria in 2012 and again for TSS in 2013. Due to these higher than anticipated influent loads, it was assumed that the CMC facility does not have any excess secondary capacity.

A "whole-plant" simulator was created in BioWin and used to assess the capacity requirements for the oxidation ditches. The model assumed the planning-level influent flow and load data for the MBCSD (Table 4). Since no process data is available for the MBCSD flows and loads, the model relied on the BioWin default wastewater characteristics. The model was initially calibrated around the CMC influent flow and loads and the conversation with the plant staff regarding typical MLSS concentrations. A minimum monthly temperature of 15°C was selected based on previous work done for the MBCSD Facility Master Plan (Carollo, September 2007) and the design aSRT was set to 15.7 days based on the 2001 CMC design criteria.

3.2 Secondary Clarifier State-Point Analysis

The capacity requirement for the secondary clarification process was evaluated using a state point analysis. Since no SVI data was available for the MBCSD flow, the state point analysis assumed an SVI of 150 mL/g and a clarification safety factor of 1.15.

3.3 Other Analyses

The capacity requirements for preliminary treatment, tertiary filtration, and disinfection of the combined MBCSD flow were determined based on the projected PHWW flow of 8.0 MGD and the CMC WWTP's current design criteria for these processes. The capacity requirement for dewatering the MBCSD flow was determined based on the MM WAS projection from the BioWin model with a factor of 1.2 applied to create a maximum week projection. The capacity requirements for the microfiltration – reverse osmosis (MF-RO) process was determined based on a mass balance of published effluent TDS data from CMC and planning level TDS data provided from the City. The RO salt rejection was assumed to be 97 percent based on typical values for a Hydranautics ESPA2 membrane.

4.0 PROCESS CAPACITY EVALUATION RESULTS

This section summarizes the results of the process capacity evaluation for each unit process.

4.1 Preliminary Treatment

Preliminary treatment at the CMC WWTP consists of mechanical bar screens followed by influent pumping, aerated grit removal, and fine screening. The existing preliminary treatment facilities were generally sized for a PHWW flow of 5.46 MGD (the fine screens were sized for a PHWW flow of 5.6 MGD). Since the projected CMC PHWW flow is 5.2 MGD, the existing preliminary treatment facilities do not have sufficient capacity to handle the MBCSD flows. Additionally, there is not sufficient space available near the existing preliminary treatment facilities to accommodate expansion. Thus, a new parallel preliminary treatment facility is proposed to handle the MBCSD's projected PHWW flow of 8.0 MGD.

The CMC WWTP currently has two 3/8-inch mechanically cleaned bar screens with a total capacity of 5.46 MGD followed by one 6 millimeter (mm) perforated plate fine screen with a total capacity of 5.6 MGD. The fine screen was added to the CMC WWTP in the latest major expansion to help deal with small plastics that were passing through the 3/8-inch climber screens and fouling the tertiary filters. To treat the MBCSD flow, a new screening facility with three screening channels will be added, allowing for one of the proposed new screens to operate as a standby during AA and MM conditions. A third screen channel is required to accommodate the design PHWW flow of 8.0 MGD. It has been assumed that these screens will be equipped with smaller effective openings than the existing climber screens such that the MBCSD flows will not require a subsequent fine screening step.

The CMC WWTP currently has two duty and one standby raw wastewater pumps with a firm capacity of 5.46 MGD. To treat the MBCSD flow, a parallel influent pump station will be added with three duty pumps and one standby pump. Each pump will have a capacity of 2.67 MGD, resulting in a pump station with a firm capacity of 8.0 MGD.

The CMC WWTP currently has one aerated grit chamber, with a total capacity of 5.46 MGD sized to allow for a PHWW flow hydraulic retention time (HRT) of 3.5 minutes. To treat the MBCSD flow, one new aerated grit chamber is proposed, sized for a 3.5-minute HRT at the PHWW flow of 8.0 MGD.

4.2 Secondary Treatment

Secondary treatment at the CMC WWTP consists of two 1.76 million gallon (MG) oxidation ditches followed by two 65-foot diameter secondary clarifiers. Since the CMC facility has observed recent MM loads in excess of the plants original design criteria, the existing oxidation ditches and secondary clarifiers do not have sufficient capacity to handle any of the combined MBCSD flows and loads.

Based upon these assumptions described above for the state point analysis, and assuming a PHWW flow of 8.0 MGD (Table 5), three new 65-foot diameter secondary clarifiers would be needed to allow for a maximum MLSS concentration of 3,000 mg/L. The resulting state point curve is shown in Figure 4.

Based on this maximum MLSS concentration, the assumed minimum design aSRT of 15.7 days listed in the 2001 design of the CMC facility, and the assumed minimum month wastewater temperature of 15ºC, two new oxidation ditches would be required to treat the City flows and loads. The detailed BioWin output detailing the sizing of these facilities is included in Appendix A.

Additional precautions should be taken in the design of the secondary system due to the daily effluent total nitrogen limit of 10 mg/L. These include:

- Additional data is needed from both the MBCSD and CMC to evaluate the variation in influent temperature and flows and loads (including influent TKN).
- The oxidation ditches should be designed with an ammonia-based aeration control scheme including online dissolved oxygen (DO), TSS, and ammonia and nitrate probes. This additional level of control will aid the plant staff in responding to problems with nitrification and denitrifcation as they occur.
- A methanol feed facility should be considered to allow for supplemental BOD should a drop in influent BOD occur. Since additional analysis is needed to confirm the need for methanol addition, the cost for this methanol facility has not been included in the cost estimates presented in a latter section of this report.

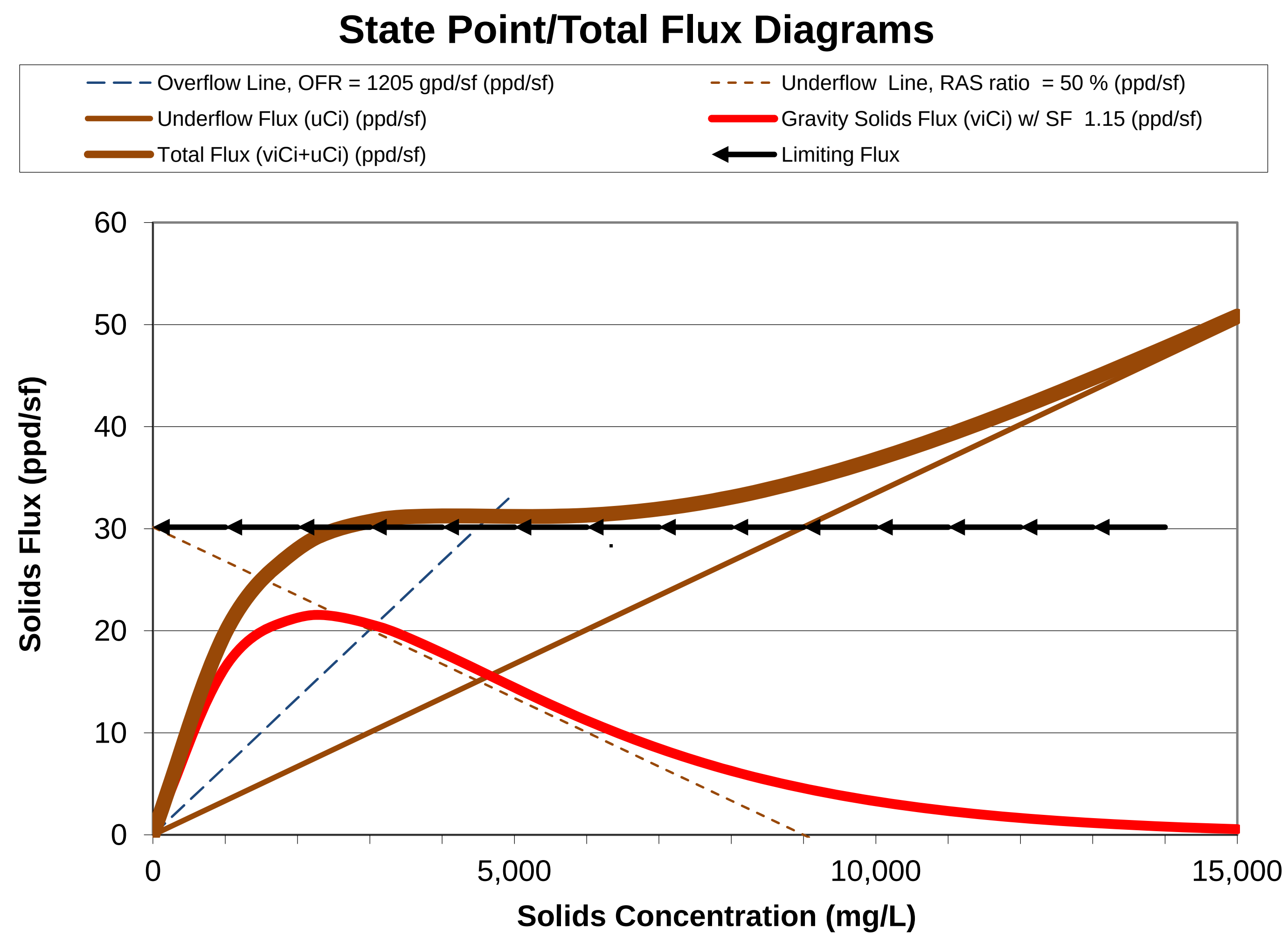
4.3 Tertiary Treatment and Disinfection

This section provides a summary of the process capacity evaluation for the tertiary filtration, MF-RO and UV disinfection processes.

4.3.1 <u>Tertiary Filtration</u>

The secondary effluent is filtered and disinfected prior to reuse and discharge. The existing filtration and disinfection processes were sized for a PHWW flow of 5.2 MGD. Since the projected CMC PHWW flow is 5.2 MGD, the existing filtration and disinfection facilities do not have sufficient capacity to handle the MBCSD flows. New filters and disinfection facilities are proposed to handle the MBCSD's projected PHWW flow of 8.0 MGD.

The CMC WWTP currently has eight continuous backwash filters (Parkson DynaSand®) that are sized based on a peak flow hydraulic loading rate of 9.0 gallons per minute per square foot (gpm/sf). To treat the MBCSD's PHWW flow of 8.0 MGD at a design hydraulic loading rate of 9.0 gpm/sf, 13 new filters are required. One additional standby unit is proposed to provide standby capacity during peak flows, bringing the total number of proposed filters to 14.



Notes: Assumes 3 – 65 ft diameter secondary clarifiers, a SVI of 150 mL/g a PHWW flow of 8 MGD and a clarification safety factor of 1.15.

STATE POINT ANALYSIS FOR CITY FLOWS

FIGURE 4

CITY OF MORRO BAY

CAPACITY EVALUATION OF THE CALIFORNIA MEN'S COLONY WWTP

carollo

pw://Carollo/Documents/Client/CA/Morro Bay/9723A00/Deliverables/Figure 4

4.3.2 Microfiltration and Reverse Osmosis Desalination Membranes

Table 6 shows the estimated combined effluent TDS of 837 mg/L. Since the combined effluent TDS exceeds the receiving water quality standard of 500 mg/L, and it is assumed that no dilution credits will be granted, a desalination process utilizing MF and RO membranes is required.

Table 6 Planning Level Effluent TDS Data
Capacity Evaluation of the California Men's Colony WWTP
City of Morro Bay

	City	CMC	Combined
Effluent MM Flow, MGD(1)	2.9	1.8	4.7
Effluent TDS, mg/L	942(2)	669(3)	837(4)

Notes:
(1) Planning level values presented in Tables 3 and 5.
(2) Data was obtained from lab results from six 24-hour composite samples taken between February 8, 2012 and February 14, 2012. Tests were conducted by FGL Environmental and Agricultural Analytical Chemists.
(3) Maximum month value based on published DMR data from July 2009 through September 2014.
(4) Data calculated based on a simple mass balance.

For this analysis a target effluent TDS of 450 mg/L was selected to provide a factor of safety of 1.1.

MF membranes strictly remove particulate matter and do not provide any desalination. MF membranes are installed ahead of RO membranes to remove any remaining particulate matter to protect the RO membranes. The MF influent will be drawn from the tertiary filter effluent to provide a more consistent feed water quality and to extend the membrane backwash cycle times. The MF membranes will operate at a flux of approximately 25 gfd with a throughput of 95 percent.

The RO process utilizes Hydranautics ESPA2 membranes with an assumed salt rejection rate of 97 percent. Assuming 80 percent recovery though the RO membranes, the brine is estimated to have a flow of 0.40 MGD with a TDS concentration of 4,730 mg/L. For this analysis, it is assumed that the brine will be disposed through an extended brine disposal pipeline that connects to the existing ocean outfall. Table 7 shows the estimated sizes for the MF and RO processes.

Table 7 Planning Level MF-RO Sizing
Capacity Evaluation of the California Men's Colony WWTP
City of Morro Bay

	MF	RO	Bypass MF-RO	Combined Effluent to Chorro Creek

Effluent MM Flow, MGD	2.5	2.0[1]	2.2	4.2
Effluent TDS, mg/L	837[2]	25[3]	837[2]	450[4]

Notes:
(1) MF and RO System size is stated based on total throughput
(2) Based on estimated combined effluent TDS shown in Table 6.
(3) Calculated assuming 80% recovery through the RO process.
(4) Calculated assuming 97% salt rejection through membrane.
(5) Data calculated based on a simple mass balance.

4.3.3 UV Disinfection

The CMC WWTP currently has two UV disinfection channels, each with a capacity of 2.6 MGD, for a total capacity of 5.2 MGD. To treat the MBCSD's PHWW flow of 8.0 MGD, three new UV channels of roughly the same size as the existing will be required.

4.4 Biosolids Handling

The CMC WWTP currently directly dewaters WAS prior to disposal using two centrifuges, each sized for a flow rate of 200 gpm and a 35 hour per week operational schedule. Since the CMC WWTP has observed influent solids loads in excess of the original design criteria, it is assumed that the current dewatering facility does not have excess capacity to treat the MBCSD flow and retain the same level of redundancy currently provided by the existing dewatering facility. Two new centrifuges are proposed to dewater the MBCSD WAS assuming a flow rate of 200 gpm, a WAS concentration of 7,000 mg/L, and the same 35 hour per week operational schedule. With four centrifuges, the facility will have the ability to handle the maximum week WAS production anticipated for the combined MBCSD and CMC flows with one unit out of service.

5.0 HYDRAULIC CAPACITY EVALUATION

5.1 Methodology

In order to complete the hydraulic evaluation of the existing CMC WWTP and determine the necessary improvements and plant configuration changes required to accommodate the additional MBCSD flows, a hydraulic model was developed. The model was developed using the Carollo's proprietary *Hydraulix*® tool. The following major steps were involved in developing the hydraulic model.

- **Step 1**: Identify flow pathways through the plant, from inlet to discharge at the Discharge Wet Well located in the previous chlorine contact basin.

- **Step 2**: In each pathway, identify the hydraulic control points, which define the segments for each pathway.

- **Step 3**: In those instances where more than one flow pathway exists per segment, select the pathway that has the highest likely headloss (i.e., defines the most restrictive or critical pathway).

- **Step 4**: For each segment, identify the headloss elements (pipeline, channel, weir, sluice gate, etc.), and, starting at the downstream control point, use the associated *Hydraulix*® calculation modules as "building blocks" to construct the model based on dimensions and elevations from the conformed drawings.

- **Step 5**: Integrate the various segments by identifying the appropriate flow split and recycle streams as influent flow to the plant is separated out between individual structures within the plant.

The detailed hydraulic analysis is included in Appendix B.

5.2 Assumptions

5.2.1 Roughness Coefficients

In addition to the physical attributes of the various flow-conveyance structures (i.e., diameter, width, length, elevation, slope, etc.), the model hydraulic calculations require roughness coefficients for channels and pipelines. Since headloss through these structures increases with age, conservative coefficients were selected to reflect that condition, even though some of these structures are still relatively new. The selected roughness coefficients used for this analysis include the following:

- Manning coefficient, n (channels) = 0.013

- Absolute roughness, e (pipelines) = 0.004 feet

5.2.2 Control Point Elevations

The control point elevations are a critical input parameter. All headloss through a segment is added to the control point elevation to determine the anticipated water surface elevation in the upstream control structure. The control point elevations were derived from the conformed drawings. The critical control point elevations are shown in Table 8.

Table 8 Hydraulic Analysis Control Points
Capacity Evaluation of the California Men's Colony Wastewater Treatment Plant
City of Morro Bay

Control Point Location	Elevation, ft
Oxidation Ditch Splitter Structure Weir(1)	210.75
Oxidation Ditch Effluent Weir(1)	209.61
Mixed Liquor Splitter Structure Weir(1)	208.68

Secondary Clarifier Effluent Weir(1)	207.68
Tertiary Filter Effluent Trough(1)	202.57
UV Disinfection Effluent Weir(2)	199.44

Notes:
(1) Elevations obtained from the California Men's Colony San Luis Obispo, California Wastewater Collection/Treatment Upgrade Record Drawings (December 2007).
(2) Elevation obtained from the final California Men's Colony – CMC Wastewater Treatment Plant Disinfection Upgrade Drawings (May 09, 2012).

5.2.3 Common Hydraulic Grade Line

The conceptual design and hydraulic evaluation was completed with the assumption that the new improvements presented in the previous section will be operated at the same hydraulic grade line as the existing plant. This will allow the plant to operate as a single wastewater facility (as opposed to parallel plants) and give operations staff the greatest amount of redundancy and flexibility. This assumption requires that flow be combined and split equally between each stage of treatment. Achieving a common hydraulic grade line for both the existing and new facilities complicates the site layout for the necessary improvements as the distance between processes needs to be as similar as possible to prevent surcharging a weir and providing unequal flow to a downstream process. The site layout presented in a latter section of this report was developed to accommodate these hydraulic challenges.

5.3 Evaluation Results

The CMC WWTP is capable of passing the new PHWW flow with the addition of the several improvements. The existing WWTP hydraulics do not deviate significantly from the original design between the inlet of the oxidation ditches through the secondary clarifiers. The existing secondary clarifier effluent lines connect and run a short distance to the existing tertiary filters. A new filter feed splitter box would be required to distribute flow between the existing and future filter galleries, however it would be difficult to account for the different number of filters operating in each gallery. Relocating this filter feed box to a site equidistant from the existing and proposed secondary clarifiers results in too much additional headloss to continue to supply the filters via gravity.

To rectify this situation, the secondary clarifier effluent lines will flow by gravity into a new filter feed pump station (FFPS). The FFPS allows the secondary clarifiers to gravity flow into the pump station wet well where the filter pumps lift the secondary effluent into a new filter feed distribution manifold. The manifold will connect to both the existing and new filter galleries with magnetic flow meters and flow control valves at the entrance to each to distribute flow based on the number of filters currently in run status at each location. The FFPS and new filter gallery are identified in the site layout included in a latter section of this report. The cost for this new pump station is also included as part of the tertiary filter costs presented in a latter section of this report.

6.0 IMPROVEMENTS NECESSARY TO ACCOMMODATE ADDITIONAL FLOW

This section summarizes the design criteria and conceptual facility layout for the required improvements necessary to accommodate the additional flow from the MBCSD.

6.1 Design Criteria

The design criteria for the proposed improvements are summarized in Table 9.

Table 9 Design Criteria
Capacity Evaluation of the California Men's Colony WWTP
City of Morro Bay

Parameter	Existing(1)	New	Total
Influent Flows and Loads			
AA Flow, MGD	1.3	1.5	2.8
MM Flow, MGD	1.8	2.9	4.7
Peak Flow, MGD	5.2	8.0	13.2
MM BOD, ppd	7,500	5,500	13,000
MM TSS, ppd	7,500	6,300	13,800
MM TKN, ppd	950(2)	940	1,890
Preliminary Treatment			
Mechanical Bar Screens			
Number	2	3+0	
Bar Spacing, inches	3/8	1/4	2 at 3/8; 3 at 1/4
Capacity (each), MGD	2.73	2.67	
Channel Width, feet	2.5	2	
Raw Wastewater Pumps			
Number	2+1	3+1	5+2
Type	Dry pit submersible	Dry pit submersible	
Capacity (each), MGD	2.73	2.67	3 at 2.73; 3 at 2.67
Firm Capacity, MGD	5.46	8.0	13.46
Fine Screens			
Number	1	0	1
Screen Perforations, mm	6	--	6

Table 9 Design Criteria
Capacity Evaluation of the California Men's Colony WWTP
City of Morro Bay

Parameter	Existing(1)	New	Total
Capacity, MGD	5.6	--	5.6
Washer compactor			
Number	1	--	1
Capacity, cfh	86	--	86
Motor Size, hp	3	--	3
Grit Chamber			
Number	1	1	2
Type	Aerated	Aerated	Aerated
Length, feet	14	18	1 at 14; 1 at 18
Depth, feet	10	10	10
Width, feet	12	15	1 at 12; 1 at 15
Peak Capacity, MGD	5.46	8.0	13.46
HRT (at PHWW flow), minutes	3.5	3.5	3.5
Secondary Treatment			
Oxidation Ditch			
Number	2	2	4
Aeration Type	Mechanical	Mechanical	Mechanical
Side Water Depth, feet	13	13	13
Basin Volume (each), MG	1.76	1.76	1.76
Anoxic Volume (each), MG	0.35	0.35	0.35
Aerobic Volume (each), MG	1.41	1.41	1.41
Total, MG	3.52	3.52	7.04
Anoxic mixers			
Number (per ditch)	1	1	1
Drive Motor, hp	15	15	15
Drive Type	Constant Speed	Constant Speed	Constant Speed
Surface Aerators			
Number (per ditch)	2	2	2
Type	Surface	Surface	Surface

Table 9	Design Criteria Capacity Evaluation of the California Men's Colony WWTP City of Morro Bay		
Parameter	**Existing[1]**	**New**	**Total**
Drive Type	Two Speed	VFD[3]	VFD
Drive Motor, hp	60/125	125	125
Online Monitoring Equipment			
Ammonia Probe (total)	0	1	1
Nitrate Probe (total)	0	3	3
TSS Probe (total)	0	2	2
ORP[4] Probe (total)	0	2	2
DO Probe (total)	0	2	2
Ammonia-Based SRT Control System	0	1	1
Secondary Clarifiers			
Sludge Removal Mechanism Type	Spiral Scraper	Spiral Scraper	Spiral Scraper
Number	2	3	5
Diameter, feet	65	65	65
Side Water Depth, feet	14	14	14
Surface Area (total), sf	6,636	9,954	16,590
RAS/WAS Pump Station			
Number	2+1	3+1	5+2
Type	Centrifugal	Centrifugal	Centrifugal
Pump Capacity, each	1.13	1.3	3 at 1.13; 4 at 1.3
Firm Capacity, MGD	2.26	4	6.26
Tertiary Treatment and Disinfection			
Filtration			
Type	Continuous Backwash (DynaSand®)	Continuous Backwash (DynaSand®)	Continuous Backwash (DynaSand®)
Number	8	14	22
Surface Area (each), sf	50	50	50
Loading Rate (at PHWW flow), gpm/sf	9.0	9.0	9.0
MF			
Permeate capacity, MGD	0	2.5	2.5
Recovery, %	0	95	95

Table 9	Design Criteria Capacity Evaluation of the California Men's Colony WWTP City of Morro Bay		
Parameter	**Existing(1)**	**New**	**Total**
Flux, gfd	0	25	25
RO			
Permeate capacity, MGD	0	2.0	2.0
Recovery, %	0	80	80
Flux, gfd	0	11	11
UV Disinfection			
Type	Low Pressure, High Output	Low Pressure, High Output	Low Pressure, High Output
Configuration	Open Channel	Open Channel	Open Channel
Channels	2	3	5
Capacity per Channel, MGD	2.6	2.67	2.6
Total Capacity, MGD	5.2	8.0	13.2
Design UV dose, mJ/cm^2 (5)	100	100	100
Biosolids Handling			
Dewatering			
Type	Centrifuge	Centrifuge	Centrifuge
Number	1+1	2	3+1
Solids Loading, ppd	4,600	5,000(6)	9,600
Hydraulic Loading Rate, gpm/unit	200	200	200
Operating Cycle during Maximum Week, hours/week	35	35	35

Notes:
(1) Based on the 2001 Wastewater Collection/Treatment Upgrade Design Criteria Drawing G03.
(2) The design criteria table from the 2011 design listed an AA NH_3 load of 450 ppd. The maximum month TKN load was calculated assuming that a NH_3/TKN ratio of 0.66 and a MM/AA TKN load ratio equal to the design MM/AA BOD load ratio.
(3) VFD = Variable frequency drive
(4) ORP = Oxidation-reduction potential
(5) mJ/cm^2 = Millijoule per square centimeter
(6) The anticipated maximum week solids load was calculated by assuming a MW/MM WAS load peak factor of 1.2.

6.2 Facility Layout

The first criterion for locating the proposed improvements was to place them where they could be physically accommodated on the site. While the site does have some available space, it is fairly constrained given the size of the required improvements (i.e., oxidation ditches and secondary clarifiers). With the larger improvements located on the site, the remaining improvements were located to accommodate the hydraulic grade line fore the existing facilities. Lastly, wherever possible, the improvements were located to minimize the additional yard piping required. Minimizing the additional yard piping through the facility layout reduces cost and minimizes construction impacts to the existing WWTP.

It is anticipated that the new conveyance pipeline will enter the site from the northwest. The new influent pumping and screening facility, and aerated grit chamber required to accommodate the MBCSD flows are located in a clear area immediately northwest of the existing preliminary treatment facilities.

A new oxidation ditch splitter structure will be located across the road from the existing fine screen and oxidation ditches. At this structure, screened wastewater from CMC and MBCSD will combine with RAS from both the existing and new secondary clarifiers so that it can be evenly split between the four oxidation ditches. The new oxidation ditches and secondary clarifiers are located to the southeast of the existing oxidation ditches. This will require the relocation of the existing pond and maintenance building.

The new FFPS and the new tertiary filters will be located adjacent to the existing Chlorination Building and Chlorine Contact Basins. The new UV structure will be located at the base of the new oxidation ditches in a similar location to the existing UV structure.

Figure 5 shows a rendering of the proposed site layout. Additional renderings are provided in Appendix C.

7.0 RAW WASTEWATER CONVEYANCE EVALUATION

7.1 Background

This section describes the facilities required to convey raw wastewater from the existing MBCSD WWTP site to CMC where it will be treated. These improvements generally fall into the following two categories:

- Conveyance pipeline; and
- Raw wastewater pumping station

PROPOSED SITE LAYOUT
FIGURE 5

CITY OF MORRO BAY
CAPACITY EVALUATION OF THE CALIFORNIA MEN'S COLONY WWTP

7.2 Conveyance Pipeline

7.2.1 Description

7.2.1.1 Pipe Size and Design Flows

Long transmission lines carrying raw surface water or wastewater like the conveyance pipeline require that the conduit be sized for both the maximum and minimum flow conditions. The new pipeline will need to be able to convey a PHWW flow of 8.0 MGD. The maximum velocity in pipelines is governed more by the amount of pressure available to drive flow than a numerical limit. The minimum flow condition should achieve a minimum velocity of at least 1 foot per second (fps). A minimum velocity of 1 fps will re-suspend any solids that may settle in the pipeline during periods of low or no flow. Ideally, the minimum flow condition should be close to the AA design flow so that the pumps in the pump station operate near their best efficiency point.

For this analysis, the minimum design flow selected was 2 MGD. With a minimum flow of 2 MGD and a minimum velocity of 1 fps, the required pipe size is approximately 24 inches in diameter. At the PHWW flow of 8.0 MGD, the maximum velocity in the pipeline is approximately 4 fps.

7.2.1.2 Pipeline Material

Transmission mains in this size range are typically constructed from polyvinyl chloride (PVC), ductile iron pipe (DIP), or welded steel pipe (WSP). Each of these pipe materials is available in the pressure class required for the new conveyance pipeline. During subsequent phases of the project, an analysis will be completed to determine if the pipeline should be limited to a single material, multiple materials, rigid or flexible pipe, or open to bid.

7.2.1.3 Pipeline Appurtenances

Long transmission lines need isolation valves located along the alignment to allow a portion of the pipeline to be taken out of service for cleaning and maintenance. For this analysis, it was assumed that there would be an isolation valve located along every mile of pipe for a total of eight valves. Isolation valves on large diameter piping are frequently smaller than the transmission line. This increases the velocity through the valve and causes a small amount of additional headloss. However, the increased velocity also serves to scour material out of the valve body keeping it cleaner. Isolation vales are assumed to be 18-inch diameter plug valves.

7.2.2 Proposed Alignment

The proposed alignment extends from the existing WWTP generally along Highway 1 to the CMC WWTP as shown in Appendix D. The total length is approximately 8.1 miles with an elevation gain of approximately 180 feet.

7.2.3 Design Criteria

A summary of the design criteria and the results of the hydraulic analysis are shown in Table 10.

Table 10 Design Criteria – Wastewater Conveyance Pipeline
Capacity Evaluation of the California Men's Colony WWTP
City of Morro Bay

Parameter	Criteria
Peak Flow, MGD	8.0
Minimum Flow, MGD	2.0
Minimum Velocity, fps	1.0
Pipe Diameter, inches	24
Lining Material	Double-Thick CML[1]
Isolation Valve	
Type	Plug
Size, inches	18
Spacing, per mile	1

Notes:
(1) CML = Cement mortar lining

7.3 Raw Wastewater Pumping Station

7.3.1 Description

The raw wastewater pumping station (RWWPS) will lift raw sewage from the existing MBCSD WWTP through the new conveyance pipeline to the CMC WWTP for treatment.

7.3.1.1 Pumping Station Configuration

As explained previously, the minimum flow through the pipeline is limited to 2 MGD to maintain adequate velocity in the pipe. Setting the design flow at 2 MGD per pump and providing redundancy with the largest unit out of service in the event of a pump failure requires four duty pumps plus a standby.

The new RWWPS will require a new concrete wet well. The wet well is sized to accommodate the selected pump configuration. The active volume of the pump station will be located below the invert of the sewer inlet pipe so that even when the wet well is full it will not surcharge the existing line.

The pumps will all operate on VFDs, which will allow the pumps to run at a reduced speed to modulate the output based on an input signal such as the wet well level. In this case, the first pump will operate at maximum speed to maintain the 2 MGD minimum flow rate. As influent flow increases beyond the 2 MGD capacity of a single pump, additional pumps will be called to run. These pumps will modulate speed to maintain the set level in the wet well. This operating strategy minimizes the number of starts and stops for the pumps, which will extend their service life.

7.3.1.2 Pump Type

The new RWWPS will not provide screening and removal of solids that make their way into the collection system. This requires that the pumps installed be capable of passing any solids that accumulate in the wet well. The conceptual design assumes that submersible, solids-handling pumps will be installed on guides rails at the bottom of the wet well. If a pump fails or is clogged, the spare pump will automatically be called to run and an alarm will notify the operator that a pump needs attention.

7.3.1.3 Total Design Head Requirements

Total design head (TDH) is the total amount of energy required to convey water the entire length of the pipeline from the RWWPS to the CMC WWTP. TDH is calculated by summing the total change in elevation required, also known as static lift, and the total amount of headloss that occurs throughout the system.

Static lift includes the change in elevation between the water surface elevation at the RWWPS and the water surface elevation at the discharge. This difference in elevation is not dependent on the flow through the pipeline. In addition to elevation change, it is desirable to maintain a positive residual pressure in the pipeline. This residual pressure can be added to the static lift, as it also does not change with the amount of flow.

Headloss is the amount of energy spent to move water past the wall of the pipeline. Headloss calculations for the transmission line were completed using another *Hydraulix*® model separate from the model created for the hydraulic evaluation of the CMC WWTP. The amount of headloss through the line is dependent on both the velocity through the line and the friction factor of the surface in contact with the wastewater. In the case of flexible pipe materials, such as PVC, this is typically the pipe wall itself. For rigid pipes, such as DIP or WSP, this is frequently a liner applied to the inside of the pipe barrel to protect the pipe material from the corrosive effects of wastewater. The friction factor is based on the absolute roughness of the pipe wall with rougher materials producing more friction and consequently more headloss. This analysis has assumed CML to calculate the friction factor. Assuming a rougher material such as CML instead of PVC at this stage provides additional conservatism in the TDH calculation in the event PVC is later selected as the desired pipe material.

In addition to friction losses, small amounts of energy loss occur when the pipeline changes direction at fittings, or if the pipeline changes shape (reduced size, valve body, etc.). These losses are termed minor losses, and were accounted for by adding an additional one percent to the length of the pipe. Analysis of minor losses through addition of pipe length is known as the equivalent length method.

All of these components taken together provide the TDH used to select a pump for the new RWWPS.

7.3.2 Location and Site Layout

The RWWPS will be located on the site of the existing MBCSD WWTP near the existing headworks facility. The new RWWPS will be constructed within, but separately from, the existing WWTP to minimize the interference with the existing facility.

7.3.3 Design Criteria

A summary of the design criteria are shown in Table 11.

Table 11 Design Criteria – Wastewater Raw Wastewater Pumping Station
Capacity Evaluation of the California Men's Colony WWTP
City of Morro Bay

Parameter	Criteria
Peak Flow, MGD	8.0
Pump Flow, MGD	2.0
Total Design Head, ft	295
Total Static Head, ft	215
Pump Station Configuration	4+1
Pump Type	Submersible, Solids Handling

8.0 PLANNING-LEVEL COST ESTIMATES

8.1 Introduction

The cost estimate is one of the most sensitive products prepared for a project. The level of accuracy that can be expected is directly proportional to the level of engineering effort completed. Each cost estimate must be carefully prepared from the conceptual level to the facilities plan level, through the preliminary design and the final engineer's estimate.

8.2 Scope and Level of Accuracy

The Association for the Advancement of Cost Engineering (AACE) International (formally known as the American Association of Cost Engineers) has suggested levels of accuracy for five estimate classes. These five estimate classes are presented in the AACE International Recommended Practice No. 18R-97.

Table 12 presents a summary of these five estimate classes and their characteristics including expected accuracy ranges determined for each process area to determine the total capital costs.

The quantity and quality of the information required to prepare an estimate depends on the end use for that estimate. Typically, as a project progresses from the conceptual phase to the study phase, preliminary design and final design, the quantity and quality of information increases, thereby providing data for development of a progressively more accurate cost estimate. A contingency is often used to compensate for lack of detailed engineering data, oversights, anticipated changes, and imperfection in the estimating methods used. As the quantity and quality of data becomes better, smaller contingency allowances are typically utilized. For the individual components described in this TM, cost estimates are developed following the AACE International Recommended Practice No. 18R-97 estimate Class 4.

Class 4 estimates are prepared for any number of strategic business planning purposes including, but not limited to, detailed strategic planning, confirmation of economic and/or technical feasibility, and preliminary budget approval or approval to proceed to next stage. Limited information is available at the time when a Class 4 estimate is developed. Therefore, Class 4 estimates virtually always use stochastic estimating methods such as parametric or other modeling techniques, and various factors. Subsequently, estimated costs have fairly wide accuracy ranges. Typical accuracy ranges for Class 4 estimates are –15 percent to –30 percent on the low side, and +20 percent to +50 percent on the high side, depending on the technological complexity of the project, availability and accuracy of appropriate reference information, and the inclusion of an appropriate contingency determination. Capital costs for the necessary treatment plant improvements and raw wastewater conveyance facilities needed for combined MBCSD to be treated at the CMC WWTP are prepared based on Class 4 estimates.

8.3 Basis of Cost Evaluations

The costs presented in this TM are based on preliminary layouts, preliminary unit process sizes, and conceptual alternative configurations. Capital costs have been estimated from unit costs developed from the following sources:

- Final Engineer’s Estimate for the California Men’s Colony Wastewater Treatment Plant Improvement Project (Carollo, January 2001)

Table 12 Category of Cost Estimates[1]
Capacity Evaluation of the California Men's Colony WWTP
City of Morro Bay

	Primary Characteristic	Secondary Characteristic			
Estimate Class	**Level of Project Definition Expressed as percent of Complete Definition**	**End Usage**	**Methodology Typical Estimating Method**	**Expected Accuracy Range Typical Variation in Low and High Ranges[a]**	**Preparation Effort Typical Degree of Effort Relative to Least Cost Index of 1[b]**
Class 5	0% to 2%	Concept Screening	Capacity Factored, Parametric Models, Judgment, or Analogy	L: -20% to -50% H: +30% - +100%	1
Class 4	1% to 15%	Study or Feasibility	Equipment Factored or parametric Models	L: - 15% to -30% H: +20% - +50%	2 to 4
Class 3	10% to 40%	Budget, Authorization, or Control	Semi-Detailed Unit Costs with Assembly Level Line Items	L: - 10% to -20% H: +10% - +30%	3 to 10
Class 2	30% to 70%	Control or Bid/Tender	Detailed Unit Cost with Forced Detailed Take-Off	L: - 5% to -15% H: +5% - +20%	4 to 20
Class 1	50% to 100%	Check Estimate or Bid/Tender	Detailed Unit Cost with Detailed Take-Off	L: - 3% to -10% H: +3% - +15%	5 to 100

Notes:
(1) Table 1.1 comes from the AACE International Recommended Practices and Standards, No. 18R-97.
- (a) The state of process technology and availability of applicable reference cost data affect the range markedly. The +/- value represents typical percentage variation of actual costs from the cost estimate after application of contingency (typically at a 50% level of confidence) for a give scope.
- (b) If the range index value of "1" represents 0.005% of project costs, then an index value of 100 represents 0.5%. Estimate preparation effort is highly dependent upon the size of the project and the quality of estimating data and tools.

- Final Engineer's for the California Men's Colony Wastewater Treatment Plant Disinfection Upgrade (JR Conkey & Associates, February 2012)

- Carollo Cost Estimating System (CCES)

A summary of the economic criteria used for estimating costs is presented in Table 13. These economic criteria were applied to the capital costs determined for each process area to determine the total capital cost.

Table 13 Economic Criteria
Capacity Evaluation of the California Men's Colony WWTP
City of Morro Bay

Item	Assumption
General	
Cost in Time and Place	Costs are based on 2014 (ENRCCI[1] = 10737) in San Luis Obispo, CA
Direct Cost Factors	
General Conditions	10 percent applied to the Total Capital Cost
Site Work	2.5 percent applied to the Total Capital Cost
Yard Piping and Miscellaneous Structures	5.0 percent applied to the Total Capital Cost
Electrical and Instrumentation	15 percent applied to the Total Capital Cost
Indirect Cost Factors	
Design Contingency	30 percent applied to the Total Capital Cost
General Contractor Overhead and Profit (OH&P)	18 percent applied to the Total Capital Cost
Escalation to Mid-Point of Construction[2]	12.6 percent applied to the Total Direct Cost
Sales Tax[3]	3.5 percent applied to the Total Direct Cost
Project Cost Factors	
Engineering, Administration and Legal	35 percent applied to the Total Estimated Construction Cost

Notes:
(1) ENRCCI = Engineering News Record Construction Cost Index
(2) Escalation based on an annual escalation rate of 3 percent to a mid-point of construction in November 2018
(3) Sales tax calculated as 8.7 percent applied to 40 percent of the Total Direct Cost

8.4 Capital Costs

While the estimated construction costs represent the average bidding conditions for many projects, variations in bidding climate at the time the facilities are constructed can affect actual construction costs. Further, the size of the facilities may be refined during preliminary design based on the most current operational information available. For these reasons, the actual construction costs may be lower or higher than originally estimated. As mentioned earlier, Class 4 estimates are not as accurate as estimates prepared in conjunction with preliminary or final design.

Construction costs have historically escalated with time. This trend is expected to continue in the future. To record these trends in rising costs, several indices have been established for various fields of construction. The standard indicator of changes in heavy construction prices is the ENRCCI. Capital costs developed for the CMC WWTP improvements outlined in this TM are based on July 2009 costs for San Luis Obispo with an ENRCCI of 6825 and February 2012 costs with an ENRCCI of 10092.

As the financial analysis is developed, the estimated costs will be escalated to the projected time of construction. The estimated escalation rate is 3 percent. This escalation rate has been applied to current costs to a mid-point of construction of November 2018 based on direction from the City.

The construction costs presented include contractor's overhead and profit, and design contingencies. Costs to the owner, such as engineering, legal, administrative, project contingencies, and construction management costs are added to the construction costs. A variable project cost factor of 35 percent is applied to the construction costs to arrive at the total estimated project capital cost.

Several different approaches have been used to develop construction cost estimates for the CMC WWTP improvements and new conveyance facilities. Treatment plant costs have been developed using a capacity factored estimate approach. Conveyance facilities costs are based on unit costs.

8.4.1 Treatment Plant Cost Estimating Approach

As mentioned previously, the CMC WWTP improvement cost estimates have been developed using a capacity factored estimate approach. The basis of these estimates is the final engineer’s estimates from the last major expansions to the CMC facility completed in 2003 and 2013. A summary of these estimates is included in Appendix E. In order to develop cost factors, direct costs for each process were escalated to current values using an ENRCCI of 10737. These direct costs were then converted to unit costs using the appropriate design criteria. Table 12 includes the design criteria for each unit process and the associated unit cost used to develop the capital cost estimates for the CMC WWTP improvements.

For project cost components not represented by the unit costs in Table 14, cost factors were applied to the total capital cost for the improvements to account for the following items:

- General conditions
- Site work
- Yard piping
- Electrical and instrumentation

8.4.2 Raw Wastewater Conveyance Cost Estimating Approach

Cost estimates for the RWWPS and conveyance pipeline necessary to convey sewage from the current MBCSD WWTP site to the CMC WWTP were developed using the CCES. The CCES is a cost-estimating tool supported by a compilation of up-to-date cost databases focused on the water and wastewater industry. The development of the estimates for these facilities began with a conceptual alignment of the conveyance pipeline. Based on the design PHWW flow requirements of 8.0 MGD, the elevation difference between the two sites, and the alignment length, the diameter for the pipeline was selected. Following selection of the pipeline diameter, the TDH for the system was determined in order to identify the size of the pumps needed to lift the raw wastewater from the MBCSD WWTP to the CMC WWTP. Once the pumps were preliminarily selected, the wet well was sized. Quantity take-offs were then done based on the conceptual design of the conveyance pipeline and RWWPS for items that could be quantified at this stage in the project.

Cost factors were applied to the total capital cost for the RWWPS and force main to account for the following items:

- General conditions
- Electrical and instrumentation (applied to the RWWPS only)

8.5 Results

A summary of the cost estimate results for the RWWPS, conveyance pipeline, and CMC WWTP improvements is included in Table 15. Cost estimating details for these facilities are included in Appendix F.

Table 14 Unit Cost Development for CMC WWTP Improvements
Capacity Evaluation of the California Men's Colony WWTP
City of Morro Bay

Process	Total Capital Cost	Design Criteria		Unit Costs	
		Value	Unit	Value	Unit
Influent Pumping and Screening[(1)]	$1,464,260	5.46	MGD	$331,238.98	$/MGD
Aerated Grit Removal[(1)]	$322,990	12,566	Gallons	$31.75	$/Gallon
Oxidation Ditches[(1)]	$2,879,450	3,520,000	Gallons	$1.01	$/Gallon
Secondary Clarification[(1)]	$1,144,620	694,986	Gallons	$2.03	$/Gallon
RAS/WAS Pumping[(1)]	$291,970	3.4	MGD	$106,065.76	$/MGD
Tertiary Filtration[(1)]	$972,780	8	Filter Cells	$150,189.83	$/Filter Cell
UV Disinfection[(2)]	$2,048,241	2	Channels	$1,024,120.25	$/Channel
MF-RO	TBD	2.25 (MF) / 1.8 (RO)	MGD	TBD	$/Gallon
Brine disposal	TBD	0.55	MGD	TBD	$/Gallon
Biosolids Dewatering[(1)]	$2,265,890	4,603	Pounds per Day	$608.01	$/Pounds per Day

Notes:

(1) Costs developed using the Final Engineer's Estimate for the California Men's Colony Wastewater Treatment Plant Improvement Project (Carollo, January 2001)
(2) Cost developed using the Final Engineer's for the California Men's Colony Wastewater Treatment Plant Disinfection Upgrade (JR Conkey & Associates, February 2012)

Table 15	Summary of Total Project Costs Capacity Evaluation of the California Men's Colony WWTP City of Morro Bay
CMC WWTP Improvements	
General Conditions	$2,778,000
Site Work	$694,000
Yard Piping-Misc. Structures	$2,083,000
Influent Pumping-Screening	$2,650,000
Aerated Grit Removal	$641,000
Oxidation Ditches	$3,555,000
RAS-WAS Pump Station	$424,000
Secondary Clarifiers	$2,116,000
Tertiary Filters	$2,797,000
UV Disinfection	$3,072,000
MF-RO	TBD
Brine disposal	TBD
Biosolids Dewatering	$2,799,000
Electrical-Instrumentation	$4,167,000
Subtotal	**$27,776,000**
New Conveyance Facilities	
8 MGD Raw Wastewater Pump Station	$2,036,000
24-inch Raw Wastewater Force Main	$8,263,000
Subtotal	**$10,299,000**
Total Capital Cost	$38,075,000
Total Construction Cost(1)	$68,028,000
Total Project Cost(2)	$91,838,000

Notes:

(1) Cost includes contingency (30 percent), general contractor overhead and profit (18 percent), escalation to mid-point of construction (12.6 percent), and sales tax (3.5 percent).

(2) Cost includes engineering, administration, and legal (35 percent).

APPENDIX A – BIOWIN OUTPUT

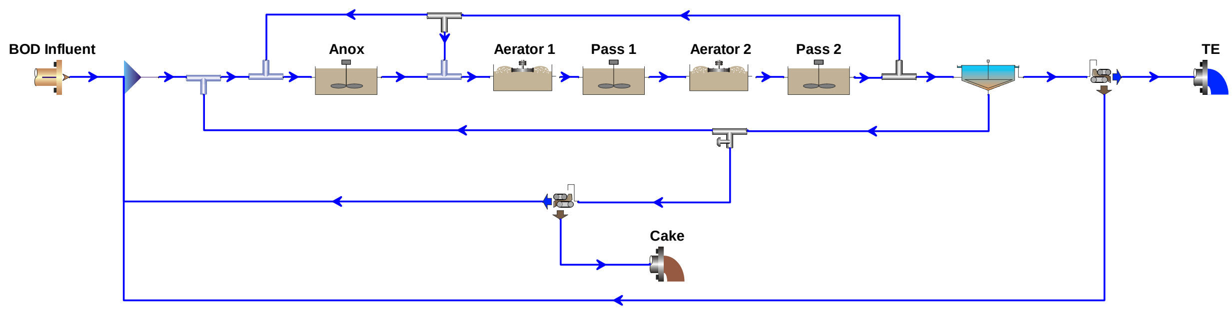
BioWin user and configuration data

Project details
User name: AConklin

Created: 10/24/2014Saved: 11/20/2014

Target aSRT: 16.00 daysSRT: **** days
Temperature: 15.0°C

Flowsheet



Configuration information for all Bioreactor units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]	# of diffusers
Anox	0.7000	7198.1842	13.000	Un-aerated
Pass 1	1.0533	1.083E+4	13.000	Un-aerated
Pass 2	1.0533	1.083E+4	13.000	Un-aerated

Operating data Average (flow/time weighted as required)

Element name	Average DO Setpoint [mg/L]
Anox	0
Pass 1	0
Pass 2	0

Aeration equipment parameters

Element name	k1 in C = k1(PC)^0.25 + k2	k2 in C = k1(PC)^0.25 + k2	Y in Kla = C Usg ^ Y - Usg in [m3/(m2 d)]	Area of one diffuser	% of tank area covered by diffusers [%]
Anox	2.5656	0.0432	0.8200	0.4413	10.0000
Pass 1	2.5656	0.0432	0.8200	0.4413	10.0000
Pass 2	2.5656	0.0432	0.8200	0.4413	10.0000

Configuration information for all BOD Influent units

Operating data Average (flow/time weighted as required)

Element name	BOD Influent
Flow	2.9
Total Carbonaceous BOD mgBOD/L	227.00
Volatile suspended solids mgVSS/L	221.00
Total suspended solids mgTSS/L	260.00
Total Kjeldahl Nitrogen mgN/L	39.00
Total P mgP/L	10.00
Nitrate N mgN/L	0
pH	7.30
Alkalinity mmol/L	6.00
Calcium mg/L	80.00
Magnesium mg/L	15.00
Dissolved oxygen mg/L	0

Element name	BOD Influent
Fbs - Readily biodegradable (including Acetate) [gCOD/g of total COD]	0.1600
Fac - Acetate [gCOD/g of readily biodegradable COD]	0.1500
Fxsp - Non-colloidal slowly biodegradable [gCOD/g of slowly degradable COD]	0.9129
Fus - Unbiodegradable soluble [gCOD/g of total COD]	0.0500
Fup - Unbiodegradable particulate [gCOD/g of total COD]	0.1300
Fna - Ammonia [gNH3-N/gTKN]	0.6600
Fnox - Particulate organic nitrogen [gN/g Organic N]	0.5000
Fnus - Soluble unbiodegradable TKN [gN/gTKN]	0.0200
FupN - N:COD ratio for unbiodegradable part. COD [gN/gCOD]	0.0350
Fpo4 - Phosphate [gPO4-P/gTP]	0.5000
FupP - P:COD ratio for unbiodegradable part. COD [gP/gCOD]	0.0110
FZbh - OHO COD fraction [gCOD/g of total COD]	0.0200
FZbm - Methylotroph COD fraction [gCOD/g of total COD]	1.000E-4
FZaob - AOB COD fraction [gCOD/g of total COD]	1.000E-4
FZnob - NOB COD fraction [gCOD/g of total COD]	1.000E-4
FZamob - ANAMMOX COD fraction [gCOD/g of total COD]	1.000E-4
FZbp - PAO COD fraction [gCOD/g of total COD]	1.000E-4
FZbpa - Propionic acetogens COD fraction [gCOD/g of total COD]	1.000E-4
FZbam - Acetoclastic methanogens COD fraction [gCOD/g of total COD]	1.000E-4
FZbhm - H2-utilizing methanogens COD fraction [gCOD/g of total COD]	1.000E-4
FZe - Endogenous products COD fraction [gCOD/g of total COD]	0

Configuration information for all Model clarifier units

Physical data

Element name	Volume[Mil. Gal]	Area[ft2]	Depth[ft]	Number of layers	Top feed layer	Feed Layers
SC	0.6950	6636.0000	14.000	10	6	1

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
SC	Flow paced	100.00 %

Element name	Average Temperature	Reactive
SC	Uses global setting	No

Configuration information for all Dewatering unit units

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
Filters	Flow paced	10.00 %
Centrifuges	Flow paced	0.50 %

Element name	Percent removal
Filters	60.00
Centrifuges	85.00

Configuration information for all Splitter units

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
RAS splitter	Flowrate [Side]	0.0799178609117129
ML splitter	Flowrate [Side]	250
IR splitter	Fraction	0.85

Configuration information for all Bioreactor (surface aerators) units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]
Aerator 1	0.3567	3667.9890	13.000
Aerator 2	0.3567	3667.9890	13.000

Operating data Average (flow/time weighted as required)

Element name	Average Power supply rate [hp]
Aerator 1	117.5
Aerator 2	117.5

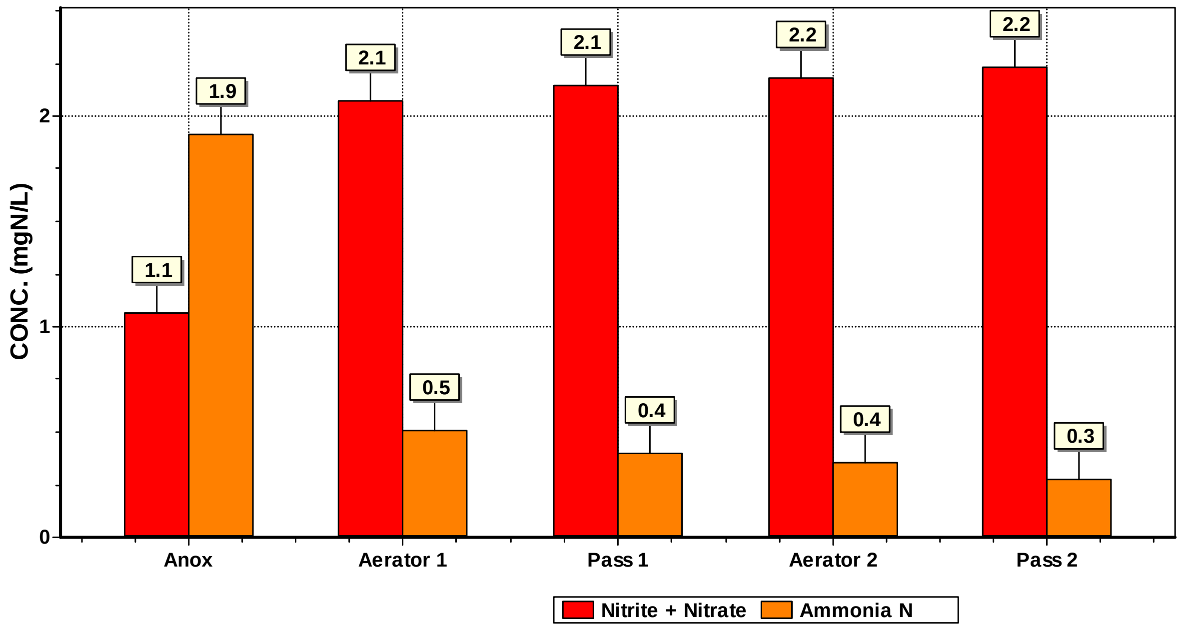
Aeration equipment parameters

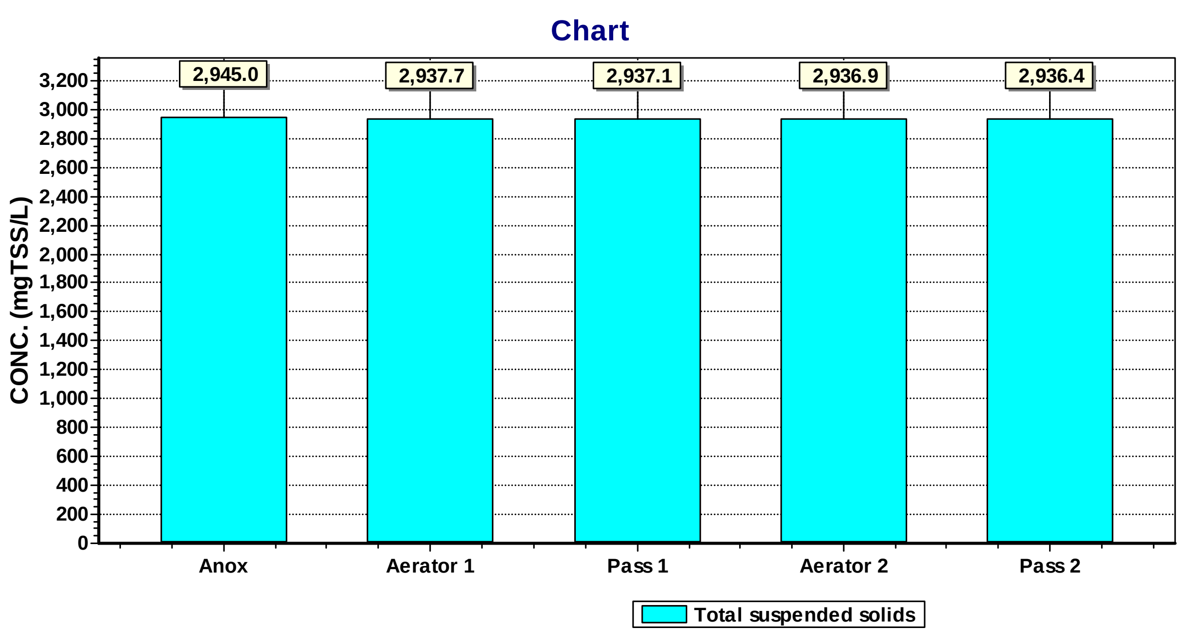
Element name	Surface aerator Std. oxygen transfer rate [lb O /(hp hr)]	Maximum power per rotor [hp]
Aerator 1	2.4670	26.8097
Aerator 2	2.4670	26.8097

Element name	Alpha (surf) OR Alpha F (diff) [-]	Beta [-]	Surface pressure [kPa]	Fractional effective saturation depth (Fed) [-]
Aerator 1	0.8500	0.9500	101.3250	0.3250
Aerator 2	0.8500	0.9500	101.3250	0.3250

Element name	Supply gas CO2 content [vol. %]	Supply gas O2 [vol. %]	Off-gas CO2 [vol. %]	Off-gas O2 [vol. %]	Off-gas H2 [vol. %]	Off-gas NH3 [vol. %]	Off-gas CH4 [vol. %]	Surface turbulence factor [-]
Aerator 1	0.0350	20.9500	2.0000	18.8000	0	0	0	2.0000
Aerator 2	0.0350	20.9500	2.0000	18.8000	0	0	0	2.0000

BioWin Album





Global Parameters

AOB

Name	Default	Value	
Max. spec. growth rate [1/d]	0.9000	0.9000	1.0720
Substrate (NH4) half sat. [mgN/L]	0.7000	0.7000	1.0000
Byproduct NH4 logistic slope [-]	50.0000	50.0000	1.0000
Byproduct NH4 inflection point [mgN/L]	1.4000	1.4000	1.0000
AOB denite DO half sat. [mg/L]	0.1000	0.1000	1.0000
AOB denite HNO2 half sat. [mgN/L]	5.000E-6	5.000E-6	1.0000
Aerobic decay rate [1/d]	0.1700	0.1700	1.0290
Anoxic/anaerobic decay rate [1/d]	0.0800	0.0800	1.0290
KiHNO2 [mmol/L]	0.0050	0.0050	1.0000

NOB

Name	Default	Value	
Max. spec. growth rate [1/d]	0.7000	0.7000	1.0600
Substrate (NO2) half sat. [mgN/L]	0.1000	0.1000	1.0000
Aerobic decay rate [1/d]	0.1700	0.1700	1.0290
Anoxic/anaerobic decay rate [1/d]	0.0800	0.0800	1.0290
KiNH3 [mmol/L]	0.0750	0.0750	1.0000

ANAMMOX

Name	Default	Value	
Max. spec. growth rate [1/d]	0.1000	0.1000	1.1000
Substrate (NH4) half sat. [mgN/L]	2.0000	2.0000	1.0000
Substrate (NO2) half sat. [mgN/L]	1.0000	1.0000	1.0000
Aerobic decay rate [1/d]	0.0190	0.0190	1.0290
Anoxic/anaerobic decay rate [1/d]	0.0095	0.0095	1.0290
Ki Nitrite [mgN/L]	1000.0000	1000.0000	1.0000
Nitrite sensitivity constant [L / (d mgN)]	0.0160	0.0160	1.0000

OHO

Name	Default	Value	
Max. spec. growth rate [1/d]	3.2000	3.2000	1.0290
Substrate half sat. [mgCOD/L]	5.0000	5.0000	1.0000
Anoxic growth factor [-]	0.5000	0.5000	1.0000
Denite N2 producers (NO3 or NO2) [-]	0.5000	0.5000	1.0000
Aerobic decay rate [1/d]	0.6200	0.6200	1.0290
Anoxic decay rate [1/d]	0.2330	0.2330	1.0290
Anaerobic decay rate [1/d]	0.1310	0.1310	1.0290
Hydrolysis rate [1/d]	2.1000	2.1000	1.0290
Hydrolysis half sat. [-]	0.0600	0.0600	1.0000
Anoxic hydrolysis factor [-]	0.2800	0.2800	1.0000
Anaerobic hydrolysis factor (AS) [-]	0.0400	0.0400	1.0000
Anaerobic hydrolysis factor (AD) [-]	0.2000	0.2000	1.0000
Adsorption rate of colloids [L/(mgCOD d)]	0.1500	0.1500	1.0290
Ammonification rate [L/(mgN d)]	0.0400	0.0400	1.0290
Assimilative nitrate/nitrite reduction rate [1/d]	0.5000	0.5000	1.0000
Fermentation rate [1/d]	1.6000	1.6000	1.0290
Fermentation half sat. [mgCOD/L]	5.0000	5.0000	1.0000
Fermentation growth factor (AS) [-]	0.2500	0.2500	1.0000
Endogenous products decay rate[1/d]	0	0	1.0000
Free nitrous acid inhibition [mmol/L]	1.000E-7	1.000E-7	1.0000

Methylotrophs

Name	Default	Value	
Max. spec. growth rate [1/d]	1.3000	1.3000	1.0720
Methanol half sat. [mgCOD/L]	0.5000	0.5000	1.0000
Denite N2 producers (NO3 or NO2) [-]	0.5000	0.5000	1.0000
Aerobic decay rate [1/d]	0.0400	0.0400	1.0290
Anoxic/anaerobic decay rate [1/d]	0.0300	0.0300	1.0000
Free nitrous acid inhibition [mmol/L]	1.000E-7	1.000E-7	1.0000

PAO

Name	Default	Value	
Max. spec. growth rate [1/d]	0.9500	0.9500	1.0000
Max. spec. growth rate, P-limited [1/d]	0.4200	0.4200	1.0000
Substrate half sat. [mgCOD(PHB)/mgCOD(Zbp)]	0.1000	0.1000	1.0000
Substrate half sat., P-limited [mgCOD(PHB)/mgCOD(Zbp)]	0.0500	0.0500	1.0000
Magnesium half sat. [mgMg/L]	0.1000	0.1000	1.0000
Cation half sat. [mmol/L]	0.1000	0.1000	1.0000
Calcium half sat. [mgCa/L]	0.1000	0.1000	1.0000
Aerobic/anoxic decay rate [1/d]	0.1000	0.1000	1.0000
Aerobic/anoxic maintenance rate [1/d]	0	0	1.0000
Anaerobic decay rate [1/d]	0.0400	0.0400	1.0000
Anaerobic maintenance rate [1/d]	0	0	1.0000
Sequestration rate [1/d]	4.5000	4.5000	1.0000
Anoxic growth factor [-]	0.3300	0.3300	1.0000

Acetogens

Name	Default	Value	
Max. spec. growth rate [1/d]	0.2500	0.2500	1.0290
Substrate half sat. [mgCOD/L]	10.0000	10.0000	1.0000
Acetate inhibition [mgCOD/L]	10000.0000	10000.0000	1.0000
Anaerobic decay rate [1/d]	0.0500	0.0500	1.0290
Aerobic/anoxic decay rate [1/d]	0.5200	0.5200	1.0290

Methanogens

Name	Default	Value	
Acetoclastic max. spec. growth rate [1/d]	0.3000	0.3000	1.0290
H2-utilizing max. spec. growth rate [1/d]	1.4000	1.4000	1.0290
Acetoclastic substrate half sat. [mgCOD/L]	100.0000	100.0000	1.0000
Acetoclastic methanol half sat. [mgCOD/L]	0.5000	0.5000	1.0000
H2-utilizing CO2 half sat. [mmol/L]	0.1000	0.1000	1.0000
H2-utilizing substrate half sat. [mgCOD/L]	0.1000	0.1000	1.0000
H2-utilizing methanol half sat. [mgCOD/L]	0.5000	0.5000	1.0000
Acetoclastic propionic inhibition [mgCOD/L]	10000.0000	10000.0000	1.0000
Acetoclastic anaerobic decay rate [1/d]	0.1300	0.1300	1.0290
Acetoclastic aerobic/anoxic decay rate [1/d]	0.6000	0.6000	1.0290
H2-utilizing anaerobic decay rate [1/d]	0.1300	0.1300	1.0290
H2-utilizing aerobic/anoxic decay rate [1/d]	2.8000	2.8000	1.0290

pH

Name	Default	Value
OHO low pH limit [-]	4.0000	4.0000
OHO high pH limit [-]	10.0000	10.0000
Methylotrophs low pH limit [-]	4.0000	4.0000
Methylotrophs high pH limit [-]	10.0000	10.0000
Autotrophs low pH limit [-]	5.5000	5.5000
Autotrophs high pH limit [-]	9.5000	9.5000
PAO low pH limit [-]	4.0000	4.0000
PAO high pH limit [-]	10.0000	10.0000
OHO low pH limit (anaerobic) [-]	5.5000	5.5000
OHO high pH limit (anaerobic) [-]	8.5000	8.5000
Propionic acetogens low pH limit [-]	4.0000	4.0000
Propionic acetogens high pH limit [-]	10.0000	10.0000
Acetoclastic methanogens low pH limit [-]	5.0000	5.0000
Acetoclastic methanogens high pH limit [-]	9.0000	9.0000
H2-utilizing methanogens low pH limit [-]	5.0000	5.0000
H2-utilizing methanogens high pH limit [-]	9.0000	9.0000

Switches

Name	Default	Value
Aerobic/anoxic DO half sat. [mgO2/L]	0.0500	**0.2500**
Anoxic/anaerobic NOx half sat. [mgN/L]	0.1500	0.1500
AOB DO half sat. [mgO2/L]	0.2500	0.2500
NOB DO half sat. [mgO2/L]	0.5000	0.5000
ANAMMOX DO half sat. [mgO2/L]	0.0100	0.0100
Anoxic NO3(->NO2) half sat. [mgN/L]	0.1000	0.1000
Anoxic NO3(->N2) half sat. [mgN/L]	0.0500	0.0500
Anoxic NO2(->N2) half sat. (mgN/L)	0.0100	0.0100
NH3 nutrient half sat. [mgN/L]	0.0050	0.0050
PolyP half sat. [mgP/mgCOD]	0.0100	0.0100
VFA sequestration half sat. [mgCOD/L]	5.0000	5.0000
P uptake half sat. [mgP/L]	0.1500	0.1500
P nutrient half sat. [mgP/L]	0.0010	0.0010
Autotroph CO2 half sat. [mmol/L]	0.1000	0.1000
H2 low/high half sat. [mgCOD/L]	1.0000	1.0000
Propionic acetogens H2 inhibition [mgCOD/L]	5.0000	5.0000
Synthesis anion/cation half sat. [meq/L]	0.0100	0.0100

Changed Aerobic/Anoxic DO half sat switch based on suggestion from Envirosim for modeling oxidation ditches.

Common

Name	Default	Value
Biomass volatile fraction (VSS/TSS)	0.9200	0.9200
Endogenous residue volatile fraction (VSS/TSS)	0.9200	0.9200
N in endogenous residue [mgN/mgCOD]	0.0700	0.0700
P in endogenous residue [mgP/mgCOD]	0.0220	0.0220
Endogenous residue COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200
Particulate substrate COD:VSS ratio [mgCOD/mgVSS]	1.6000	1.6000
Particulate inert COD:VSS ratio [mgCOD/mgVSS]	1.6000	1.6000

AOB

Name	Default	Value
Yield [mgCOD/mgN]	0.1500	0.1500
AOB denite NO2 fraction as TEA [-]	0.5000	0.5000
Byproduct NH4 fraction to N2O [-]	0.0025	0.0025
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous residue [-]	0.0800	0.0800
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

NOB

Name	Default	Value
Yield [mgCOD/mgN]	0.0900	0.0900
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous residue [-]	0.0800	0.0800
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

ANAMMOX

Name	Default	Value
Yield [mgCOD/mgN]	0.1140	0.1140
Nitrate production [mgN/mgBiomassCOD]	2.2800	2.2800
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous residue [-]	0.0800	0.0800
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

OHO

Name	Default	Value
Yield (aerobic) [-]	0.6660	0.6660
Yield (fermentation, low H2) [-]	0.1000	0.1000
Yield (fermentation, high H2) [-]	0.1000	0.1000
H2 yield (fermentation low H2) [-]	0.3500	0.3500
H2 yield (fermentation high H2) [-]	0	0
Propionate yield (fermentation, low H2) [-]	0	0
Propionate yield (fermentation, high H2) [-]	0.7000	0.7000
CO2 yield (fermentation, low H2) [-]	0.7000	0.7000
CO2 yield (fermentation, high H2) [-]	0	0
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Endogenous fraction - aerobic [-]	0.0800	0.0800
Endogenous fraction - anoxic [-]	0.1030	0.1030
Endogenous fraction - anaerobic [-]	0.1840	0.1840
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200
Yield (anoxic) [-]	0.5400	0.5400
Yield propionic (aerobic) [-]	0.6400	0.6400
Yield propionic (anoxic) [-]	0.4600	0.4600
Yield acetic (aerobic) [-]	0.6000	0.6000
Yield acetic (anoxic) [-]	0.4300	0.4300
Yield methanol (aerobic) [-]	0.5000	0.5000
Adsorp. max. [-]	1.0000	1.0000
Max fraction to N2O at high FNA over nitrate [-]	0.0500	0.0500
Max fraction to N2O at high FNA over nitrite [-]	0.1000	0.1000

Methylotrophs

Name	Default	Value
Yield (anoxic) [-]	0.4000	0.4000
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous residue [-]	0.0800	0.0800
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200
Max fraction to N2O at high FNA over nitrate [-]	0.1000	0.1000
Max fraction to N2O at high FNA over nitrite [-]	0.1500	0.1500

PAO

Name	Default	Value
Yield (aerobic) [-]	0.6390	0.6390
Yield (anoxic) [-]	0.5200	0.5200
Aerobic P/PHA uptake [mgP/mgCOD]	0.9300	0.9300
Anoxic P/PHA uptake [mgP/mgCOD]	0.3500	0.3500
Yield of PHA on sequestration [-]	0.8890	0.8890
N in biomass [mgN/mgCOD]	0.0700	0.0700
N in sol. inert [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous part. [-]	0.2500	0.2500
Inert fraction of endogenous sol. [-]	0.2000	0.2000
P/Ac release ratio [mgP/mgCOD]	0.5100	0.5100
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200
Yield of low PP [-]	0.9400	0.9400

Acetogens

Name	Default	Value
Yield [-]	0.1000	0.1000
H2 yield [-]	0.4000	0.4000
CO2 yield [-]	1.0000	1.0000
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous residue [-]	0.0800	0.0800
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

Methanogens

Name	Default	Value
Acetoclastic yield [-]	0.1000	0.1000
Methanol acetoclastic yield [-]	0.1000	0.1000
H2-utilizing yield [-]	0.1000	0.1000
Methanol H2-utilizing yield [-]	0.1000	0.1000
N in acetoclastic biomass [mgN/mgCOD]	0.0700	0.0700
N in H2-utilizing biomass [mgN/mgCOD]	0.0700	0.0700
P in acetoclastic biomass [mgP/mgCOD]	0.0220	0.0220
P in H2-utilizing biomass [mgP/mgCOD]	0.0220	0.0220
Acetoclastic fraction to endog. residue [-]	0.0800	0.0800
H2-utilizing fraction to endog. residue [-]	0.0800	0.0800
Acetoclastic COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200
H2-utilizing COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

General

Name	Default	Value
Molecular weight of other anions [mg/mmol]	35.5000	35.5000
Molecular weight of other cations [mg/mmol]	39.1000	39.1000
Mg to P mole ratio in polyphosphate [mmolMg/mmolP]	0.3000	0.3000
Cation to P mole ratio in polyphosphate [meq/mmolP]	0.1500	0.1500
Ca to P mole ratio in polyphosphate [mmolCa/mmolP]	0.0500	0.0500
Cation to P mole ratio in organic phosphate [meq/mmolP]	0.0100	0.0100
Bubble rise velocity (anaerobic digester) [cm/s]	23.9000	23.9000
Bubble Sauter mean diameter (anaerobic digester) [cm]	0.3500	0.3500
Anaerobic digester gas hold-up factor []	1.0000	1.0000
Tank head loss per metre of length (from flow) [m/m]	0.0025	0.0025

Mass transfer

Name	Default	Value	
Kl for H2 [m/d]	17.0000	17.0000	1.0240
Kl for CO2 [m/d]	10.0000	10.0000	1.0240
Kl for NH3 [m/d]	1.0000	1.0000	1.0240
Kl for CH4 [m/d]	8.0000	8.0000	1.0240
Kl for N2 [m/d]	15.0000	15.0000	1.0240
Kl for N2O [m/d]	8.0000	8.0000	1.0240
Kl for O2 [m/d]	13.0000	13.0000	1.0240

Henry's law constants

Name	Default	Value	
CO2 [M/atm]	0.0340	0.0340	2400.0000
O2 [M/atm]	0.0013	0.0013	1500.0000
N2 [M/atm]	6.500E-4	6.500E-4	1300.0000
N2O [M/atm]	0.0250	0.0250	2600.0000
NH3 [M/atm]	58.0000	58.0000	4100.0000
CH4 [M/atm]	0.0014	0.0014	1600.0000
H2 [M/atm]	7.800E-4	7.800E-4	500.0000

Physico-chemical rates

Name	Default	Value	
Struvite precipitation rate [1/d]	3.000E+10	3.000E+10	1.0240
Struvite redissolution rate [1/d]	3.000E+11	3.000E+11	1.0240
Struvite half sat. [mgTSS/L]	1.0000	1.0000	1.0000
HDP precipitation rate [L/(molP d)]	1.000E+8	1.000E+8	1.0000
HDP redissolution rate [L/(mol P d)]	1.000E+8	1.000E+8	1.0000
HAP precipitation rate [molHDP/(L d)]	5.000E-4	5.000E-4	1.0000

Physico-chemical constants

Name	Default	Value
Struvite solubility constant [mol/L]	6.918E-14	6.918E-14
HDP solubility product [mol/L]	2.750E-22	2.750E-22
HDP half sat. [mgTSS/L]	1.0000	1.0000
Equilibrium soluble PO4 with Al dosing at pH 7 [mgP/L]	0.0100	0.0100
Al to P ratio [molAl/molP]	0.8000	0.8000
Al(OH)3 solubility product [mol/L]	1.259E+9	1.259E+9
AlHPO4+ dissociation constant [mol/L]	7.943E-13	7.943E-13
Equilibrium soluble PO4 with Fe dosing at pH 7 [mgP/L]	0.0100	0.0100
Fe to P ratio [molFe/molP]	1.6000	1.6000
Fe(OH)3 solubility product [mol/L]	0.0500	0.0500
FeH2PO4++ dissociation constant [mol/L]	5.012E-22	5.012E-22

Aeration

Name	Default	Value
Alpha (surf) OR Alpha F (diff) [-]	0.5000	0.5000
Beta [-]	0.9500	0.9500
Surface pressure [kPa]	101.3250	101.3250
Fractional effective saturation depth (Fed) [-]	0.3250	0.3250
Supply gas CO2 content [vol. %]	0.0350	0.0350
Supply gas O2 [vol. %]	20.9500	20.9500
Off-gas CO2 [vol. %]	2.0000	2.0000
Off-gas O2 [vol. %]	18.8000	18.8000
Off-gas H2 [vol. %]	0	0
Off-gas NH3 [vol. %]	0	0
Off-gas CH4 [vol. %]	0	0
Surface turbulence factor [-]	2.0000	2.0000
Set point controller gain []	1.0000	1.0000

Modified Vesilind

Name	Default	Value
Maximum Vesilind settling velocity (Vo) [ft/min]	0.387	0.387
Vesilind hindered zone settling parameter (K) [L/g]	0.370	0.370
Clarification switching function [mg/L]	100.000	100.000
Specified TSS conc.for height calc. [mg/L]	2500.000	2500.000
Maximum compactability constant [mg/L]	15000.000	15000.000

Double exponential

Name	Default	Value
Maximum Vesilind settling velocity (Vo) [ft/min]	0.934	0.934
Maximum (practical) settling velocity (Vo') [ft/min]	0.615	0.615
Hindered zone settling parameter (Kh) [L/g]	0.400	0.400
Flocculent zone settling parameter (Kf) [L/g]	2.500	2.500
Maximum non-settleable TSS [mg/L]	20.0000	20.0000
Non-settleable fraction [-]	0.0010	0.0010
Specified TSS conc. for height calc. [mg/L]	2500.0000	2500.0000

Emission factors

Name	Default	Value
Carbon dioxide equivalence of nitrous oxide	296.0000	296.0000
Carbon dioxide equivalence of methane	23.0000	23.0000

Biofilm general

Name	Default	Value	
Attachment rate [g / (m2 d)]	80.0000	80.0000	1.0000
Attachment TSS half sat. [mg/L]	100.0000	100.0000	1.0000
Detachment rate [g/(m3 d)]	8.000E+4	8.000E+4	1.0000
Solids movement factor []	10.0000	10.0000	1.0000
Diffusion neta []	0.8000	0.8000	1.0000
Thin film limit [mm]	0.5000	0.5000	1.0000
Thick film limit [mm]	3.0000	3.0000	1.0000
Assumed Film thickness for tank volume correction (temp independant) [mm]	0.7500	0.7500	1.0000
Film surface area to media area ratio - Max.[ ]	1.0000	1.0000	1.0000
Minimum biofilm conc. for streamer formation [gTSS/m2]	4.0000	4.0000	1.0000

Maximum biofilm concentrations [mg/L]

Name	Default	Value	
Ordinary heterotrophic organisms (OHO)	5.000E+4	5.000E+4	1.0000
Methylotrophs	5.000E+4	5.000E+4	1.0000
Ammonia oxidizing biomass (AOB)	1.000E+5	1.000E+5	1.0000
Nitrite oxidizing biomass (NOB)	1.000E+5	1.000E+5	1.0000
Anaerobic ammonia oxidizers (ANAMMOX)	5.000E+4	5.000E+4	1.0000
Polyphosphate accumulating organisms (PAO)	5.000E+4	5.000E+4	1.0000
Propionic acetogens	5.000E+4	5.000E+4	1.0000
Methanogens - acetoclastic	5.000E+4	5.000E+4	1.0000
Methanogens - hydrogenotrophic	5.000E+4	5.000E+4	1.0000
Endogenous products	3.000E+4	3.000E+4	1.0000
Slowly bio. COD (part.)	5000.0000	5000.0000	1.0000
Slowly bio. COD (colloid.)	4000.0000	4000.0000	1.0000
Part. inert. COD	5000.0000	5000.0000	1.0000
Part. bio. org. N	0	0	1.0000
Part. bio. org. P	0	0	1.0000
Part. inert N	0	0	1.0000
Part. inert P	0	0	1.0000
Stored PHA	5000.0000	5000.0000	1.0000
Releasable stored polyP	1.150E+6	1.150E+6	1.0000
Fixed stored polyP	1.150E+6	1.150E+6	1.0000
Readily bio. COD (complex)	0	0	1.0000
Acetate	0	0	1.0000
Propionate	0	0	1.0000
Methanol	0	0	1.0000
Dissolved H2	0	0	1.0000
Dissolved methane	0	0	1.0000
Ammonia N	0	0	1.0000
Sol. bio. org. N	0	0	1.0000
Nitrous Oxide N	0	0	1.0000
Nitrite N	0	0	1.0000
Nitrate N	0	0	1.0000
Dissolved nitrogen gas	0	0	1.0000
PO4-P (Sol. & Me Complexed)	1.000E+10	1.000E+10	1.0000
Sol. inert COD	0	0	1.0000
Sol. inert TKN	0	0	1.0000
ISS Influent	1.300E+6	1.300E+6	1.0000
Struvite	8.500E+5	8.500E+5	1.0000
Hydroxy-dicalcium-phosphate	1.150E+6	1.150E+6	1.0000
Hydroxy-apatite	1.600E+6	1.600E+6	1.0000
Magnesium	0	0	1.0000
Calcium	0	0	1.0000
Metal	1.000E+10	1.000E+10	1.0000
Other Cations (strong bases)	0	0	1.0000
Other Anions (strong acids)	0	0	1.0000
Total CO2	0	0	1.0000
User defined 1	0	0	1.0000
User defined 2	0	0	1.0000
User defined 3	5.000E+4	5.000E+4	1.0000
User defined 4	5.000E+4	5.000E+4	1.0000
Dissolved oxygen	0	0	1.0000

Effective diffusivities [m2/s]

Name	Default	Value	
Ordinary heterotrophic organisms (OHO)	5.000E-14	5.000E-14	1.0290
Methylotrophs	5.000E-14	5.000E-14	1.0290
Ammonia oxidizing biomass (AOB)	5.000E-14	5.000E-14	1.0290
Nitrite oxidizing biomass (NOB)	5.000E-14	5.000E-14	1.0290
Anaerobic ammonia oxidizers (ANAMMOX)	5.000E-14	5.000E-14	1.0290
Polyphosphate accumulating organisms (PAO)	5.000E-14	5.000E-14	1.0290
Propionic acetogens	5.000E-14	5.000E-14	1.0290
Methanogens - acetoclastic	5.000E-14	5.000E-14	1.0290
Methanogens - hydrogenotrophic	5.000E-14	5.000E-14	1.0290
Endogenous products	5.000E-14	5.000E-14	1.0290
Slowly bio. COD (part.)	5.000E-14	5.000E-14	1.0290
Slowly bio. COD (colloid.)	5.000E-12	5.000E-12	1.0290
Part. inert. COD	5.000E-14	5.000E-14	1.0290
Part. bio. org. N	5.000E-14	5.000E-14	1.0290
Part. bio. org. P	5.000E-14	5.000E-14	1.0290
Part. inert N	5.000E-14	5.000E-14	1.0290
Part. inert P	5.000E-14	5.000E-14	1.0290
Stored PHA	5.000E-14	5.000E-14	1.0290
Releasable stored polyP	5.000E-14	5.000E-14	1.0290
Fixed stored polyP	5.000E-14	5.000E-14	1.0290
Readily bio. COD (complex)	6.900E-10	6.900E-10	1.0290
Acetate	1.240E-9	1.240E-9	1.0290
Propionate	8.300E-10	8.300E-10	1.0290
Methanol	1.600E-9	1.600E-9	1.0290
Dissolved H2	5.850E-9	5.850E-9	1.0290
Dissolved methane	1.963E-9	1.963E-9	1.0290
Ammonia N	2.000E-9	2.000E-9	1.0290
Sol. bio. org. N	1.370E-9	1.370E-9	1.0290
Nitrous Oxide N	1.607E-9	1.607E-9	1.0290
Nitrite N	2.980E-9	2.980E-9	1.0290
Nitrate N	2.980E-9	2.980E-9	1.0290
Dissolved nitrogen gas	1.900E-9	1.900E-9	1.0290
PO4-P (Sol. & Me Complexed)	2.000E-9	2.000E-9	1.0290
Sol. inert COD	6.900E-10	6.900E-10	1.0290
Sol. inert TKN	6.850E-10	6.850E-10	1.0290
ISS Influent	5.000E-14	5.000E-14	1.0290
Struvite	5.000E-14	5.000E-14	1.0290
Hydroxy-dicalcium-phosphate	5.000E-14	5.000E-14	1.0290
Hydroxy-apatite	5.000E-14	5.000E-14	1.0290
Magnesium	7.200E-10	7.200E-10	1.0290
Calcium	7.200E-10	7.200E-10	1.0290
Metal	4.800E-10	4.800E-10	1.0290
Other Cations (strong bases)	1.440E-9	1.440E-9	1.0290
Other Anions (strong acids)	1.440E-9	1.440E-9	1.0290
Total CO2	1.960E-9	1.960E-9	1.0290
User defined 1	6.900E-10	6.900E-10	1.0290
User defined 2	6.900E-10	6.900E-10	1.0290
User defined 3	5.000E-14	5.000E-14	1.0290
User defined 4	5.000E-14	5.000E-14	1.0290
Dissolved oxygen	2.500E-9	2.500E-9	1.0290

EPS Strength coefficients [ ]

Name	Default	Value	
Ordinary heterotrophic organisms (OHO)	1.0000	1.0000	1.0000
Methylotrophs	1.0000	1.0000	1.0000
Ammonia oxidizing biomass (AOB)	5.0000	5.0000	1.0000
Nitrite oxidizing biomass (NOB)	25.0000	25.0000	1.0000
Anaerobic ammonia oxidizers (ANAMMOX)	10.0000	10.0000	1.0000
Polyphosphate accumulating organisms (PAO)	1.0000	1.0000	1.0000
Propionic acetogens	1.0000	1.0000	1.0000
Methanogens - acetoclastic	1.0000	1.0000	1.0000
Methanogens - hydrogenotrophic	1.0000	1.0000	1.0000
Endogenous products	1.0000	1.0000	1.0000
Slowly bio. COD (part.)	1.0000	1.0000	1.0000
Slowly bio. COD (colloid.)	1.0000	1.0000	1.0000
Part. inert. COD	1.0000	1.0000	1.0000
Part. bio. org. N	1.0000	1.0000	1.0000
Part. bio. org. P	1.0000	1.0000	1.0000
Part. inert N	1.0000	1.0000	1.0000
Part. inert P	1.0000	1.0000	1.0000
Stored PHA	1.0000	1.0000	1.0000
Releasable stored polyP	1.0000	1.0000	1.0000
Fixed stored polyP	1.0000	1.0000	1.0000
Readily bio. COD (complex)	0	0	1.0000
Acetate	0	0	1.0000
Propionate	0	0	1.0000
Methanol	0	0	1.0000
Dissolved H2	0	0	1.0000
Dissolved methane	0	0	1.0000
Ammonia N	0	0	1.0000
Sol. bio. org. N	0	0	1.0000
Nitrous Oxide N	0	0	1.0000
Nitrite N	0	0	1.0000
Nitrate N	0	0	1.0000
Dissolved nitrogen gas	0	0	1.0000
PO4-P (Sol. & Me Complexed)	1.0000	1.0000	1.0000
Sol. inert COD	0	0	1.0000
Sol. inert TKN	0	0	1.0000
ISS Influent	0.3300	0.3300	1.0000
Struvite	1.0000	1.0000	1.0000
Hydroxy-dicalcium-phosphate	1.0000	1.0000	1.0000
Hydroxy-apatite	1.0000	1.0000	1.0000
Magnesium	0	0	1.0000
Calcium	0	0	1.0000
Metal	1.0000	1.0000	1.0000
Other Cations (strong bases)	0	0	1.0000
Other Anions (strong acids)	0	0	1.0000
Total CO2	0	0	1.0000
User defined 1	0	0	1.0000
User defined 2	0	0	1.0000
User defined 3	1.0000	1.0000	1.0000
User defined 4	1.0000	1.0000	1.0000
Dissolved oxygen	0	0	1.0000

APPENDIX B – HYDRAULIX® CALCULATIONS

Hydraulix by carollo engineers

PROJECT : CMC WWTP Evaluation
PHWWF (13.2 MGD)

CHECKED : BS **BY :** ETC

JOB # : 9723A.00 **REVISION:** **DATE :** 2/7/2011 **DATE :** 11/18/2014

	Equation Ref.	HGL	EGL

DOWNSTREAM CONTROL

Number of Duty Channels 5
Number of Weirs/Channel 3

EGL =	**198.06**		Max WSE in Effluent Structure Storage Basin. HGL 198.06, EGL 198.06
Flow =	**13.20 mgd =**	**20.42 cfs**	

[STRAIGHT EDGED SHARP CRESTED WEIR]

Flow 12.6 mgd = 19.5 cfs — Subtracted 400 gpm, which will be going to discharge and not flowing over weir
201.68

WSE Downstream of Weir	198.06	ft
Weir Crest Elevation	198.00	ft
Downstream head, Hd	0.06	ft
Length of Weir, L	21.00	ft

WEIR IS SUBMERGED

Free Discharging Weir Computation {6}

Head on Weir, H	NA	ft
Upstream WSE	NA	ft

Submerged Weir Computation {7}

K	0.04	
M	0.01	
Increment	0.10	ft
Upstream Head, Hu1	0.43	ft
F(H1)	0.00	
F'(H1)	-8.72	
Upstream Head, Hu2	0.43	ft
Upstream WSE	198.43	ft

Head over Weir *0.43 ft*

Condition Upstream of Weir — HGL 198.43, EGL 198.43

[CHANNEL FRICTION LOSSES] (Recycle Water Wet Well) {5}

Flow, Q	7.92	mgd = 12.3 cfs
Channel Width	6.00	ft
Total Channel Length	24.50	
Downstream Invert El	188.00	
Channel Slope	0.00%	
Manning Coeff, n	0.013	

Number of Duty Channels (T 5
Number of Weirs/Channel (N 3

Station	Invert Up	Invert Down	Depth (ft)	Vel. (fps)	Hydr. Radius (ft)	Sf	Avg. Sf	Friction Loss (ft)	HGL	EGL
0.0	188.00	188.00	10.43	0.196	2.33	0.000	----	----	198.43	198.43
4.9	188.00	188.00	10.43	0.196	2.33	0.000	0.000	0.00	198.43	198.43
9.8	188.00	188.00	10.43	0.196	2.33	0.000	0.000	0.00	198.43	198.43
14.7	188.00	188.00	10.43	0.196	2.33	0.000	0.000	0.00	198.43	198.43
19.6	188.00	188.00	10.43	0.196	2.33	0.000	0.000	0.00	198.43	198.43
24.5	188.00	188.00	10.43	0.196	2.33	0.000	0.000	0.00	198.43	198.43

TOTAL ENERGY LOSS *0.00 ft*

Condition at Upstream End of Channel — HGL 198.43, EGL 198.43

[PIPE FRICTION LOSSES (DARCY-WEISBACH / COLEBROOK)] **36" UV Effluent Pipe to Effluent Structure** {4}

Flow 7.9 mgd = 12.3 cfs

Pipe Diameter, D	36	inch
Pipe Length, L	420	ft
Absolute Roughness, ε	0.00040	ft
Pipe velocity, v	1.73	fps
Kinematic Viscosity	1.000E-05	ft^2/sec
Reynold's Number, R	520001	
Friction factor, f	0.0147	

Equivalent Hazen-Williams "C" = 146.4512

Equation Ref.	HGL	EGL

Friction Energy Loss, h_L 0.10 ft

MINOR PIPE LOSS HEADING **30" UV Effluent Pipe to Effluent Structure**

Flow, Q 7.9 mgd = 12.3 cfs

No.	Description	Flow (mgd)	Flow (cfs)	K	Dia Up (in)	Dia Down (in)	Vel Up (fps)	Vel Down (fps)	Vel Head (ft)	Minor Loss (ft)
1	Outlet Loss - Still Water	7.92	12.25	1.00	36	----	1.73	----	0.05	0.05
2	90 º Elbow - Regular Fl.	7.92	12.25	0.30	36	----	1.73	----	0.05	0.03
2	45 º Bend - Regular Fl.	7.92	12.25	0.23	36	----	1.73	----	0.05	0.02
1	Butterfly Valve (Open)	7.92	12.25	0.50	36	----	1.73	----	0.05	0.02
1	Entrance Loss - Flush	7.92	12.25	1.00	----	36	----	1.73	0.05	0.05
									Sum =	0.17

Total Energy Loss = 0.26 ft

Upstream Condition HGL 198.65 EGL 198.70

FLOW SPLIT **Individual 20" UV Effluent Pipes Combining** Number of Duty Channels 3

Downstream Flow 7.9 mgd = 12.3 cfs

New Flow 2.6 mgd = 4.1 cfs

[CHANNEL FRICTION LOSSES] **{ 5 }**

Flow, Q 2.64 mgd = 4.1 cfs
Channel Width 7.50 ft
Total Channel Length 50.00
Downstream Invert El 191.00
Channel Slope 0.00%
Manning Coeff, n 0.013

Station	Invert Up	Invert Down	Depth (ft)	Vel. (fps)	Hydr. Radius (ft)	Sf	Avg. Sf	Friction Loss (ft)	HGL	EGL
0.0	191.00	191.00	7.70	0.071	2.52	0.000	----	----	198.70	198.70
10.0	191.00	191.00	7.70	0.071	2.52	0.000	0.000	0.00	198.70	198.70
20.0	191.00	191.00	7.70	0.071	2.52	0.000	0.000	0.00	198.70	198.70
30.0	191.00	191.00	7.70	0.071	2.52	0.000	0.000	0.00	198.70	198.70
40.0	191.00	191.00	7.70	0.071	2.52	0.000	0.000	0.00	198.70	198.70
50.0	191.00	191.00	7.70	0.071	2.52	0.000	0.000	0.00	198.70	198.70

TOTAL ENERGY LOSS *0.00 ft*

Condition at Upstream End of Channel HGL 198.70 EGL 198.70

FLOW SPLIT

Number of Weirs 3

Downstream Flow 2.6 mgd = 4.1 cfs

New Flow 0.9 mgd = 1.4 cfs

Lateral Spillway - Discharge into launder uniformly along entire length of launder

Flow, Q 0.88 mgd = 1.4 cfs
Width, b 0.63 ft 9.58 in
Length, L 11 ft
Manning Coeff, n 0.013

Mannings Equation
yc = 0.53 ft
yl = 1.26 ft
yu = 1.34 ft

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	Equation Ref.	HGL	EGL

Slope, So 0.000 ft/ft
Invert Elevation at Outlet 197.44 ft — 24.00 in depth of trough
HGL at outlet 198.70 ft

HGLu = 198.78 ft

Station	Invert	Flow (cfs)	Depth (ft)	Vel. (fps)	Hydr. Radius (ft)	Sf	Avg. Sf	Friction Loss (ft)	HGL	D (HGL)	EGL
0.00	197.44	1.36	1.26	1.72	0.252	0.0014			198.70		198.74
2.20	197.44	1.09	1.29	1.34	0.253	0.0009	0.0011	0.0025	198.73	0.037	198.76
4.40	197.44	0.82	1.32	0.98	0.254	0.0005	0.0007	0.0014	198.76	0.026	198.77
6.60	197.44	0.54	1.34	0.65	0.255	0.0002	0.0003	0.0007	198.78	0.017	198.78
8.80	197.44	0.27	1.35	0.32	0.255	0.0000	0.0001	0.0003	198.79	0.010	198.79
11.00	197.44	0.00	1.35	0.00	0.255	0.0000	0.0000	0.0001	198.79	0.003	198.79

Total Energy Loss = 0.05 ft

WSE Upstream of lateral spillway — HGL 198.79 — EGL 198.79

[STRAIGHT EDGED SHARP CRESTED WEIR]

Flow 0.9 mgd = 1.4 cfs

0.48

WSE Downstream of Weir 198.79 ft
Weir Crest Elevation 199.44 ft
Downstream head, Hd -0.65 ft
Length of Weir, L 20.16 ft

WEIR IS FREE-DISCHARGING

Free Discharging Weir Computation { 6 }
Head on Weir, H 0.07 ft
Upstream WSE 199.51 ft

Submerged Weir Computation { 7 }
K NA
M NA
Increment NA ft
Upstream Head, Hu1 NA ft
F(H1) NA
F'(H1) NA
Upstream Head, Hu2 NA ft
Upstream WSE NA ft

Head over Weir *0.07 ft*

Condition Upstream of Weir — HGL 199.51 — EGL 199.51

FLOW SPLIT

Number of Weirs 3

Downstream Flow 0.9 mgd = 1.4 cfs

New Flow 2.6 mgd = 4.1 cfs

[CHANNEL FRICTION LOSSES] { 5 }

Flow, Q 2.64 mgd = 4.1 cfs
Channel Width 3.40 ft — Width changes. Used average of upstream and downstream width.
Total Channel Length 3.00
Downstream Invert El 197.44
Channel Slope -18.00%
Manning Coeff, n 0.013

Station	Invert Up	Invert Down	Depth (ft)	Vel. (fps)	Hydr. Radius (ft)	Sf	Avg. Sf	Friction Loss (ft)	HGL	EGL
0.0	197.44	197.44	2.07	0.581	0.93	0.000	----	----	199.51	199.51
0.6	197.33	197.44	2.18	0.552	0.95	0.000	0.000	0.00	199.51	199.51
1.2	197.22	197.33	2.29	0.525	0.97	0.000	0.000	0.00	199.51	199.51
1.8	197.12	197.22	2.39	0.502	0.99	0.000	0.000	0.00	199.51	199.51
2.4	197.01	197.12	2.50	0.480	1.01	0.000	0.000	0.00	199.51	199.51
3.0	196.90	197.01	2.61	0.460	1.03	0.000	0.000	0.00	199.51	199.51

TOTAL ENERGY LOSS *0.00 ft*

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	Equation Ref.	HGL	EGL
Condition at Upstream End of Channel		199.51	199.51

MINOR CHANNEL LOSS HEADING

Flow, Q 2.6 mgd = 4.1 cfs

No.	Description	Flow (mgd)	Flow (cfs)	K	Width Up (ft)	Width Down (ft)	Depth (ft)	Vel Up (fps)	Vel Down (fps)	Vel Head (ft)	Minor Loss (ft)
1	Sudden Expansion	2.64	4.08	1.00	2.33	4.50	2.07	0.85	0.44	0.01	0.01
										Sum =	0.00814

Total Energy Loss = 0.01 ft

	Equation Ref.	HGL	EGL
Upstream Condition		199.51	199.52

U.V. Basin Channel:
Flow, Q 2.6 mgd = 4.1 cfs
Channel width, W 2.3 ft
Bottom Channel Elevation = 196.90 ft
Energy Loss, hL 0.056 ft **0.6 inches was calculated from the sizing spreadsheet for max flow with 1 channels with 3 banks in the channel**

Flow Area of Channel, A 6.17 sq ft 2.75
Velocity, V 0.66 fps

	Equation Ref.	HGL	EGL
Condition Upstream of UV Banks		199.57	199.57

Water Level upstream of first UV bank = 2.67 *ft* ***Ok***
Water level over center line of top lamp of first UV bank = *0.17 ft or 2.042 in*
Note: Water level upstream of first UV Bank Shall not Exceed 2.75 ft.

[SUBMERGED ORIFICE (CIRCULAR)] **{ 3 }**

Flow 2.6 mgd = 4.1 cfs

Downstream WSE 199.57 ft
Downstream Depth, d 2.67 ft = 32.0 inches
Number of water covered rows: 10
Number of Ports 105 **(105 total holes in baffle plate)**
Flow Per Port 0.02514 mgd = 0.0 cfs
Port Diameter 0.1666667 ft = 2.0 inches
Upstream Invert El. 196.90 ft
Discharge Coefficient, C 0.61
Velocity through port, v 1.78 fps

Orifice Energy Loss, h_L 0.13 ft

	Equation Ref.	HGL	EGL
Condition Upstream of Orifice		199.65	199.70

[CHANNEL FRICTION LOSSES] **{ 5 }**

Flow, Q 2.64 mgd = 4.1 cfs
Channel Width 2.33 ft
Total Channel Length 12.00
Downstream Invert El 196.90
Channel Slope 0.00%
Manning Coeff, n 0.013

Station	Invert Up	Invert Down	Depth (ft)	Vel. (fps)	Hydr. Radius (ft)	Sf	Avg. Sf	Friction Loss (ft)	HGL	EGL
0.0	196.90	196.90	2.80	0.626	0.82	0.000	----	----	199.70	199.70
2.4	196.90	196.90	2.80	0.626	0.82	0.000	0.000	0.00	199.70	199.70
4.8	196.90	196.90	2.80	0.626	0.82	0.000	0.000	0.00	199.70	199.70
7.2	196.90	196.90	2.80	0.626	0.82	0.000	0.000	0.00	199.70	199.70
9.6	196.90	196.90	2.80	0.626	0.82	0.000	0.000	0.00	199.70	199.70
12.0	196.90	196.90	2.80	0.626	0.82	0.000	0.000	0.00	199.70	199.70

TOTAL ENERGY LOSS 0.00 ft

	Equation Ref.	HGL	EGL
Condition at Upstream End of Channel		199.70	199.70

PARSHALL FLUME { 13 }

Flow, Q = 2.6 mgd
4.1 cfs (0.3 < Q < 100)

Downstream WSE = 199.70 ft
Downstream EGL = 199.70 ft
Throat width = 0.8 ft (available sizes = 1, 2, 3, 3.5, 4, 5, 6, 7, and 8 (W-2 Contract Drawings)
Flume invert elevation = 199.30 ft
Upstream channel width = 2.33 ft

Downstream depth, Hb = 0.40 ft
Upstream depth, Ha = 1.23 ft
Upstream velocity = 1.43 fps
Submergence = **32.4** %
Headloss = 0.861 ft **** NOT USED ****

	HGL	EGL
WSE Upstream of Flume	200.53	200.56

[CHANNEL FRICTION LOSSES] { 5 }

Flow, Q 2.64 mgd = 4.1 cfs
Channel Width 2.33 ft
Total Channel Length 11.00
Downstream Invert El 199.05
Channel Slope 0.00%
Manning Coeff, n 0.013

Station	Invert Up	Invert Down	Depth (ft)	Vel. (fps)	Hydr. Radius (ft)	Sf	Avg. Sf	Friction Loss (ft)	HGL	EGL
0.0	199.05	199.05	1.49	1.179	0.65	0.000	----	----	200.54	200.56
2.2	199.05	199.05	1.49	1.179	0.65	0.000	0.000	0.00	200.54	200.56
4.4	199.05	199.05	1.49	1.178	0.65	0.000	0.000	0.00	200.54	200.56
6.6	199.05	199.05	1.49	1.178	0.65	0.000	0.000	0.00	200.54	200.56
8.8	199.05	199.05	1.49	1.178	0.65	0.000	0.000	0.00	200.54	200.56
11.0	199.05	199.05	1.49	1.177	0.65	0.000	0.000	0.00	200.54	200.56

TOTAL ENERGY LOSS 0.00 ft

	HGL	EGL
Condition at Upstream End of Channel	200.54	200.56

[GATE - RECTANGULAR OPENING] (UV Influent upstream of Parshall Flume) { 14 }

Flow, Q 2.6 mgd = 4.1 cfs

Gate Width 2.33 ft
Full Height of Opening 3 ft
Gate Percent Open 100%
Discharge Coefficient, C 0.61
Velocity through gate, v 0.58 fps

Energy Loss thru Gate, h_L 0.01 ft

	HGL	EGL
Condition Upstream of Gate	200.57	200.57

Channel FLOW SPLIT (Flow From UV Influent Split Box Into Each Individual UV Channel)

Downstream Flow 2.6 mgd = 4.1 cfs Number of Duty Channels 3

New Flow 7.9 mgd = 12.3 cfs

[Influent CHANNEL FRICTION LOSSES] (UV Influent 16 feet X 5 feet) { 5 }

Flow, Q 7.92 mgd = 12.3 cfs
Channel Width 16.00 ft
Total Channel Length 5.00
Downstream Invert El 191.00

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		Equation Ref.	HGL	EGL

Channel Slope 0.00%
Manning Coeff, n 0.013

Station	Invert Up	Invert Down	Depth (ft)	Vel. (fps)	Hydr. Radius (ft)	Sf	Avg. Sf	Friction Loss (ft)	HGL	EGL
0.0	191.00	191.00	9.57	0.080	4.36	0.000	----	----	200.57	200.57
1.0	191.00	191.00	9.57	0.080	4.36	0.000	0.000	0.00	200.57	200.57
2.0	191.00	191.00	9.57	0.080	4.36	0.000	0.000	0.00	200.57	200.57
3.0	191.00	191.00	9.57	0.080	4.36	0.000	0.000	0.00	200.57	200.57
4.0	191.00	191.00	9.57	0.080	4.36	0.000	0.000	0.00	200.57	200.57
5.0	191.00	191.00	9.57	0.080	4.36	0.000	0.000	0.00	200.57	200.57

TOTAL ENERGY LOSS *0.00 ft*

Condition at Upstream End of Channel — HGL 200.57 — EGL 200.57

[PIPE FRICTION LOSSES (DARCY-WEISBACH / COLEBROOK)] (20 inch Filter Effluent) {4}

Flow 7.9 mgd = 12.3 cfs

Pipe Diameter, D 30 inch
Pipe Length, L 450 ft
Absolute Roughness, ε 0.00040 ft
Pipe velocity, v 2.50 fps
Kinematic Viscosity 1.000E-05 ft^2/sec
Reynold's Number, R 624001
Friction factor, f 0.0147 Equivalent Hazen-Williams "C" = 144.3961

Friction Energy Loss, h_L 0.26 ft

MINOR PIPE LOSS HEADING (20 inch Filter Effluent Pipe)

Flow, Q 7.9 mgd = 12.3 cfs

No.	Description	Flow (mgd)	Flow (cfs)	K	Dia Up (in)	Dia Down (in)	Vel Up (fps)	Vel Down (fps)	Vel Head (ft)	Minor Loss (ft)
2	90 º Elbow - Regular Fl.	7.92	12.25	0.30	30	----	2.50	----	0.10	0.06
1	Outlet Loss - Still Water	7.92	12.25	1.00	30	----	2.50	----	0.10	0.10
									Sum =	0.15

Total Energy Loss = 0.41 ft

Upstream Condition — HGL 200.99 — EGL 200.99

FLOW SPLIT (20 inch East Dynasand Effluent combined with 16 inch West Effluent)
FLOW SPLIT

Downstream Flow 7.9 mgd = 12.3 cfs

New Flow 4.0 mgd = 6.1 cfs

[PIPE FRICTION LOSSES (DARCY-WEISBACH / COLEBROOK)] (16 inch West Dynasand) {4}

Flow 4.0 mgd = 6.1 cfs

Pipe Diameter, D 16 inch
Pipe Length, L 56 ft
Absolute Roughness, ε 0.00040 ft
Pipe velocity, v 4.39 fps
Kinematic Viscosity 1.000E-05 ft^2/sec
Reynold's Number, R 585001
Friction factor, f 0.0161 Equivalent Hazen-Williams "C" = 139.1119

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Equation Ref.	HGL	EGL

Friction Energy Loss, h_L 0.20 ft

MINOR PIPE LOSS HEADING (16 inch Western Dynasand Effluent)

Flow, Q 4.0 mgd = 6.1 cfs

No.	Description	Flow (mgd)	Flow (cfs)	K	Dia Up (in)	Dia Down (in)	Vel Up (fps)	Vel Down (fps)	Vel Head (ft)	Minor Loss (ft)
1	Increaser	3.96	6.13	0.25	16	20	4.39	2.81	0.18	0.04
1	Wye - Thru Straight Run	2.26	3.50	0.45	16	----	2.51	----	0.10	0.04
1	Wye - Thru Straight Run	1.70	2.63	0.45	16	----	1.88	----	0.05	0.02
1	Wye - Thru Straight Run	1.13	1.75	0.45	16	----	1.25	----	0.02	0.01
									Sum =	0.12

Total Energy Loss = 0.33 ft

Upstream Condition 201.31 201.31

FLOW SPLIT (20 inch Dynasand Effluent to 8 inch Effluent)

Downstream Flow 4.0 mgd = 6.1 cfs

New Flow 0.6 mgd = 0.9 cfs

[PIPE FRICTION LOSSES (DARCY-WEISBACH / COLEBROOK)] (8 inch Dynasand Effluent) { 4 }

Flow 0.6 mgd = 0.9 cfs

Pipe Diameter, D 8 inch
Pipe Length, L 15 ft
Absolute Roughness, ε 0.00040 ft
Pipe velocity, v 2.51 fps
Kinematic Viscosity 1.000E-05 ft^2/sec
Reynold's Number, R 167143
Friction factor, f 0.0196 Equivalent Hazen-Williams "C" = 139.1889

Friction Energy Loss, h_L 0.04 ft

MINOR PIPE LOSS HEADING (8 inch Effluent Pipe to Dynasand Cell)

Flow, Q 0.6 mgd = 0.9 cfs

No.	Description	Flow (mgd)	Flow (cfs)	K	Dia Up (in)	Dia Down (in)	Vel Up (fps)	Vel Down (fps)	Vel Head (ft)	Minor Loss (ft)
1	Wye - Thru Side Outlet	0.57	0.88	1.35	8	----	2.51	----	0.10	0.13
1	45 º Bend - Regular Fl.	0.57	0.88	0.23	8	----	2.51	----	0.10	0.02
1	90 º Elbow - Regular Fl.	0.57	0.88	0.30	8	----	2.51	----	0.10	0.03
1	90 º Elbow - Regular Fl.	0.57	0.88	0.30	8	----	2.51	----	0.10	0.03
1	Increaser	0.57	0.88	0.25	8	16	2.51	0.63	0.09	0.02
1	Entrance Loss - Flush	0.57	0.88	0.50	----	8	----	2.51	0.10	0.05
									Sum =	0.28

Total Energy Loss = 0.33 ft

Upstream Condition 201.64 201.64
Dynasand Effluent Weir Trough Elevation 202.57
Head Available (feet) 0.93

WSE at Filter Feed Box 207.17
WSE in Filter Feed Pump Station 206.50
Freeboard at Secondary Clarifier -0.60
Static Lift 0.67

FLOW SPLIT

			Equation Ref.	HGL	EGL

Downstream Flow 0.6 mgd = 0.9 cfs

New Flow 7.9 mgd = 12.3 cfs

[PIPE FRICTION LOSSES (DARCY-WEISBACH / COLEBROOK)] { 4 }

Flow 7.9 mgd = 12.3 cfs

Pipe Diameter, D	30	inch
Pipe Length, L	525	ft
Absolute Roughness, ε	0.00040	ft
Pipe velocity, v	2.50	fps
Kinematic Viscosity	1.000E-05	ft^2/sec
Reynold's Number, R	624001	
Friction factor, f	0.0147	Equivalent Hazen-Williams "C" = 144.3961

Friction Energy Loss, h_L 0.30 ft

MINOR PIPE LOSS HEADING

Flow, Q 7.9 mgd = 12.3 cfs

No.	Description	Flow (mgd)	Flow (cfs)	K	Dia Up (in)	Dia Down (in)	Vel Up (fps)	Vel Down (fps)	Vel Head (ft)	Minor Loss (ft)
1	Outlet Loss - Still Water	7.92	12.25	1.00	30	----	2.50	----	0.10	0.10
2	45 º Bend - Regular Fl.	7.92	12.25	0.23	30	----	2.50	----	0.10	0.04
1	90 º Elbow - Regular Fl.	7.92	12.25	0.30	30	----	2.50	----	0.10	0.03
1	Wye - Thru Straight Run	7.92	12.25	0.45	30	----	2.50	----	0.10	0.04
									Sum =	0.21

Total Energy Loss = 0.51 ft

	HGL	EGL
Upstream Condition	207.01	207.01

FLOW SPLIT

Downstream Flow 7.9 mgd = 12.3 cfs

New Flow 5.3 mgd = 8.2 cfs

[PIPE FRICTION LOSSES (DARCY-WEISBACH / COLEBROOK)] { 4 }

Flow 5.3 mgd = 8.2 cfs

Pipe Diameter, D	30	inch
Pipe Length, L	110	ft
Absolute Roughness, ε	0.00040	ft
Pipe velocity, v	1.66	fps
Kinematic Viscosity	1.000E-05	ft^2/sec
Reynold's Number, R	416001	
Friction factor, f	0.0153	Equivalent Hazen-Williams "C" = 146.0638

Friction Energy Loss, h_L 0.03 ft

MINOR PIPE LOSS HEADING

Flow, Q 5.3 mgd = 8.2 cfs

No.	Description	Flow (mgd)	Flow (cfs)	K	Dia Up (in)	Dia Down (in)	Vel Up (fps)	Vel Down (fps)	Vel Head (ft)	Minor Loss (ft)
1	Wye - Thru Straight Run	5.28	8.17	0.45	30	----	1.66	----	0.04	0.02

Sum = 0.02

Total Energy Loss = 0.05 ft

Upstream Condition HGL 207.06 EGL 207.06

FLOW SPLIT

Downstream Flow 5.3 mgd = 8.2 cfs

New Flow 2.6 mgd = 4.1 cfs

[PIPE FRICTION LOSSES (DARCY-WEISBACH / COLEBROOK)] { 4 }

Flow 2.6 mgd = 4.1 cfs

Pipe Diameter, D 30 inch
Pipe Length, L 100 ft
Absolute Roughness, ε 0.00040 ft
Pipe velocity, v 0.83 fps
Kinematic Viscosity 1.000E-05 ft^2/sec
Reynold's Number, R 208000
Friction factor, f 0.0167 Equivalent Hazen-Williams "C" = 147.4178

Friction Energy Loss, h_L 0.01 ft

MINOR PIPE LOSS HEADING

Flow, Q 2.6 mgd = 4.1 cfs

No.	Description	Flow (mgd)	Flow (cfs)	K	Dia Up (in)	Dia Down (in)	Vel Up (fps)	Vel Down (fps)	Vel Head (ft)	Minor Loss (ft)
1	Entrance Loss - Flush	2.64	4.08	0.50	----	30	----	0.83	0.01	0.01
1	45 º Bend - Regular Fl.	2.64	4.08	0.23	30	----	0.83	----	0.01	0.00
									Sum =	0.01

Total Energy Loss = 0.02 ft

Upstream Condition HGL 207.08 EGL 207.08

[V-NOTCH WEIR]

Flow 2.6 mgd = 4.1 cfs

WSE Downstream of Weir 207.08 ft TOW 208.93
Weir Crest Elevation 207.68 ft
Downstream head, Hd -0.60 ft

Weir Length 204.20 ft
Distance Between Notches 6.00 in
Number of Notches 408

WEIR IS FREE-DISCHARGING

Free Discharging Weir Computation { 8 }
Head on Weir, H 0.11 ft
Upstream WSE 207.79 ft

Submerged Weir Computation { 9 }
K NA
M NA
Increment NA ft
Upstream Head, Hu1 NA ft
F(H1) NA
F'(H1) NA
Upstream Head, Hu2 NA ft
Upstream WSE NA ft

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	Equation Ref.	HGL	EGL
Head over Weir *0.11 ft*			
WSE in Secondary Clarifier		207.79	207.79

FLOW SPLIT

Flow Conditions			
PHWWF (CMC)	5.3 mgd		
PHWWF (CMC)	8.0 mgd		
RAS	50 percent of inf		

Downstream Flow 2.6 mgd = 4.1 cfs

New Flow 4.0 mgd = 6.2 cfs

[PIPE FRICTION LOSSES (DARCY-WEISBACH / COLEBROOK)] { 4 }

Flow 4.0 mgd = 6.2 cfs

Pipe Diameter, D	24 inch
Pipe Length, L	20 ft
Absolute Roughness, ε	0.00040 ft
Pipe velocity, v	1.96 fps
Kinematic Viscosity	1.000E-05 ft^2/sec
Reynold's Number, R	392955
Friction factor, f	0.0158

Equivalent Hazen-Williams "C" = 144.7564

Friction Energy Loss, h_L 0.01 ft

MINOR PIPE LOSS HEADING

Flow, Q 4.0 mgd = 6.2 cfs

No.	Description	Flow (mgd)	Flow (cfs)	K	Dia Up (in)	Dia Down (in)	Vel Up (fps)	Vel Down (fps)	Vel Head (ft)	Minor Loss (ft)
1	Outlet Loss - Still Water	3.99	6.17	1.00	24	----	1.96	----	0.06	0.06
1	90 º Elbow - Regular Fl.	3.99	6.17	0.30	24	----	1.96	----	0.06	0.02
									Sum =	0.08

Total Energy Loss = 0.09 ft

	HGL	EGL
	207.88	207.88

[PIPE FRICTION LOSSES (DARCY-WEISBACH / COLEBROOK)] { 4 }

Flow 4.0 mgd = 6.2 cfs

Pipe Diameter, D	24 inch
Pipe Length, L	500 ft
Absolute Roughness, ε	0.00040 ft
Pipe velocity, v	1.96 fps
Kinematic Viscosity	1.000E-05 ft^2/sec
Reynold's Number, R	392955
Friction factor, f	0.0158

Equivalent Hazen-Williams "C" = 144.7564

Friction Energy Loss, h_L 0.24 ft

MINOR PIPE LOSS HEADING

Flow, Q 4.0 mgd = 6.2 cfs

No.	Description	Flow (mgd)	Flow (cfs)	K	Dia Up (in)	Dia Down (in)	Vel Up (fps)	Vel Down (fps)	Vel Head (ft)	Minor Loss (ft)
1	Entrance Loss - Flush	3.99	6.17	0.50	----	24	----	1.96	0.06	0.03
1	45 º Bend - Regular Fl.	3.99	6.17	0.23	24	----	1.96	----	0.06	0.01

PROJECT : CMC WWTP Evaluation
PHWWF (13.2 MGD)

CHECKED :	BS	BY :	ETC
DATE :	2/7/2011	DATE :	11/18/2014

JOB # : 9723A.00 REVISION:

Equation Ref.	HGL	EGL

No.	Description	Flow (mgd)	Flow (cfs)	K	Dia Up (in)	Dia Down (in)	Vel Up (fps)	Vel Down (fps)	Vel Head (ft)	Minor Loss (ft)
1	90 º Elbow - Regular Fl.	3.99	6.17	0.30	24	----	1.96	----	0.06	0.02
									Sum =	0.06

Total Energy Loss = 0.30 ft

HGL 208.18 EGL 208.18

[STRAIGHT EDGED SHARP CRESTED WEIR]

Flow 4.0 mgd = 6.2 cfs

WSE Downstream of Weir	208.18 ft
Weir Crest Elevation	208.68 ft
Downstream head, Hd	-0.50 ft
Length of Weir, L	5.00 ft

WEIR IS FREE-DISCHARGING

Free Discharging Weir Computation { 6 }

Head on Weir, H	0.52 ft
Upstream WSE	209.20 ft

Submerged Weir Computation { 7 }

K	NA	
M	NA	
Increment	NA	ft
Upstream Head, Hu1	NA	ft
F(H1)	NA	
F'(H1)	NA	
Upstream Head, Hu2	NA	ft
Upstream WSE	NA	ft

Head over Weir *0.52 ft*

WSE in Effluent Box of ML Splitter Structure HGL 209.20 EGL 209.20

FLOW SPLIT

Downstream Flow 4.0 mgd = 6.2 cfs

New Flow 10.0 mgd = 15.4 cfs

[PIPE FRICTION LOSSES (DARCY-WEISBACH / COLEBROOK)] { 4 }

Flow 10.0 mgd = 15.4 cfs

Pipe Diameter, D	36 inch
Pipe Length, L	250 ft
Absolute Roughness, ε	0.00040 ft
Pipe velocity, v	2.18 fps
Kinematic Viscosity	1.000E-05 ft^2/sec
Reynold's Number, R	654926
Friction factor, f	0.0144

Equivalent Hazen-Williams "C" = 145.5241

Friction Energy Loss, h_L 0.09 ft

MINOR PIPE LOSS HEADING

Flow, Q 10.0 mgd = 15.4 cfs

No.	Description	Flow (mgd)	Flow (cfs)	K	Dia Up (in)	Dia Down (in)	Vel Up (fps)	Vel Down (fps)	Vel Head (ft)	Minor Loss (ft)
1	Outlet Loss - Still Water	9.98	15.43	1.00	36	----	2.18	----	0.07	0.07
1	Entrance Loss - Flush	9.98	15.43	0.50	----	36	----	2.18	0.07	0.04
1	90 º Elbow - Regular Fl.	9.98	15.43	0.30	36	----	2.18	----	0.07	0.02
									Sum =	0.13

	Equation Ref.	HGL	EGL
Total Energy Loss = 0.22 ft			
WSE in Influent Box of ML Splitter Structure		209.42	209.42

FLOW SPLIT

Downstream Flow	10.0	mgd =	15.4	cfs
New Flow	5.0	mgd =	7.7	cfs

[STRAIGHT EDGED SHARP CRESTED WEIR]

Flow	5.0	mgd =	7.7	cfs
WSE Downstream of Weir	209.42	ft		
Weir Crest Elevation	209.61	ft		
Downstream head, Hd	-0.19	ft		
Length of Weir, L	17.50	ft		

WEIR IS FREE-DISCHARGING

Free Discharging Weir Computation { 6 }

Head on Weir, H	0.26	ft
Upstream WSE	209.87	ft

Submerged Weir Computation { 7 }

K	NA	
M	NA	
Increment	NA	ft
Upstream Head, Hu1	NA	ft
F(H1)	NA	
F'(H1)	NA	
Upstream Head, Hu2	NA	ft
Upstream WSE	NA	ft

Head over Weir *0.26 ft*

	HGL	EGL
WSE in Oxidation Ditch	209.87	209.87

[PIPE FRICTION LOSSES (DARCY-WEISBACH / COLEBROOK)] { 4 }

Flow	5.0	mgd =	7.7	cfs
Pipe Diameter, D	24	inch		
Pipe Length, L	375	ft		
Absolute Roughness, ε	0.00040	ft		
Pipe velocity, v	2.46	fps		
Kinematic Viscosity	1.000E-05	ft^2/sec		
Reynold's Number, R	491194			
Friction factor, f	0.0155		Equivalent Hazen-Williams "C" =	143.7954

Friction Energy Loss, h_L 0.27 ft

MINOR PIPE LOSS HEADING

Flow, Q 5.0 mgd = 7.7 cfs

No.	Description	Flow (mgd)	Flow (cfs)	K	Dia Up (in)	Dia Down (in)	Vel Up (fps)	Vel Down (fps)	Vel Head (ft)	Minor Loss (ft)
1	Entrance Loss - Flush	4.99	7.72	0.50	----	24	----	2.46	0.09	0.05
1	Outlet Loss - Still Water	4.99	7.72	1.00	24	----	2.46	----	0.09	0.09
1	90 º Elbow - Regular Fl.	4.99	7.72	0.30	24	----	2.46	----	0.09	0.03
									Sum =	0.17

Total Energy Loss = 0.44 ft

	HGL	EGL
WSE in Effluent Box of Oxidation Ditch Splitter Structure	210.31	210.31

PROJECT : CMC WWTP Evaluation
PHWWF (13.2 MGD)

CHECKED : BS **BY :** ETC
JOB # : 9723A.00 **REVISION:** **DATE :** 2/7/2011 **DATE :** 11/18/2014

	Equation Ref.	HGL	EGL

[STRAIGHT EDGED SHARP CRESTED WEIR]

Flow	5.0	mgd =	7.7 cfs
WSE Downstream of Weir	210.31	ft	
Weir Crest Elevation	210.75	ft	
Downstream head, Hd	-0.44	ft	
Length of Weir, L	5.00	ft	

WEIR IS FREE-DISCHARGING

Free Discharging Weir Computation {6}

Head on Weir, H	0.60	ft
Upstream WSE	211.35	ft

Submerged Weir Computation {7}

K	NA	
M	NA	
Increment	NA	ft
Upstream Head, Hu1	NA	ft
F(H1)	NA	
F'(H1)	NA	
Upstream Head, Hu2	NA	ft
Upstream WSE	NA	ft

Head over Weir *0.60 ft*

WSE in Influent Box of Oxidation Ditch Splitter Structure HGL 211.35 EGL 211.35

FLOW SPLIT

Downstream Flow	5.0	mgd =	7.7 cfs
New Flow	5.2	mgd =	8.0 cfs

[PIPE FRICTION LOSSES (DARCY-WEISBACH / COLEBROOK)] {4}

Flow	5.2	mgd =	8.0 cfs
Pipe Diameter, D	24	inch	
Pipe Length, L	100	ft	
Absolute Roughness, ε	0.00040	ft	
Pipe velocity, v	2.56	fps	
Kinematic Viscosity	1.000E-05	ft^2/sec	
Reynold's Number, R	512122		
Friction factor, f	0.0154		Equivalent Hazen-Williams "C" = 143.5948
Friction Energy Loss, h_L	0.08	ft	

MINOR PIPE LOSS HEADING

Flow, Q 5.2 mgd = 8.0 cfs

No.	Description	Flow (mgd)	Flow (cfs)	K	Dia Up (in)	Dia Down (in)	Vel Up (fps)	Vel Down (fps)	Vel Head (ft)	Minor Loss (ft)
2	90 º Elbow - Regular Fl.	5.20	8.04	0.30	24	----	2.56	----	0.10	0.06
1	Outlet Loss - Still Water	5.20	8.04	1.00	24	----	2.56	----	0.10	0.10
1	Entrance Loss - Rounded	5.20	8.04	0.23	----	24	----	2.56	0.10	0.02
1	Tee - Thru Straight Run	5.20	8.04	0.60	24	----	2.56	----	0.10	0.06
									Sum =	0.16

Total Energy Loss = 0.33 ft

WSE in Fine Screen Facility (Downstream of Screen) HGL 211.67 EGL 211.67

Loss through Fine Screen 0.91
WSE Upstream if Fine Screen 212.58

PROJECT : CMC WWTP Evaluation
PHWWF (13.2 MGD)

CHECKED : BS **BY :** ETC

JOB # : 9723A.00 **REVISION:** **DATE :** 2/7/2011 **DATE :** 11/18/2014

	Equation Ref.	HGL	EGL
Top of Slab at Fine Screen		214.29	
Freeboard at Fine Screen		1.71	
Loss from Aerated Grit Chamber to Fine Screen		0.7	
WSE in Aerated Grit Effluent Channel		213.28	

[STRAIGHT EDGED SHARP CRESTED WEIR]

Flow	5.2	mgd =	8.0 cfs
WSE Downstream of Weir	213.28	ft	
Weir Crest Elevation	213.00	ft	
Downstream head, Hd	0.28	ft	
Length of Weir, L	14.00	ft	

WEIR IS SUBMERGED

Free Discharging Weir Computation { 6 }

Head on Weir, H	NA	ft
Upstream WSE	NA	ft

Submerged Weir Computation { 7 }

K	0.01	
M	0.15	
Increment	0.10	ft
Upstream Head, Hu1	0.40	ft
F(H1)	0.00	
F'(H1)	-6.16	
Upstream Head, Hu2	0.40	ft
Upstream WSE	213.40	ft

Head over Weir *0.40 ft*

	HGL	EGL
WSE in Aerated Grit Chamber	213.40	213.40

APPENDIX C – CONCEPTUAL SITE RENDERINGS

APPENDIX D – PROPOSED CONVEYANCE PIPELINE ALIGNMENT

Possible Force Main Alignment

1 inch:2,420 feet

MAP NOTES:
2011 AERIAL PHOTO
PROVIDED BY COUNTY
OF SAN LUIS OBISPO.

MKN

APPENDIX E – COST ESTIMATES FOR PREVIOUS CMC UPGRADE PROJECTS

UPDATED PROJECT BUDGET ESTIMATE

PROJECT :	CALIFORNIA MEN'S COLONY WASTEWATER TREATMENT PLANT IMPROVEMENT PROJECT	**DATE :**	2/6/2001
JOB # :	4396.D11	**BY :**	BHT/BEH
ELEMENT # :	#1 TO #18	**ESTIMATE ENR :**	6,825
		PROJECTED CONSTRUCTION MIDPOINT ENR:	7,400
ELEMENT :	OVERALL CONSTRUCTION COST EXCLUDING UNANTICIPATED / OUT OF SCOPE WORK		

ELEMENT #	ELEMENT	ESTIMATE COST	COST AT MIDPOINT ENR
1	GENERAL CONDITIONS	$ 776,250	$ 841,650
2	SITE WORK	$ 592,820	$ 642,760
3	YARD PIPING / MISC STRUCTURES	$ 1,348,870	$ 1,462,510
4	HEADWORKS / INFLUENT PUMP STATION	$ 1,464,260	$ 1,587,620
5	MCC / GENERATOR BLDG	$ 501,890	$ 544,170
6	GRIT CHAMBER	$ 322,990	$ 350,200
7	OXIDATION DITCHES	$ 2,879,450	$ 3,122,040
8	CLARIFIERS	$ 1,144,620	$ 1,241,050
9	RAS/WAS PUMP STATION	$ 291,970	$ 316,570
10	TERTIARY FILTERS	$ 972,780	$ 1,054,740
11	CHLORINE CONTACT BASINS	$ 478,870	$ 519,210
12	CHEMICAL STORAGE & HANDLING AREA	$ 396,310	$ 429,700
13	CONVERT DIGESTER #2 TO STORAGE	$ 200,000	$ 216,850
14	BIOSOLIDS DEWATERING BUILDING	$ 2,265,890	$ 2,456,790
15	TEMP SLUDGE CAKE STORAGE	$ 110,750	$ 120,080
16	MAINTENANCE BUILDING	$ 150,540	$ 163,220
17	ELECTRICAL / INSTRUMENTATION	$ 2,225,050	$ 2,412,510
18	TRUNK SEWER	$ 4,502,680	$ 4,882,030
	TOTAL CONSTRUCTION COST @ mid-July 1999 ENR OF 6825 =	**$ 20,625,990**	
	ESTIMATED BID PRICE BASED ON January 2003 ENR OF 7400 =		**$ 22,363,700**

CMC WWTP Disinfection Upgrade
San Luis Obispo, CA.

100% Construction Drawings
Cost Estimate

$5,936,645.07

February 10, 2012

PREPARED FOR:

Carollo Engineers, Inc.
2880 Gateway Oaks Drive, Suite 300
Sacramento, CA 95833

Table of Contents

Cost Estimate Assumptions

Project Recap

Unit Price Recap

Disclaimer

CMC WWTP Disinfection Upgrade

Estimate Notes & Assumptions

1. **Cost Estimate based on 100% CD's dated February 2012, the soils report dated December 2000, and various other documents received from Carollo Eng.**
2. **All materials quoted in this estimate are standard materials used in local state agency projects.**
3. **All construction equipment is sized & priced for local site conditions.**
4. **Labor rates are taken from the latest prevailing wage rate tables (DIR) as of this date**
5. **Contractor to have complete access to project.**
6. **This estimate reflects summertime working conditions unless otherwise noted.**

Exclusions

1. **All tests, fees, permits.**
2. **Removal, relocation, or repair of underground obstructions and/or utilities not shown on the plans or visible from the surface.**
3. **All offsite construction.**

California Department of Corrections
100% CD Cost Estimate

PROJECT: CMC WWTP Upgrade — **ESTIMATE DATE:** February 10, 2012

LOCATION: San Luis Obispo, CA. — **PLAN & SPEC DATE:** February 2012

ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
Site Work	L/S	1.00	$70,698.32	**$70,698.32**
Yard Piping	L/S	1.00	$497,275.93	**$497,275.93**
Fine Screen	L/S	1.00	$488,715.05	**$488,715.05**
Secondary Clarifier	L/S	1.00	$149,370.90	**$149,370.90**
Tertiary Filter	L/S	1.00	$33,598.59	**$33,598.59**
CL2 Basin	L/S	1.00	$140,781.36	**$140,781.36**
Effluent Structure	L/S	1.00	$127,631.59	**$127,631.59**
Filter Return PS	L/S	1.00	$78,454.62	**$78,454.62**
Effluent Metering Vault	L/S	1.00	$56,014.03	**$56,014.03**
UV Basin	L/S	1.00	$1,786,028.43	**$1,786,028.43**
CL2 Building	L/S	1.00	$9,571.41	**$9,571.41**
Electrical & Instrumentation	L/S	1.00	$893,610.00	**$893,610.00**
Extra UV Lamps	L/S	1.00	$195,000.00	**$195,000.00**
			Subtotal	**$4,526,750.23**
			10% General Conditions	**$452,675.02**
			6% Overhead & Profit	**$298,765.52**
			2.25% Bonds & Insurance	**$118,759.29**
			10% Construction Contingency	**$539,695.01**
			Total Estimated Cost	**$5,936,645.07**

Disclaimer

Since J.R. Conkey & Associates has no control over the cost of labor, materials, or equipment, or over the contractor's method of determining prices, or over competitive bidding or market conditions, the statement of probable construction cost provided for herein is made on the basis of professional experience and qualifications. The statement represents J.R. Conkey & Associates best judgment as a professional construction consultant familiar with the construction industry. However J.R. Conkey & Associates cannot and does not guarantee that the proposals, bids, or the construction cost will not vary from opinions of probable cost prepared by them.

APPENDIX F – COST ESTIMATE DETAILS FOR PROPOSED WWTP IMPROVEMENTS AND NEW CONVEYANCE FACILITIES

carollo
Engineers...Working Wonders With Water®

PROJECT SUMMARY

Project:	**CMC Capacity Evaluation - WWTP Improvements**	**Estimate Class:**	**4**
		PIC:	**SGS**
Client:	**City of Morro Bay**	**PM:**	**ETC**
Location:	**San Luis Obispo, CA**	**Date:**	**October 16, 2014**
Zip Code:	**93401**	**By:**	**ETC**
Carollo Job #	**9723A.00**	**Reviewed:**	**BS**

NO.	DESCRIPTION		TOTAL
01	General Conditions		$2,777,693
02	Site Work		$694,423
03	Yard Piping-Misc. Structures		$2,083,270
04	Influent Pumping-Screening		$2,649,912
05	Aerated Grit Removal		$641,223
06	Oxidation Ditches		$3,555,200
07	RAS-WAS Pump Station		$424,263
08	Secondary Clarifiers		$2,116,238
09	Tertiary Filters		$2,797,138
10	UV Disinfection		$3,072,361
11	Biosolids Dewatering		$2,798,670
12	Electrical-Instrumentation		$4,166,540
	TOTAL DIRECT COST		**$27,776,930**
	Contingency	30.0%	$8,333,079
	Subtotal		**$36,110,009**
	General Contractor Overhead, Profit & Risk	18.0%	$6,499,802
	Subtotal		**$42,609,811**
	Escalation to Mid-Point (November 2018)	12.6%	$5,347,907
	Subtotal		**$47,957,717**
	Sales Tax (Based on 8.7%)	3.5%	$1,668,929
	Subtotal		**$49,626,646**
	Bid Market Allowance	0.0%	$0
	TOTAL ESTIMATED CONSTRUCTION COST		**$49,626,646**
	Engineering, Legal & Administration Fees	35.0%	$17,369,326
	Owner's Reserve for Change Orders	0.0%	$0
	TOTAL ESTIMATED PROJECT COST		**$66,995,972**

The cost estimate herein is based on our perception of current conditions at the project location. This estimate reflects our professional opinion of accurate costs at this time and is subject to change as the project design matures. Carollo Engineers have no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the *work or of determining prices, competitive bidding or market conditions, practices or bidding strategies. Carollo Engineers cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented as shown.*

Carollo Engineers...Working Wonders With Water®

PROJECT SUMMARY

Project:	**CMC Capacity Evaluation - RWW Pump Station**	**Estimate Class:**	**4**
Client:	**City of Morro Bay**	**PIC:**	**SGS**
Location:	**San Luis Obispo, CA**	**PM:**	**ETC**
Zip Code:	**93401**	**Date:**	**November 20, 2014**
Carollo Job #	**9723A.00**	**By:**	**ETC**
		Reviewed:	**BS**

NO.	DESCRIPTION		TOTAL
01	General Conditions		$203,638
02	RWW Pump Station		$1,527,284
03	Electrical-Instrumentation		$305,457
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
			$0
	TOTAL DIRECT COST		**$2,036,379**
	Contingency	30.0%	$610,914
	Subtotal		**$2,647,292**
	General Contractor Overhead, Profit & Risk	18.0%	$476,513
	Subtotal		**$3,123,805**
	Escalation to Mid-Point	12.6%	$392,065
	Subtotal		**$3,515,870**
	Sales Tax (Based on 8.7%)	3.5%	$122,352
	Subtotal		**$3,638,222**
	Bid Market Allowance	0.0%	$0
	TOTAL ESTIMATED CONSTRUCTION COST		**$3,638,222**
	Engineering, Legal & Administration Fees	35.0%	$1,273,378
	Owner's Reserve for Change Orders	0.0%	$0
	TOTAL ESTIMATED PROJECT COST		**$4,911,600**

The cost estimate herein is based on our perception of current conditions at the project location. This estimate reflects our professional opinion of accurate costs at this time and is subject to change as the project design matures. Carollo Engineers have no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the work or of determining prices, competitive bidding or market conditions, practices or bidding strategies. Carollo Engineers cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented as shown.

DETAILED COST ESTIMATE

Project: CMC Capacity Evaluation - RWW Pump
Client: City of Morro Bay
Location: San Luis Obispo, CA
Element: 02 RWW Pump Station

Date : November 20, 2014
By : ETC
Reviewed: BS

SPEC. NO.	DESCRIPTION	QUANTITY	UNIT	UNIT COST	SUBTOTAL	TOTAL
	Division 02 - Site Construction					
02240	10Hp Submersible Pump, 3" Elect.	120	DAY	$145.53	$17,464	
02260	Sheet Piling, 38#/Sf To 25' Deep, Pulled & Salvaged (Pits Only)	3,976.00	SF	$33.63	$133,715	
02300	Cat 235 Trackhoe 2.75Cy Bucket, Class B (Medium Digging), 0-20' D	1285.93	CY	$2.15	$2,760	
02300	Native Trench Backfill/Unconfined Struct. Bf, Class B Material	392.00	CY	$16.97	$6,653	
02300	Imported Trench Backfill/Unconfined Struct. Bf, Class B Material	91.85	CY	$36.87	$3,386	
02468	12" Square X 30' Long Precast Conc. Piling, In Class A,B,C, Mat'L	1,770.00	LF	$33.57	$59,414	
	Total					**$223,392**
	Division 03 - Concrete					
03300	24" Edge Forms, Slab On Grade, Add	118	LF	$28.80	$3,398	
03300	24" Structural Flat Mat On Grade	62.96	CY	$317.92	$20,016	
03300	24" Straight Wall >8' High	173.78	CY	$628.10	$109,151	
03300	12" Elevated Slab, 21'-26' High	27.26	CY	$518.74	$14,141	
03300	12" Straight Wall, To 8' High	9.48	CY	$947.90	$8,986	
03300	12" Straight Wall, To 8' High	3.17	CY	$947.90	$3,005	
03300	12" Elevated Slab To 20'	2.11	CY	$450.63	$951	
	Total					**$159,648**
	Division 11 - Equipment					
11312	100Hp Submersible Sump Pump	5	EA	$69,315.44	$346,577	
	Total					**$346,577**
	Division 15 - Mechanical					
15114	12"- 200 Psi Ci Fxf Swing Check Valve	5	EA	$6,824.73	$34,124	
15116	24" Fxf Cast Iron Plug Valve W/Handwheel Op	3	EA	$11,514.28	$34,543	
15116	12" Fxf Cast Iron Plug Valve W/Handwheel Op	5	EA	$2,487.24	$12,436	
15251	24" Cldi Flg Straight Tee In Place	7	EA	$11,478.84	$80,352	
15251	24" 90° 125# Cldi Fxf Ell	3	EA	$9,405.36	$28,216	
15251	12" 90° 125# Cldi Fxf Ell	5	EA	$2,504.58	$12,523	
15251	24" 125# Cast Iron Blind Flange	1	EA	$2,091.00	$2,091	
15251	24" Flg Cldi Pipe In Bldg	50	LF	$453.76	$22,688	
15251	12" Flg Cldi Pipe In Bldg	200	LF	$143.43	$28,685	
	Total					**$255,658**
	Division 16 - Electrical					
16000	Variable Frequency Drive (200 HP)	5.00	EA	$38,299.26	$191,496	
16232	1000 Ekw 1800Rpm, 60Hz Turbocharged Aftercooled Standby Gen Set	1.00	EA	$316,112.63	$316,113	
16272	1000 Kva Three Phase 480V Dry Type Distribution Transformer	1.00	EA	$34,399.44	$34,399	
	Total					**$542,008**
	Grand Total					**$1,527,284**

CONCEPTUAL PIPELINE MODEL - TYPE "1" TRENCH - CONFINED / URBAN

Version 2.0-4

This template calculates the excavation and backfill volumes for, what we refer to, as **TYPE 1 TRENCHES**, that are either, 1) a totally full height vertical trench, or, 2) a trench with a "vertical pit" (max depth = 4') plus equal unsupported side slopes to the surface. Type 1 Trenchs are usually considered more for "***Urban***" locations because of restricted access and excavation configuration considerations.

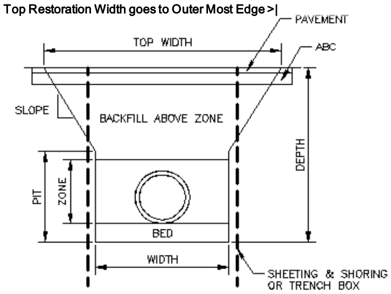
The text and numbers in **RED** are the variables to change to fit your project. These are the **ONLY** inputs that need to be changed. All of the other values shown are based on formulas. By using the side slope of: 1 Vert.to **0 Horiz**, a **vertical trench** is obtained. (Refer to Operation Note #4, for complete instructions.). Calculated values appear in the highlighted box with **bold** lettering. These values can be transferred to your estimate worksheet.

Note: All earthwork quantities are "Bank Measure" volumes without any shrink/swell factors. Operational Notes provided at approximately cell P46.

QUANTITY CALCULATIONS:

TYPE 1 TRENCH

|< Top Restoration Width goes to Outer Most Edge >|



Proj Name/No: MBCSD RWW Forcemain — Date: 25-Nov-14
Item: 24" DIP Forcemain — Proj Mgr::
Notes: MBCSD WWTP to CMC WWTP
:

DESCRIPTION	INPUT	
Pipe Diameter (Nom.)	24.00	inches
Average **Total** Exc **Depth**	6.50	feet (Include Bed Thickness)
Length	43,200.00	feet
Trench Slope: 1 Vert. to	1.00	Horiz.
Pavement Thickness:	4.00	inches
ABC Depth:	8.00	inches
No.of Pavement Cuts	2.00	Each

Calculated Values

9.0 ft	= Top Trench Width
11.0 ft	= Top Resoration Width

CALCULATED QUANTITIES for ESTIMATE

Pavement Cutting (per Inch Depth x Length)	=	**172,800 ln ft**
Pavement Removal	=	**237,600 sq ft**
Trench Excavation	=	**51,600 cu yd**
Bed + Zone fill (Excludes Pipe Volume)	=	**14,173 cu yd**
Zone Only Fill (Excludes Pipe Volume)	=	**10,973 cu yd**
Bed Only Fill	=	**3,200 cu yd**
Backfill Above Zone	=	**32,400 cu yd**
Waste if Import Bed, Zone	=	**19,200 cu yd**
Waste if Native Bed, Zone	=	**5,027 cu yd**
Surface Restoration Area	=	**237,600 sq ft**
Shoring Length	=	**43,200 ln ft**
Shoring Area	=	**NONE sq ft**

= For driven solid shoring

INPUT VARIABLES

Bed Depth =	6.0	in	Default = 6"
Zone Depth Above Pipe =	6.0	in	Default = 6"
Min. Width =	36.0	in	Indicate Practical Bucket Width
Side Width (per side x 2) =	24.0	in	Default @ 12" per side
Pit Depth =	4.0	ft	**See Note #2, #3 and #4**
	1.0	ft	Add'l **allowance** for surface restoration per side **(see Note #5)**

ESTIMATED COSTS:

DESCRIPTION	QTY	UNIT	$/UNIT	TOTAL	*$/LF*	COMMENTS
Earthwork						
Pavement Cutting	172,800	ln FT	$0.79	$135,691	*$3.14*	AC Thickness = 4 in
Pavement Removal	237,600	SF	$0.46	$110,279	*$2.55*	
Disposal Haul	2,933	CY	$13.65	$40,055	*$0.93*	Assumed haul distance is:
Trench Excavation	51,600	CY	$5.17	$266,625	*$6.17*	Assumed excavator used is:
Bed + Zone fill	14,173	CY	$36.87	$522,517	*$12.10*	Imported confined material used
Zone Only Fill	10,973	CY		$0	*$0.00*	Imported confined material used
Bed Only Fill	3,200	CY		$0	*$0.00*	Imported confined material used
Backfill Above Zone	32,400	CY	$16.97	$549,923	*$12.73*	Native unconfined material from trench used
Waste if Import Bed, Zone	19,200	CY		$0	*$0.00*	Assumed haul distance is:
Waste if Native Bed, Zone	5,027	CY	$13.65	$68,637	*$1.59*	Assumed haul distance is:
Surface Restoration Area	237,600	SF	$2.78	$660,626	*$15.29*	AC replacement is assumed to be:
Shoring Area	43,200	LF	$4.19	$180,922	*$4.19*	Trench Bracing, 3' W X 5' D Alum. Hyd. Shores
(Other as Needed)				$0	*$0.00*	
				$0	*$0.00*	Add in Allowances for Dewatering, etc. that might apply.
Earthwork Subtotal				$2,535,275	*$58.69*	
Pipe						Insert pipe type
24" Class 250 DIP CML&C	43,200	LF	$105.78	$4,569,605	*$105.78*	
18" Isolation Plug Valves	8	EA	$5,870.06	$46,961	*$1.09*	
24"x18" Eccentric Reducers	16	EA	$8,961.51	$143,384	*$3.32*	Add in Allowances for Fittings, etc., if needed.
24" Restraining FCAs	16	EA	$2,206.35	$35,302	*$0.82*	
24" Fittings (90, 45, 22.5, Tee	1	LS	$124,626.68	$124,627	*$2.88*	
Air/Vac Valve	16	EA	$3,567.31	$57,077	*$1.32*	
Pipe Subtotal				$4,976,955	*$115.21*	
Miscellaneous						Items may include Valve Boxes, Manholes, etc.
				$0	*$0.00*	
				$0	*$0.00*	
Miscellaneous Subtotal				$0	*$0.00*	
TOTAL DIRECT COST:				**$7,512,229**	***$173.89***	
						Include/exclude adders as needed for report (except as noted)
Indirect Costs						
General Conditions			10.0%	$751,223	*$17.39*	Retain this adder here, unless defined separately
Subtotal				**$8,263,452**	***$191.28***	
Contingency			30.0%	$2,479,036	*$57.39*	
Subtotal				**$10,742,488**	***$248.67***	
General Contractor Overhead, Profit & Risk			18.0%	$1,933,648	*$44.76*	Retain this adder here
Subtotal				**$12,676,136**	***$293.43***	
Escalation to Mid-Point			12.6%	$1,590,967	*$36.83*	
Subtotal				**$14,267,103**	***$330.26***	
Sales Tax (Based on 8.7%)			3.5%	$496,495	*$11.49*	
Subtotal				**$14,763,598**	***$341.75***	
Bid Market Allowance			0.0%	$0	*$0.00*	
TOTAL INDIRECT COST:				**$7,251,368**	***$167.86***	
TOTAL ESTIMATED CONSTRUCTION COST				**$14,763,598**	***$341.75***	

December 2014

City of Morro Bay - New Water Reclamation Facility

Draft Technical Memorandum – *Design Alternative for Rancho Colina Site*

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WATER • WASTEWATER • WATER REUSE

City of Morro Bay
New Water Reclamation Facility

DRAFT Technical Memorandum: Design Alternative for Rancho Colina Site

December 2014

Prepared by:

____
Eileen Shields, PE

____
Michael Nunley, PE

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SECTION 1 INTRODUCTION

1.1 Purpose of Report

The City of Morro Bay performed a screening of potential sites for the new Water Reclamation Facility (WRF) to replace the existing wastewater treatment plant. One concept is to modify the existing California Men's Colony Wastewater Treatment Plant (CMC WWTP) to also treat wastewater from the City of Morro Bay (City) and Cayucos Sanitary District (CSD). This alternative would consist of partnering with multiple agencies, including the State of California Department of Corrections and Rehabilitation (CDCR), the CSD and potentially the County of San Luis Obispo. The City is performing a separate study to determine the likely costs and feasibility of such an upgrade (Capacity Evaluation of the California Men's Colony Wastewater Treatment Plant Technical Memorandum by Carollo Engineers, Draft November 2014 or "CMC Capacity Evaluation").

Alternatively, the City could pursue a separate site, such as the Rancho Colina site in the Morro Valley. The Rancho Colina site ranked first among seven potential sites reviewed for the new WRF in the New Water Reclamation Facility Project Final Options Report (John F. Rickenbach Consulting, January 10, 2014). Sites were evaluated and ranked based on several issues, including environmental, logistics, engineering and design, and cost. A vicinity map is included as **Figure 1-1**, showing the City's existing WWTP and the Rancho Colina site. The purpose of this technical memorandum is to provide an evaluation of a WRF design alternative at the Rancho Colina site that will be a functional equivalent to an upgraded CMC WWTP in order to help inform the City Council.

The design alternative presented herein is not meant to provide a Master Plan or preliminary design for the City's new WRF, but rather to inform the City Council so that they may evaluate the potential range in costs for the two options. The objective of this memorandum is to present a treatment concept that could possibly be delivered within 5 years. As described in the Draft Work Plan Memorandum (April, 2014), this design alternative would represent "Phase I" of the City's water reclamation program and will produce filtered, disinfected wastewater. Phasing the program may be necessary in order to provide time for identifying recycled water users, developing agreements, designing transmission systems, and constructing the required delivery systems while still allowing the City to complete a "Reclamation-Ready" facility within five years.

The plant design presented herein does not include many of the amenities or features that City residents identified as desired features for the new WRF. Similarly, the CMC Evaluation will present a plant design that will cost-effectively expand the existing CMC facility to meet combined City and CSD flows and loads without adding other project features. Since Rancho Colina is a large, undeveloped site, and the City would own it, there is a greater ability to add project components that are important to the public and to the Council. Examples are a City corporation yard, alternative energy (such as solar panels) or possibly a community park, which are not likely to be possible at CMC since the City will not own that property or own the treatment facility itself, but could be incorporated into a Rancho Colina facility.

In order to provide a complete picture of the potential budgets for the regional CMC site and a Rancho Colina-based recycled water program, MKN is developing a separate cost opinion for Phase II of the City's water reclamation program. Phase II will include a recycled water transmission system with salts removal to meet water quality needs for avocados. The cost opinion for these elements will be presented in the JFR report titled "CMC vs. Rancho Colina" in order to allow a comparison of the treated wastewater cost as well as the cost for the estimated water supply benefit associated with each alternative.

1.2 Scope of Work

In order to provide a comparable evaluation that is consistent with the City's goals for the new WRF, MKN performed the following tasks:

- Utilized flows and loadings from previous WWTP design reports, consistent with the CMC Capacity Evaluation.
- Selected unit processes that can meet the following objectives and serve as a functional equivalent to the CMC expansion alternative:
    - Effluent requirements for Title 22 unrestricted reuse and most probable limitations for wet weather ocean disposal using the City's outfall.
    - Solids handling program that is comparable to the CMC WWTP process.
- Developed design criteria with redundancy and reliability requirements similar to those in the CMC Capacity Evaluation.
- Developed a planning level layout for WRF at the Rancho Colina site.
- Provided a conceptual layout for the raw wastewater lift station and force main alignment to transport wastewater from the existing City/CSD WWTP to the new WRF at the Rancho Colina site.
- Developed planning level capital cost opinion of the raw wastewater conveyance system and treatment facilities. Unit costs were based on the CMC Capacity Evaluation when appropriate.

City of Morro Bay

New Water Reclamation Facility Technical Memorandum:

Design Alternative for Rancho Colina Site

Figure 1-1:
Vicinity Map

1 inch:1,000 feet

MAP NOTES:
2011 AERIAL PHOTO PROVIDED BY COUNTY OF SAN LUIS OBISPO.
MAP PUBLISHED OCTOBER 2014.

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SECTION 2 CRITERIA FOR WRF PLANNING LEVEL DESIGN

The objectives for this conceptual WRF alternative at the Rancho Colina site are:

1. Meet anticipated permit requirements for unrestricted urban reuse and wet weather disposal using the existing ocean outfall; and
2. Provide a plant that is functionally equivalent to the potential WWTP upgrade at CMC.

The estimated influent flows and loadings and anticipated requirements for treated effluent quality were reviewed to provide a basis for the conceptual design.

2.1 Influent Flows and Loadings

The influent wastewater flows and loadings were previously evaluated as part of the wastewater master planning process, and presented in the Facility Master Plan Draft Amendment No. 2 (MWH, July 2010). The flows and loadings were established for a combined City and CSD buildout population and based on historical flows and loadings. Flows from 1995 through 2009 were reviewed to establish the basis for design for flow parameters. Loading data for 2002 through 2009 were also gathered and evaluated. The estimated influent flows and loadings were considered for both this evaluation and the CMC Capacity Evaluation and are summarized in **Table 2-1** and **Table 2-2**.

Table 2-1: Projected Influent Flows

Flow Condition	Estimated Influent Flow Rate (MGD)
Average Annual Daily Flow (AADF)	1.5
Average Daily Maximum Month Flow (ADMMF)	2.9
Peak Season Dry Weather Flow, Peak Day (PDDWF)	2.7
Annual Peak Day Flow (PDF)	5.6
Peak Hour Flow (PHF)	8.0

Table 2-2: Projected Influent Loading	
Parameter and Condition	**Estimated Influent Loading (ppd)**
Biological Oxygen Demand (BOD)	
Annual Average Day	3,500
Annual Max 30-day	4,700
Peak Season Dry Weather, Average Day	4,200
Peak Season Dry Weather, Max Month	5,500
Total Suspended Solids (TSS)	
Annual Average Day	3,800
Annual Max 30-day	5,300
Peak Season Dry Weather, Average Day	4,500
Peak Season Dry Weather, Max Month	6,300
Total Kjeldahl Nitrogen (TKN)[1]	
Annual Average Day	600
Annual Max 30-day	800
Peak Season Dry Weather, Average Day	710
Peak Season Dry Weather, Max Month	940
[1] TKN values are derived by assuming TKN/BOD ratio of 0.17.	

2.2 Treated Effluent Quality

The new WRF will provide a level of treatment to meet California Code of Regulations (CCR) Title 22 requirements for unrestricted urban irrigation (disinfected tertiary recycled water) and to meet Waste Discharge Requirements / NPDES requirements for wet weather disposal to the existing ocean outfall. These limits will be established by the Central Coast Regional Water Quality Control Board through a new permit, the Waste Discharge Requirements, for the new WRF. There will likely be separate requirements for effluent limitations for disposal to the outfall and for recycled water.

Although the exact requirements for the effluent quality are unknown, it is assumed that the limits for disposal to the outfall will be similar to full secondary treatment. The existing WWTP is permitted under Waste Discharge Requirements (WDR) Order NO. R3-2008-0065 / NPDES NO. CA0047881. Some of the effluent limits and discharge specifications are summarized in **Table 2-3**. The WDR also includes limits for protection of marine life and human health per the California Toxics Rule (not included in the table below).

Table 2-3: Existing WWTP Effluent Limits	
Parameter and Condition	**Value**
Monthly Dry Weather Flow, MGD	2.36
Biological Oxygen Demand (BOD)	
Average Monthly, mg/L	120
Instantaneous Maximum, mg/L	180
30-day Average Percent Removal, %	30
Total Suspended Solids (TSS)	
Average Monthly, mg/L	70
Instantaneous Maximum, mg/L	105
30-day Average Percent Removal, %	75
Total Coliform Bacteria	
30-day Median, MPN/100 mL	23
Maximum, MPN/100 mL	2400
Grease and Oil	
Average Monthly, mg/L	25
Average Weekly, mg/L	40
Instantaneous Maximum, mg/L	75
Settleable Solids	
Average Monthly, mg/L	1
Average Weekly, mg/L	1.5
Instantaneous Maximum, mg/L	3
Turbidity	
Average Monthly, NTU	75
Average Weekly, NTU	100
Instantaneous Maximum, NTU	225
pH	6.0 – 9.0

The effluent requirements for water reclamation will be based on CCR Title 22 requirements for the most stringent end use. Unrestricted urban irrigation requires disinfected tertiary recycled water. The estimated recycled water effluent limits are summarized in **Table 2-4**.

Table 2-4: Estimated Recycled Water Effluent Limits	
Parameter and Condition	**Value**
Biological Oxygen Demand (BOD)	
Average Monthly, mg/L	30
Instantaneous Maximum, mg/L	90
Total Suspended Solids (TSS)	
Average Monthly, mg/L	30
Instantaneous Maximum, mg/L	90
Total Coliform Bacteria	
7-day Median, MPN/100 mL	2.2
30-day Maximum, MPN/100 mL	23
Maximum, MPN/100 mL	240
Turbidity	
24-hr Average, NTU	2
95th Percentile in 24-hr, NTU	5
Maximum, NTU	10

As directed by City Council, it is assumed the plant will produce disinfected tertiary recycled water even when discharging wet weather flows to the ocean outfall.

2.3 Reliability Features

Reliability features are a requirement of Title 22 to reduce the risk of improperly treated wastewater reaching recycled water users. Reliability features are also included as best management practices in design of a wastewater treatment plant to reduce the risk of a wastewater spill or overflow, allow preventative maintenance to be performed, and provide reliable treatment. The reliability features assumed for the proposed WRF design alternative are summarized in the table below.

Table 2-5: Summary of WRF Reliability Features	
Unit Process	**Reliability Feature**
Pump Stations[1]	Adequate pumping capacity so that if the largest pumps is offline, the peak flow is met
Screens	Two fully redundant screens, each sized to handle the peak hour flow rate
Oxidation Ditch Basins	Two basins, each with sufficient capacity to provide full treatment for short periods of time
Oxidation Ditch Aerators/Mixers	Sufficient power in each basin to provide required aeration/mixing for full flows for short periods of time
Secondary Clarifiers	Two fully redundant clarifiers, each sized to handle the full flow and maximum month loading
Cloth Disk Tertiary Filters	One filter unit with one redundant filter disk. When the recycled water system is constructed, controls will be installed so that effluent is automatically diverted to ocean outfall disposal if filtered effluent does not meet turbidity requirements.

Table 2-5: Summary of WRF Reliability Features	
Unit Process	**Reliability Feature**
UV Disinfection System	Controls will be installed so that effluent is automatically diverted to the ocean outfall if minimum UV transmittance is not achieved for the disinfected effluent.
Solids Dewatering System	Provide on-the-shelf spare parts for common wear and maintenance items, and technician within 24 hours of project site
Backup Power	Provide standby generator on automatic transfer switch, sized to provide power for WRF site in case of an electrical power failure
Alarms and Monitoring	Local and remote status and alarms for equipment, power supply, individual equipment failures, and water levels in basins, treatment monitoring including quality parameters at various treatment stages.
[1]Pump stations include raw wastewater influent lift station and RAS pump station.	

SECTION 3 RAW WASTEWATER CONVEYANCE SYSTEM

Currently, wastewater from the City of Morro Bay and service area of Cayucos Sanitary District flows to the existing Morro Bay – Cayucos WWTP at 160 Atascadero Road in Morro Bay for treatment and disposal. A pump station and pipeline will be required to convey the raw wastewater from the existing service area to the new WRF site. Since the sewer system is currently configured to convey flow to the existing WWTP, it is recommended that the new influent lift station be installed at the existing WWTP. The conceptual layout for the influent lift station and force main alignment used for this analysis is shown in **Figure 3-1**.

3.1 Influent Lift Station

The new influent lift station should be located near the main influent sewer line at the WWTP and the location should consider minimizing impact to the existing WWTP during construction. The existing WWTP will be in operation until the new WRF is constructed and operational. One location that appears to meet this criteria is south of the headworks structure. This area is near the influent sewer and would allow the lift station to be constructed while minimizing disturbance to the operation of the existing facility.

For this report, it is assumed that the influent lift station will consist of three solids-handling, submersible centrifugal pumps, each capable of handling 2800 gpm at 280 feet of total dynamic head (TDH) including 160 feet of elevation difference between the sites and 120 feet of friction and minor losses. The sizing of the lift station pumps is based on providing capacity for peak hour flows (wet weather) with one pump out of service in order to meet redundancy requirements. It is assumed that the pumps will be controlled with variable frequency drives (VFDs) to more closely match incoming flows, minimize wet well retention times, and to maintain continuous flow to the new treatment facility. This conceptual design for the lift station includes a deep concrete structure with space for up to four pumps. Based on the pump sizes indicated above, a structure with inside dimensions of 30 feet by 16 feet and a depth of 26 feet was used in estimating construction costs. **Table 3-1** summarizes the conceptual design for the lift station.

Table 3-1: Influent Lift Station Conceptual Design

Category	Design Value
Pumps	
Number	3
Type	Submersible solids-handling (centrifugal)
Capacity, GPM, each	2800
Total Dynamic Head, FT	280
Speed	Variable (VFDs)
Horsepower, each	300
Wet Well	
Number	1
Width, FT	16
Length, FT	30
Total Depth, FT	26

City of Morro Bay

New Water Reclamation Facility Technical Memorandum:

Design Alternative for Rancho Colina Site

Figure 3-1:
Raw Wastewater Lift Station and Force Main Conceptual Alignment

1 inch:700 feet

MAP NOTES:
2011 AERIAL PHOTO PROVIDED BY COUNTY OF SAN LUIS OBISPO.
MAP PUBLISHED OCTOBER 2014.

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3.2 Raw Wastewater Force Main

The raw wastewater force main to convey wastewater from the influent lift station at the existing WWTP to the new WRF at the Rancho Colina site will generally follow Atascadero Road and Highway 41. The force main would likely be located within existing City owned streets, new utility easements on private property, and within the Highway 41 right-of-way which will require encroachment permit from California Department of Transportation (CalTrans). Due to the proximity of Morro Creek to Highway 41 on the south, it was assumed that the force main would be placed on the north side of the roadway. A conceptual alignment is shown on **Figure 3-1** for the purposes of estimating construction costs.

The conceptual alignment begins at the influent lift station on the existing WWTP site and travels to the east along the north side of Atascadero Road. Atascadero Road crosses underneath Highway 1 before meeting Highway 41. Based on preliminary discussions with CalTrans, a casing will be required when crossing the Highway 1 right-of-way. To ease construction and reduce traffic control requirements, it is assumed the force main would be installed using jack-and-bore construction methods within the Highway 1 right-of-way, approximately 500 feet long in order to cross Highway 1 right-of-way and avoid potential conflicts with City frontage streets and other facilities.

From the east side of Highway 1, the force main could be installed within City streets to the intersection of Atascadero and Hill Street. From there the force main would be installed within CalTrans Highway 41 right-of-way to the Righetti Property. It is assumed for ease of construction that a utility easement would be obtained to install the force main on the Righetti property along the southern property line. This easement would continue onto the adjacent Macelvaine property to the new WRF location. In total, approximately 5,000 linear feet of easement on private property would be required for this conceptual alignment.

It has been assumed that the force main would be 18 inches in diameter. This would provide sufficient pipe velocities to prevent settling of solids with one pump operating at its full capacity while minimizing head losses due to friction. It was assumed the force main will be constructed of cement mortar lined and coated (CML&C) ductile iron pipe.

Table 3-2: Raw Wastewater Force Main Conceptual Design

Category	Design Value
Diameter, inch	18
Material	Ductile Iron (CML&C)
Length, linear FT	10,000
Hwy 1 crossing length, jack and bore, linear FT	500

SECTION 4 WATER RECLAMATION FACILITY

The unit processes selected for the purposes of this technical memorandum are described in the sections below. A brief description of the purpose and type of equipment is provided, along with the design criteria used as a basis for equipment selection and sizing and a conceptual design for each process. This conceptual design was developed to provide a footprint for the layout of the new WRF at the Rancho Colina site and to develop a planning level cost opinion for comparison to the Regional CMC alternative being developed in the CMC Capacity Evaluation (ibid).

The conceptual WRF site plan for the Rancho Colina site is included as **Figure 4-1** and a process flow diagram showing the unit treatment processes is provided as **Figure 4-2**. **Section 5** contains a discussion of the conceptual site plan developed for this analysis. The cost opinions are summarized in **Section 6**.

4.1 Preliminary Treatment

Preliminary treatment is typically the first step at a wastewater treatment plant. Preliminary treatment unit processes are used to remove or reduce the size of coarse solids, and consist of screens and comminuters or grinders. Screens collect and remove coarse solids from the flow stream, while comminuters or grinders intercept coarse solids and grind or shred them in the channel, returning the smaller solids in the flow stream to be removed by downstream treatment processes. Shredded solids often create problems in downstream processes as they can create ropelike strands and cause binding in mechanical equipment or plug pipelines.

Screens

Screens provide a physical barrier between the influent sewer and the wastewater treatment plant site piping and equipment that could be damaged or plugged by large solids. The level of treatment is based primarily on the opening size, or space through which the wastewater flows, while retaining solids greater than the opening size. Typically, screens associated with wastewater treatment plants using secondary treatment processes have 0.25-inch (6-millimeter) openings. This size provides sufficient capture to protect downstream equipment.

Solids larger than the opening size are captured on the screen surface and periodically removed by a mechanical device that differs depending on the type of screen. The collected screenings are moved to a conveyance system (typically a screw conveyor or sluice trough), then to a screenings washing and dewatering equipment to wash organics back in to the process flow stream and to reduce screenings volume and hauling and disposal effort.

The main design criteria for the screens is to provide one fully redundant unit, so that if one unit is offline, the remaining screens have capacity to treat the peak hour flow rate for the plant.

The table below summarizes the screening system design assumed for the purposes of this technical memorandum. The assumed design is based on the recently installed screening system at the City's existing WWTP.

Table 4-1: Screening System Conceptual Design

Category	Design Value
Screens	
Number	2
Type	Chain & Rake, front-clean/front-return
Capacity, MGD, each	8
Channel width, FT	3

Table 4-1: Screening System Conceptual Design	
Category	**Design Value**
Channel depth, FT	5.5
Screenings washer-compactor	
Number	1
Type	Spiral
Capacity CF/hr	33 (batch mode), 99 (continuous)

Grit Removal

Grit in municipal wastewater consists of sand, gravel, coffee grounds, and other heavy solid, inorganic materials which have specific gravities or settling velocities greater than organic materials in the wastewater. Grit removal is performed to protect downstream mechanical equipment from abrasion, reduce potential for deposits in pipelines and channels, and reduce frequency of sludge digester cleaning caused by grit accumulation. Grit removal is most commonly placed after screening and prior to primary sedimentation and secondary treatment. In this case, grit removal is not required for the secondary equipment (oxidation ditches) and it is assumed that grit in the influent wastewater will settle with the solids in the secondary clarifier and eventually be wasted to the solids dewatering equipment. Many extended aeration plants do not include grit removal, as the amount of grit is variable from system to system. Sufficient space between the screens and the oxidation ditches to allow the addition of grit removal in the future is recommended in the case that the amount of grit is determined to be significant.

4.2 Primary and Secondary Treatment

The objective of primary treatment is to remove settleable solids and floating materials to reduce the suspended solids concentrations and organic loading in the wastewater. Most plants that employ primary treatment use mechanically-cleaned rectangular or circular tanks with standardized designs based on the flows and loadings and site conditions. However, not all secondary processes require primary treatment.

The role of secondary treatment in wastewater is to remove or reduce biodegradable organic material and suspended solids using biological processes. Microorganisms, primarily bacteria, are used to oxidize organic matter into simple end products (carbon dioxide and water) and cellular mass (biomass). Oxygen and nutrients are needed for this conversion. The required nutrients (ammonia and phosphate) are typically found in domestic wastewater influent. The biomass is then removed from the treated liquid by gravity settling. If the treatment process does not include primary treatment, the settleable solids in the influent wastewater is removed with the biomass in the secondary settling tanks (also called secondary clarifiers).

To provide a functionally equivalent project to the potential CMC Upgrade, oxidation ditches were selected for the secondary treatment process.

Oxidation Ditches

The oxidation ditch is an extended aeration activated sludge (EAAS) process that has been used for wastewater treatment since the 1950s. It consists of a concrete, oval-shaped channel equipped with aerators/mixing devices. Screened influent wastewater is mixed with activated sludge as it enters the channel. The aeration/mixing equipment is designed to provide sufficient mixing to keep the mixed liquor in suspension as the influent wastewater flows through the channel.

The design criteria assumed for this alternative for the oxidation ditches are to provide the following:

- Adequate volume and aeration/mixing to treat maximum month flows and loadings and meet anticipated effluent limits (**Section 2**).
- At least two equally sized basins should be provided to allow adequate treatment if one basin is taken offline for short-term maintenance.
- Adequate volume to hydraulically pass peak hour flows.

Oxidation ditches can be designed to include nitrogen removal if the treated effluent goals require it. In this case, the anticipated effluent criteria does not include a nitrogen limit and therefore the oxidation ditch design assumed for the Rancho Colina site will only include treatment for BOD and ammonia reduction, which reduces the overall required basin volume and footprint.

Table 4-2 summarizes the oxidation ditch system design assumed for the purposes of this technical memorandum.

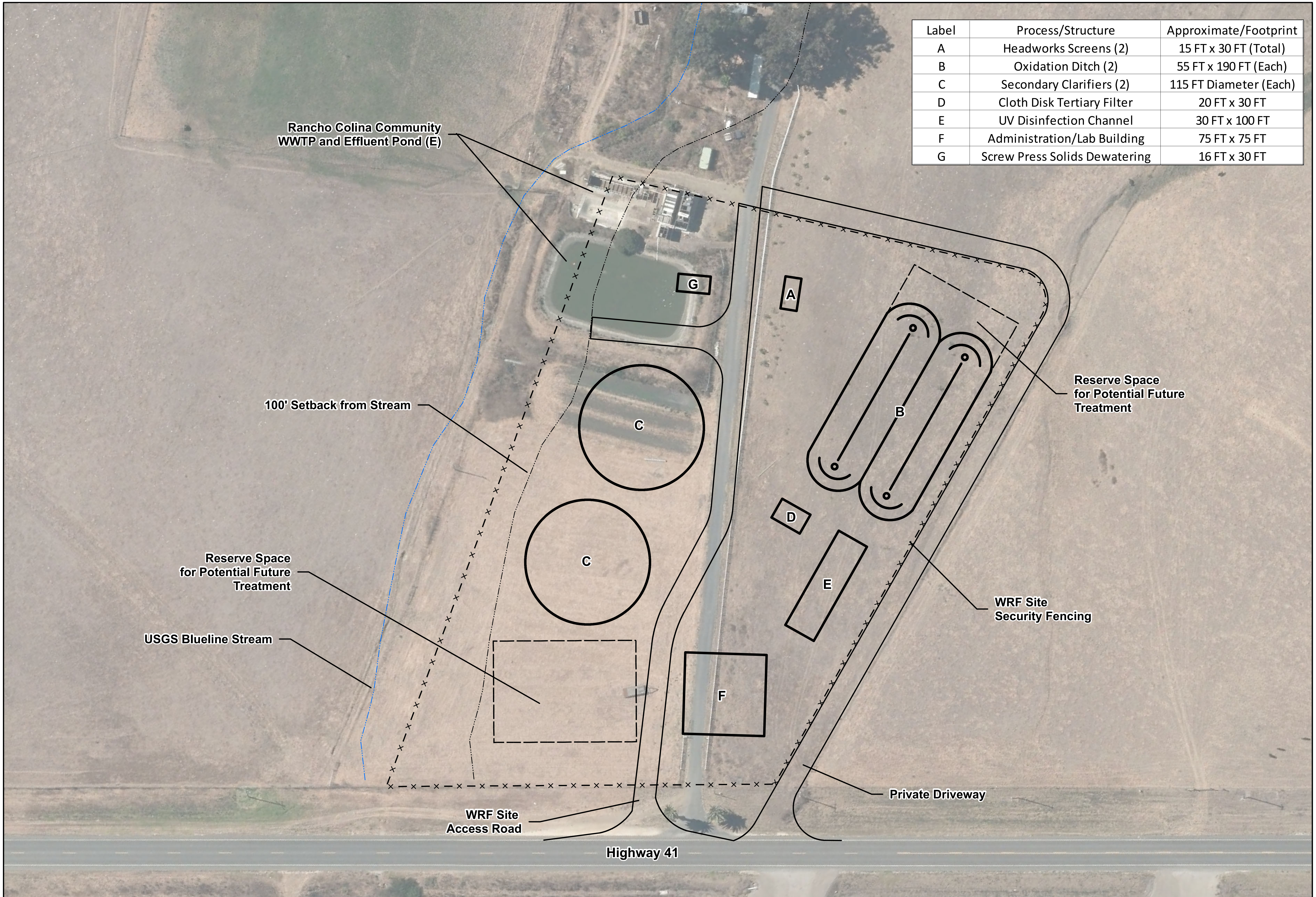
Table 4-2: Oxidation Ditch System Conceptual Design

Category	Design Value
Oxidation Ditch Basins	
Number	2
Manufacturer and model	Ovivo Carrousel®
Volume, each, MG	0.852
Maximum Month BOD Loading, ppd	5,500
Maximum Month Flow, MGD	2.9
Aerators	
Number, each basin	2
Type	Surface aerator
Horsepower, each	60

City of Morro Bay

New Water Reclamation Facility Technical Memorandum:

Design Alternative for Rancho Colina Site



Label	Process/Structure	Approximate/Footprint
A	Headworks Screens (2)	15 FT x 30 FT (Total)
B	Oxidation Ditch (2)	55 FT x 190 FT (Each)
C	Secondary Clarifiers (2)	115 FT Diameter (Each)
D	Cloth Disk Tertiary Filter	20 FT x 30 FT
E	UV Disinfection Channel	30 FT x 100 FT
F	Administration/Lab Building	75 FT x 75 FT
G	Screw Press Solids Dewatering	16 FT x 30 FT

Figure 4-1: Water Reclamation Facility Conceptual Layout

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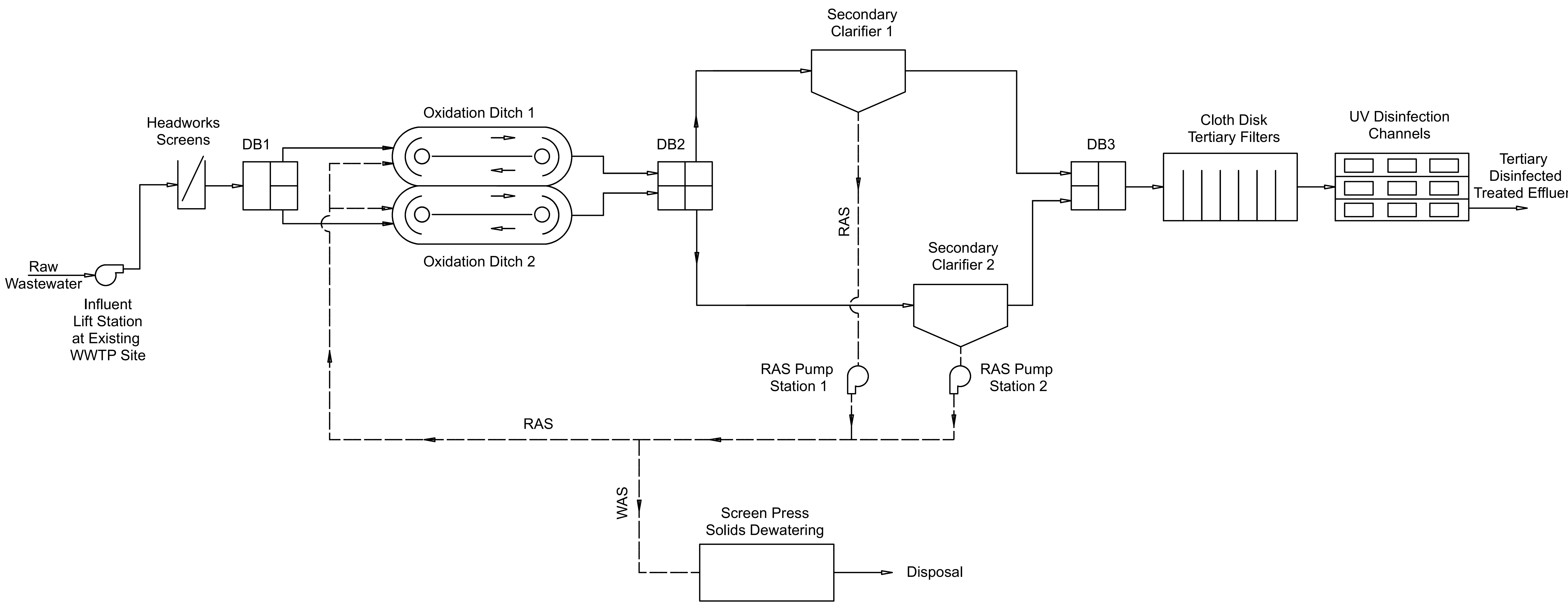
City of Morro Bay

New Water Reclamation Facility Technical Memorandum:

Design Alternative for Rancho Colina Site

Figure 4-2: Process Flow Diagram



Legend:

DB	Distribution Box
RAS	Return Activated Sludge
WAS	Waste Activated Sludge
———	Liquid Flow Stream
- - - -	Solids Flow Stream

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Secondary Clarifiers

Secondary clarifiers are located downstream of the biological treatment (oxidation ditches), similar to the layout at CMC, and provide gravity settling to remove suspended solids.

The design criteria assumed for this alternative for the secondary clarifiers are identified below:

- Adequate volume to treat design flows and loadings and meet anticipated effluent limits (**Section 2**).
- At least two equally sized clarifiers should be provided to allow adequate treatment if one clarifier is taken offline.
- Solids loading rate between 0.2 and 1.0 ppd/SF-hr during maximum month flow (ADMMF)
- Solids loading rate equal to or less than 1.4 ppd/SF-hr during peak day flow (PDF)
- Overflow rate between 200 and 400 gal/SF-day during maximum month flow (ADMMF)
- Overflow rate between 600 and 800 gal/SF-day during peak hour flow (PHF)

Table 4-3 summarizes the oxidation ditch system design assumed for the purposes of this technical memorandum.

Table 4-3: Secondary Clarifiers Conceptual Design	
Category	**Design Value**
Number	2
Type	Circular, center-feed
Manufacturer and model	Ovivo spiral scraper
Diameter, feet	115
Side Water Depth, feet	15
Overflow rate at ADMMF[1], gal/SF-day	279
Overflow rate at PHF[1], gal/SF- day	770
Solids loading rate at ADMMF[1], ppd/SF-hr	0.7
Solids loading rate at PDF[1], ppd/SF-hr	1.4
[1]Calculated rate assuming one clarifier online	

Return Activated Sludge Pump Stations

Extended aeration processes use settled solids from the clarifier to increase concentrations of the beneficial organisms in the biological basins. The solids that are returned to the basins are termed "return activated sludge" (RAS). The rate of return is typically based on the influent flow rate, and is adjusted to maintain desired operational concentrations in the basin. For this conceptual design, two RAS pump stations were assumed, one for each clarifier, each designed to pump RAS to the oxidation ditches. Each RAS pump station will consist of a concrete wet well and contain three submersible solids-handling centrifugal pumps, sized so that any two pumps can handle the peak return flow, assumed to be approximately twice the PDF at most. Variable frequency drives (VFDs) will be used to allow for flow adjustment. The conceptual design for the RAS pump stations is summarized in the table below.

Table 4-4: RAS Pump Station Conceptual Design	
Category	**Design Value**
Number	2
Pumps	
Number, each pump station	3
Type	Submersible solids-handling (centrifugal)
Capacity, GPM, each	3890
Total Dynamic Head, FT	40
Speed	Variable (VFDs)
Horsepower, each	125
Wet Well	
Number	2
Width, FT	12
Length, FT	12
Total Depth, FT	22

4.3 Tertiary Treatment

Tertiary treatment processes are installed downstream of secondary treatment processes to produce higher quality effluent, which is typically driven by stringent discharge or reuse requirements. Filtration is often required after secondary treatment processes to reduce suspended solids (including particulate BOD) concentrations for most recycled water uses. Disinfection is required for some recycled water uses. Unrestricted urban reuse, the use category assumed for this conceptual design, requires both filtration and disinfection to meet CCR Title 22 requirements.

Filtration

Tertiary filtration is typically performed using sand or disk filters. Sand filters are a type of depth filter with various design types, including upflow or downflow operation, continuous or intermittent backwash, and different bed depths, flow controls, and configurations. Depth filtration involves the removal of suspended particulates from the wastewater by passing it through a filter bed made up of granular or compressible filter media (in this case sand).

Disk filters are a type of surface filter that use pile or woven cloth to remove suspended particulate materials from wastewater by mechanical sieving, physically passing the liquid through the filter material while retaining the particles. A series of parallel disks are mounted vertically in a tank. Operations vary by manufacturer design. Wastewater is either introduced in a central feed tube or to the tank and is filtered by either flowing outward through the filters, or inward through the filters. A portion of the disks are submerged. As solids accumulate on and in the cloth media, headloss increases and resists flow. The filters are cleaned with spraybars or a vacuum system when headloss reaches limits set by the operators.

Disk filters provide competitive treatment to sand filters, typically at a lower installation cost and within a smaller footprint. Therefore, disk filters would be pursued at Rancho Colina whereas the Regional CMC Site will use the existing sand filters and possibly expand them.

The design criteria assumed for this alternative for the tertiary filters is to provide the following:

- Adequate filtration capacity to treat peak day flow assuming secondary effluent and meet anticipated effluent limits (**Section 2**).
- Provide one redundant filter disk and allow for isolation and replacement of filter disks while maintaining operations.

The conceptual design is summarized in the table below.

Table 4-5: Tertiary Filters Conceptual Design	
Category	**Design Value**
Number	1
Type	Cloth Disk
Capacity, MGD	5.6
Number of disks, total	8
Total filter area, SF	672 SF
Average filter area flow rate (ADF), GPM/SF	1.54
Peak filter area flow rate (PDF) , GPM/SF	5.76
Filter Tank	Concrete
Tank width, FT	8
Tank length, FT	22.5
Tank depth, FT	11.75

Disinfection

Disinfection involves the partial destruction of disease-causing organisms, which in wastewater consists of bacteria, protozoa, helminths, and viruses (Tchobanoglous, Burton and Stensel). Disinfection of municipal wastewater is typically accomplished through chemical agents (chlorine, sodium hypochlorite, ozone, chloramine, etc.) or physical means (ultraviolet or UV radiation). Unless dechlorination is performed to remove chlorine residual from the treated effluent, disinfection is the last step in the treatment process before discharge.

Similarly to the Regional CMC Site, UV disinfection would be used to meet the requirements for disinfected tertiary effluent. UV light inactivates pathogens by damaging the cellular structure and nucleic acids of microorganisms. There are two types of reactors available: in-vessel and open channel. The design criteria used for the CMC Capacity Evaluation (ibid) was assumed for this alternative for the disinfection system. The conceptual design assumes an open channel design and includes three channels capable of handling 8.0 MGD.

4.4 Solids Handling

Dewatering is a method of solids concentration and volume reduction. Generally, dewatering concentrates sludge to higher than 15% solids concentration. The benefits of dewatering stabilized sludge prior to disposal or recycling includes volume reduction, which reduces hauling, handling, and disposal costs. Dewatering also better prepares biosolids for composting or incineration, further reduces odors, and allows sludge to be handled more easily (as a solid). Dewatering processes can include passive processes such as sludge drying beds and mechanically assisted processes such as presses or centrifuges. A mechanically assisted process is recommended for this alternative.

Solids Dewatering System

A screw press solids dewatering system was selected for this conceptual design due to the plant size, low power requirement, low operational demands, and dewatering performance. The screw press is a continuous feed operation utilizing a gravity drainage at the inlet end of a helical feed screw that reduces the volume of the material being dewatered as it is conveyed from the inlet to the discharge end of the screw press. There are two primary configuration of screw presses: horizontal and inclined. Some screw presses also utilize the addition of lime and heat to both dewater solids, and to reduce pathogens to produce biosolids that meet Class A standards set forth in 40 CFR 503.

A flocculation vessel (or “floc tank”) is typically located upstream of the press. Polymer is combined with solids in the floc tank to enhance dewaterability of the sludge. A portion of the water is removed from the solids by gravity drainage at the inlet to the press. The screw then squeezes free water (filtrate) out of the solids by the screw which progressively reduces the volume available for the solids to occupy. The water is released through screens or perforations that surround the body of the screw. Solids exit at the screw’s discharge outlet as dewatered cake.

The design criteria assumed for this design alternative for the solids dewatering system is to provide the following:

- Adequate capacity to dewater approximately 460 dry tons per year of municipal waste activated sludge to a minimum of 15% total solids

A skid-mounted unit was assumed for the project, complete with screw press, sludge feed pump, polymer feed system and floc tank, control panel and all internal piping and wiring.

The conceptual design for the solids dewatering system is summarized in the table below.

Table 4-7: Solids Dewatering System Conceptual Design

Category	Design Value
Waste Activated Sludge (WAS) Pump	
Number	1
Type	Progressive cavity
Capacity, GPM	120
Screw Press	
Number	1
Type	Horizontal, skid mounted with WAS pump, polymer system and controls
Material	Waste activated municipal sludge
Duty cycle	12 hours/day, 5 days/week
Capacity	2.8 dry standard tons/24 hours
Inlet concentration	0.7 % Total solids
Outlet concentration	15 – 18 % Total solids

4.5 Treated Effluent Conveyance

For the purposes of this report, it is assumed that the treated effluent will be initially released through the existing ocean outfall during plant startup and commissioning, then possibly for wet weather disposal in the future. The WRF will be "recycled water ready" and produce disinfected tertiary recycled water. Costs for a recycled water pump station and pipeline will be included in Phase II of the reclamation program since it is dependent on the needs of its customers. The pipeline to the existing ocean outfall will still be utilized after the recycled water project is implemented to discharge treated effluent during periods of wet weather when irrigation is not feasible. It might also be used to discharge brine from the potential future salts removal process.

The treated effluent will need to be conveyed to the existing ocean outfall. An eighteen-inch diameter, ductile iron pipe, with cement mortar lining and coating (CML&C) is assumed. The alignment would follow the main alignment assumed for the raw wastewater force main (**Figure 3-1**), except it would leave the new WRF site near the chlorine contact basins and run to connect to the existing effluent line near the ocean outfall structure at the existing WWTP site.

Table 4-8: Treated Effluent Pipeline Conceptual Design

Category	Design Value
Diameter, inch	18
Material	Ductile Iron (CML&C)
Length, Linear FT	10,000
Hwy 1 crossing length, jack and bore, Linear FT	500

SECTION 5 CONCEPTUAL WRF SITE LAYOUT

The 187-acre Rancho Colina Site (APN 073-085-027) is located about a mile east of the Morro Bay city limits, just north of and adjacent to Highway 41. The property also extends across the highway to the south, and is adjacent to Morro Creek. Much of the Rancho Colina site contains relatively steep slopes (>10%) and at elevations greater than 250 feet. The southeastern portion of the site contains a mild slope (2-10%) with development potential, which is being considered for the new WRF site. A single-family residence occupied by the property owner, barns and outhouses lies near the southeastern portion of the site. The area also contains a small packaged wastewater treatment plant which provides treatment service to the nearby Rancho Colina residential community on the southwesterly portion of the site. The packaged WWTP would be abandoned and the new WRF would treat sewage flows from the community as part of this project.

Figures 4-1 shows the approximate footprints for the unit processes described in **Section 4**. This site provides a relatively large amount of space which allows for construction of the new facilities without interruption to the existing packaged WWTP. The existing packaged WWTP and associated pond will remain in operation until the new WRF is constructed and commissioned, at which point the WWTP and pond will be disconnected, services will be directed to the WRF headworks and the packaged WWTP equipment will be removed and the pond filled.

A valley runs along the west side of the WRF site, with what appears to be a seasonal stream (shown in blue on **Figures 4-1**). The specific setback requirements for this stream are not known at this time. A conservative 100-foot stream setback was assumed for structures.

Space was reserved on the upstream side of the oxidation ditches for the addition of an anoxic zone to allow for nitrogen removal in the future if desired. An estimated 30 feet of additional length would be required. Additionally, space was reserved along the southern side of the site for additional treatment processes and equipment that may be required for recycled water usage, including a microfiltration/reverse osmosis unit to reduce salts for salt-sensitive users and recycled water pump station.

This site provides a unique opportunity for the recycled water project due to the proximity to both the potential recycled water users identified in the Morro Valley (agricultural properties, mostly avocado growers) and the existing WWTP and ocean outfall which provide essential infrastructure for the project. A raw wastewater lift station will need to be built at the existing WWTP to transport sewage to the new WRF site, and the ocean outfall can be used for wet weather disposal when recycled water is not used and for brine disposal to discharge brine produced from salts removal[1]. Compared to the CMC site, Rancho Colina is approximately six miles closer to the existing WWTP and ocean outfall.

The visibility from Highway 41 will be a consideration for construction at this site. Feasible mitigation measures include grading of berms along the roadway with landscape to provide visual screening, constructing facilities at lower elevations so they are partially buried, and adding architectural features to WWTP buildings to minimize visual impacts.

[1] It is anticipated that salts removal (microfiltration and reverse osmosis system) will be required for an upgrade to the CMC WWTP to meet the existing permitted salts limits for the receiving water (Chorro Creek) with the addition of wastewater from Morro Bay and Cayucos which contains higher salts concentrations than the influent sewage currently treated at the CMC WWTP. Salts removal may also be required for a recycled water project at the Rancho Colina site to produce a recycled water with chloride concentrations acceptable for irrigation at the nearby avocado orchards.

SECTION 6 PRELIMINARY OPINION OF COSTS

6.1 Planning Level Construction Cost Opinion

The planning level construction cost opinion is provided for budgeting purposes only and represents a planning-level effort, based on current bid climate and installed costs for similar projects. The unit costs initially developed in this study were compared to the CMC Capacity Evaluation to confirm that the unit costs herein would result in total unit process costs that were within 10% of those developed by Carollo. Additional project details identified during planning, preliminary engineering, and design may increase or decrease the opinion of probable construction cost. Costs for property acquisition and easements on the Righetti and Macelvaine properties (line item D1) have not been determined at this time and will need to be addressed. The percentages assumed for general conditions, electrical/instrumentation, contingency, contractor overhead and profit, annual cost escalation, and sales tax are the same as those in the Carollo report.

Table 6-1: Planning Level Construction Cost Opinion – Phase I Reclamation-Ready Facility

No.	Description		Total
A.	**Treatment Facility**		
A1	General Conditions		$ 2,370,000
A2	Site Work		$ 2,370,000
A3	Yard Piping/Misc. Structures		$ 2,840,000
A4	Screening		$ 758,000
A5	Not Used		$ -
A6	Oxidation Ditches		$ 3,065,000
A7	RAS/WAS Pump Stations		$ 564,000
A8	Secondary Clarifiers		$ 3,693,000
A9	Tertiary Filters		$ 790,000
A10	UV Disinfection System		$ 3,072,000
A11	Biosolids Dewatering		$ 603,000
A12	Not Used		$ -
A13	Electrical/Instrumentation		$ 3,550,000
Total Treatment Facility Direct Costs			***$ 23,675,000***
B.	**RWW Pump Station**		
B1	General Conditions		$ 177,000
B2	RWW Pump Station		$ 1,327,000
B3	Electrical/Instrumentation		$ 265,000
Total RWW Pump Station Direct Costs			***$ 1,769,000***
C.	**Offsite Pipelines**		
C1	General Conditions		$ 531,000
C2	RWW Conveyance Force Main		$ 2,387,000
C3	Treated Effluent Pipeline		$ 2,395,000
Total Offsite Pipelines Direct Costs			***$ 5,313,000***
TOTAL PROJECT DIRECT COST			**$ 30,757,000**
D.	**Indirect Project Costs**		
D1	Property Acquisition		TBD
D2	Contingency	30%	$ 9,227,000
	Subtotal		$ 39,984,000

Table 6-1: Planning Level Construction Cost Opinion – Phase I Reclamation-Ready Facility			
No.	**Description**		**Total**
D3	General Contractor Overhead, Profit & Risk	18%	$ 7,197,000
	Subtotal		$ 47,181,000
D4	Escalation to Mid-Point		$ 5,922,000
	Subtotal		$ 53,103,000
D5	Sales Tax		$ 1,859,000
	Subtotal		$ 54,962,000
TOTAL ESTIMATED CONSTRUCTION COST			**$ 54,970,000**
D6	Engineering, Legal & Administration Fees	35%	$ 19,240,000
TOTAL ESTIMATED PROJECT COST			**$ 74,210,000**

6.2 Capital Cost Comparison to Regional CMC Alternative

In order to compare the impact of site selection on the City and CSD's capital project costs, MKN developed two cost opinions:

- Rancho Colina Option A – Project alternative described in **Table 6-1**
- Rancho Colina Option B – Project alternative described in **Table 6-1** with the following modifications to more closely resemble the unit processes included in the Carollo report for the Regional CMC Alternative:
  - Aerated grit removal was added
  - Oxidation ditches were expanded to include denitrification
  - Biosolids dewatering operation was limited to 35 hrs per week resulting in the need for two screw press units

The same percentages were applied to direct costs to calculate general conditions, site work, yard piping/miscellaneous structures, and electrical/instrumentation for Option B and Option A.

The following table compares the three capital cost alternatives. The Regional CMC Alternative was based on the CMC Capacity Evaluation (Carollo, Draft November 2014). However, since discussions with CDCR have indicated that a minimum of 2 years must be added to the proposed project schedule for interagency coordination and state approval, the cost escalation period to midpoint of construction was increased from 4 years to 6 years at 3% per year. Also, the cost for desalination of effluent from CMC WWTP (line item A12) and brine discharge pipeline back to the City's ocean outfall (line item C4) has not been evaluated and is not included in the table below. These cost opinions will be included in the final report.

Table 6-2: Comparison of Planning Level Construction Cost Opinions for new WRF at Rancho Colina Site and Regional CMC Expansion				
		Rancho Colina Option A	**Rancho Colina Option B**	**Regional CMC Expansion**
No.	**Description**	**Total**	**Total**	**Total**
A.	**Treatment Facility**			
A1	General Conditions	$ 2,370,000	$ 2,670,000	$ 2,778,000
A2	Site Work	$ 2,370,000	$ 2,670,000	$ 694,000
A3	Yard Piping/Misc. Structures	$ 2,840,000	$ 3,200,000	$ 2,083,000

Table 6-2: Comparison of Planning Level Construction Cost Opinions for new WRF at Rancho Colina Site and Regional CMC Expansion				
		Rancho Colina Option A	Rancho Colina Option B	Regional CMC Expansion
No.	**Description**	**Total**	**Total**	**Total**
A4	Screening	$ 758,000	$ 758,000	$ 2,650,000
A5	Aerated Grit Removal	$ -	$ 641,000	$ 641,000
A6	Oxidation Ditches	$ 3,065,000	$ 3,555,000	$ 3,555,000
A7	RAS/WAS Pump Stations	$ 564,000	$ 564,000	$ 424,000
A8	Secondary Clarifiers	$ 3,693,000	$ 3,693,000	$ 2,116,000
A9	Tertiary Filters	$ 790,000	$ 790,000	$ 2,797,000
A10	UV Disinfection System	$ 3,072,000	$ 3,072,000	$ 3,072,000
A11	Biosolids Dewatering	$ 603,000	$ 1,060,000	$ 2,799,000
A12	Microfiltration and Reverse Osmosis	$ -	$ -	TBD
A13	Electrical/Instrumentation	$ 3,550,000	$ 4,000,000	$ 4,167,000
Total Treatment Facility Direct Costs (Rounded)		***$ 23,675,000***	***$ 26,673,000***	***$ 27,776,000***
B.	**Raw Wastewater (RWW) Pump Station**			
B1	General Conditions	$ 177,000	$ 177,000	$ 204,000
B2	RWW Pump Station	$ 1,327,000	$ 1,327,000	$ 1,527,000
B3	Electrical/Instrumentation	$ 265,000	$ 265,000	$ 305,000
Total RWW Pump Station Direct Costs		***$ 1,769,000***	***$ 1,769,000***	***$ 2,036,000***
C.	**Offsite Pipelines**			
C1	General Conditions	$ 531,000	$ 531,000	$ 751,000
C2	RWW Conveyance Forcemain	$ 2,387,000	$ 2,387,000	$ 7,512,000
C3	Treated Effluent Pipeline	$ 2,395,000	$ 2,395,000	$ -
C4	Brine Discharge to Ocean Outfall	$ -	$ -	TBD
Total Offsite Pipelines Costs		***$ 5,313,000***	***$ 5,313,000***	***$ 8,263,000***
TOTAL PROJECT DIRECT COST		**$ 30,757,000**	**$ 33,755,000**	**$ 38,075,000**
D.	**Indirect Project Costs**			
D1	Property Acquisition	TBD	TBD	
D2	Contingency 30%	$ 9,227,000	$ 10,127,000	$ 11,423,000
	Subtotal	$ 39,984,000	$ 43,882,000	$ 49,498,000
D3	General Contractor Overhead, Profit & Risk 18%	$ 7,197,000	$ 7,899,000	$ 8,910,000
	Subtotal	$ 47,181,000	$ 51,781,000	$ 58,408,000
D4	Escalation to Mid-Point	$ 5,922,000	$ 6,499,000	$ 11,337,000
	Subtotal	$ 53,103,000	$ 58,280,000	$ 69,745,000
D5	Sales Tax	$ 1,859,000	$ 2,040,000	$ 2,441,000
	Subtotal	$ 54,962,000	$ 60,320,000	$ 72,186,000
TOTAL ESTIMATED CONSTRUCTION COST		**$ 54,970,000**	**$ 60,320,000**	**$ 72,190,000**
D6	Engineering, Legal & Administration Fees 35%	$ 19,240,000	$ 21,112,000	$ 25,267,000
TOTAL ESTIMATED PROJECT COST (ROUNDED)		**$ 74,210,000**	**$ 81,432,000**	**$ 97,457,000**

MEMORANDUM

DATE: November 7, 2014

TO: Mayor Irons and City Council Members

CC: Rob Livick, Public Services Director
Dave Buckingham, City Manager
Members of the Water Reclamation Facility Citizen's Advisory Committee (WRFCAC)

FROM: Mary Garelick, WRFCAC Finance Subcommittee Member
Richard Sadowski, WRFCAC Finance Subcommittee Member
Barbara Spagnola, WRFCAC Finance Subcommittee Member

SUBJECT: Comments on Draft Reports Regarding the City's New WRF

Thank you for providing us the opportunity to serve on the WRFCAC. We have reviewed and discussed the following draft reports:

(1) Regulatory Implications of Discharge Options for the Future City of Morro Bay WRF, dated 9/17/14
(2) Initial Findings on Grants and Strategy for the WRF, dated 10/3/14
(3) Hydrologic evaluation of the potential benefits to the City water supply from increasing wastewater discharge to Chorro Creek, dated 10/6/14
(4) Hydrologic evaluation of the potential benefits to the City water supply from reclaimed water use in the Morro Valley, dated 10/20/14

This memo summarizes our finance related comments on the above referenced reports with respect to the two sites currently under consideration.

CMC Site

- Need to know the cost of the land, if any, or any pro rata allocation that would be assessed
- Need to know the cost to convey and pump the raw and treated wastewater
- Need to understand how the overhead and maintenance costs would be apportioned among the various owners of the regional WWTP
- Need to understand possible complications and associated cost in establishing wastewater conveyance easements on Chorro Valley residential property

Rancho Colina Site

- Need to know the cost of acquiring the property
- Need to know the cost to Morro Bay to treat the wastewater to the specifications required by the growers
- If water is to be stored, need to know the cost for storage of the treated water that is not used by the growers, and who will pay for the water storage (e.g., the growers or Morro Bay)
- Need to know the cost to convey and pump the treated wastewater to the growers, and who will pay for this (e.g., the growers or Morro Bay)
- Need to know if the growers are willing to pump less water from their water wells in exchange for the reclaimed water, and if they are willing to relinquish ownership rights of their water wells

Both CMC and Rancho Colina Sites

- Need to know the monetary value of the increased groundwater yield to Morro Bay's well fields, and need to thoroughly understand the difference in the monetary value of increased ground water yield between the two sites
- Need to understand the opportunity costs for both sites
- Consider impact of drought relief funding to cover some of the facility costs, in particular if one site is more likely to be eligible for any such funding

Recommendations

1. It is critical that the City be adequately prepared for contract negotiations, as both the business and the legal terms and conditions will be complex, lengthy, detailed and different for each location. Large projects can typically be bid to several competing entities by requiring the "down selected" bidders to accept (agree to) a minimal set of legal terms and conditions before the winning bidder is chosen, and the final terms, including pricing, are negotiated. This method of contracting provides some assurance that the winning bidder will not engage in a lengthy contract negotiation period requesting or requiring additional concessions while the competing bidders may no longer be interested since they were notified they were not selected. Thus the recommendation is that the City initiates the negotiation process before final selection, and use the outcome of the preliminary negotiations to determine and validate the final awardee. The City may also want to consider hiring a professional firm that specializes in this type of negotiations.

2. Open the RFP to alternative and innovative WRF designs that are not limited to the Design-Bid-Build (DBB) process, but include Design-Bid-Operate-Finance (DBOF) business models. The City's Facility Master Plan (FMP) for the former WWTP project was essentially a high-level design for a specific type of technology. If we did the FMP for the WRF now, it would severely limit the options for innovative solutions and would not reflect progressive options for designing and building a WRF and associated financing and cost reductions. Therefore, we recommend that the FMP not be done until technology options have been explored and an informed choice is made by the Mayor and Council. Additionally, the RFP must provide that proposal selection will be conducted in accordance with the requirements of applicable law, including the Infrastructure Financing Act in the California Government Codes; any proposal that does not fulfill the requirements of such law will be considered non-responsive. Also the RFP must contain provisions that ensure capital resources are available for build out and facility expansion is such an expansion is required and directed by the City. This provision will give Morro Bay the flexibility to continue with the WRF project without the risk of the Cayucos Sanitary District (CSD) delaying the process at a later date.

3. Los Osos obtained funding from USDA for sewer collection, treatment, and effluent disposal despite having a population greater than 10,000 (which is the population threshold for grants and loans to rural communities). This was possible because Los Osos obtained a congressional exemption from the population requirement. We recommend that Morro Bay investigate whether seeking a congressional exemption for the WRF is worth pursuing.

4. **While we recognize there are many outstanding questions regarding these sites that cannot be answered at this time, we believe it might be prudent for the City Council to consider postponing their site decision for a month to six weeks. All of the above referenced reports are very thorough and detailed, but have been just recently presented to the WRFCAC in the last 30 days. Extending the site decision deadline for a short period provides sufficient time for final review of all the reports, while also eliminating the perception of a "rushed" decision being executed.**

WRFCAC Finance Subcommittee Members:

Mary V Garelick	Nov. 7, 2014
Mary Garelick	Date
Richard E. Sadowski	Nov. 7, 2014
Richard Sadowski	Date
Barbara Spagnola	NOV 7, 2014
Barbara Spagnola	Date

MEMO

To: John Diodati, Chairman of the Water Reclamation Facility Citizen's Advisory Committee (WRFCAC)

From: Environmental Sub-Committee of the WRFCAC

Subject: Environmental sub-committee comments regarding the comparison between the Rancho Colina and CMC sites

The subcommittee found environmental concerns with each site that deserves consideration. Citing the recent studies and having approached the comparison from a CEQA/NEPA perspective, the subcommittee identified many items that could be problematic for both sites. The subcommittee also identified items that may have merit for both sites. The city's LCP was also referenced in identifying some of these items looking for consistency.

Attached is the subcommittee's comments on the comparison between the Rancho Colina and CMC sites from an environmental point of view. The decision makers will ultimately make a choice and the subcommittee would like them to be informed of the concerns.

Water Reclamation Facility Citizen's Advisory Committee Environmental Sub-Committee Comments (November 18, 2014)

Rancho Colina vs. CMC

Rancho Colina

Concerns:

- Class 1 Environmental Impacts (significant and unavoidable impacts).
- Sensitive prehistoric cultural resources are known to be present in area (Section 106 of the National Historic Preservation Act will apply. Requirements of newly enacted AB52 may be required if the NOP is filed on or after July 1, 2015). See General Comments section for summary of cultural resources.
- Traffic on State Highway 41 may be impacted and most likely there will be a requirement by Caltrans to widen the highway for a new northbound left turn lane.
- Continuous perpetual pumping to the proposed plant site and ultimately beyond to upland growers.
- Future intended distribution conveyances to upland growers (cumulative impacts).
- Would require cooperation from upland growers to cease their groundwater pumping and their crop water demand has allegedly been underestimated (Table 2, Cleath-Harris report). The City may not realize any benefit to their wells in the lower Morro Valley basin (page 3 of Cleath-Harris report on Morro Valley).
- Brand new discharge permit needed from the Regional Board where facility is proposed.
- Socioeconomic impacts due to high construction expenses and continuous operational costs (potential unintended displacement of low and fixed income residents).
- Proposed facility may require land annexation through LAFCO and the County will need to update its LCP with the Coastal Commission's blessing in order to allow new "*treatment works*".
- Will require constant use of desalinization plant in order for the city to benefit from any reclaimed water, if at all, taken from the Morro Valley wells in contrast with LU Policy 3.08(5) of the city's LCP.
- Lacks consistency with LU Policy 3.06 to accommodate the buildout population of the City and the city's capacity of 2.4 MGD by itself.
- Lacks consistency with LU Policy 80 of the city's LCP where it states, *"The City should implement the proposed wastewater reclamation program to provide an additional 770 acre-feet per year of water supply for agricultural and golf course purposes…".*

Merits:

- Close proximity to potential water reclamation participants.
- Has potential to be "Regional" if Cayucos decides to partner with the City.
- Ocean outfall is more easily accessible for emergency discharge or brine.
- Groundwater recharge and offsets realized from use of reclaimed water for agricultural purposes that could recharge the City wells located at the narrows and help combat salt water intrusion.

CMC

<u>Concerns:</u>

- Class 1 Environmental Impacts (significant and unavoidable impacts). May not necessarily be the case if the existing CMC plant is simply upgraded and shared with Morro Bay and Cayucos to accommodate their additional wastewater flow.
- Sensitive prehistoric cultural resources are known to be present in the Chorro Valley area (Section 106 of the National Historic Preservation Act will apply. Requirements of newly enacted AB52 may be required if the NOP is filed on or after July 1, 2015). See General Comments section for summary of cultural resources.
- Continuous perpetual pumping to the proposed plant site but not beyond.
- Prime ag. where proposed facility is shown. Not necessarily applicable if the existing CMC plant is upgraded.
- Chorro Creek is a Section 303(d) listed waterway (Section 303(d) of the Clean Water Act).
- Brand new discharge permit needed from the Regional Board where facility is proposed, however, if the existing CMC plant is upgraded to accommodate the additional wastewater flow from Morro Bay and Cayucos, then the existing discharge permit could simply be modified (Table 1 - Walker Report).
- Socioeconomic impacts due to high construction expenses and continuous operational costs (potential unintended displacement of low and fixed income residents).
- Lacks consistency with LU Policy 3.06 to accommodate the build out population of the City and the city's capacity of 2.4 MGD by itself.

<u>Merits:</u>

- Upgrading and sharing the existing CMC plant to accommodate the additional wastewater flow from Morro Bay and Cayucos could be considered as an "Environmentally Superior Alternative".
- Has a better potential maximum benefit to the city's well field according to the Cleath Harris report. Should seriously consider wheeling surplus water resulting from the additional discharge into Chorro Valley over to the Morro Valley. That surplus water could be extracted out of the city's Chorro Valley wells and conveyed through the city's existing distribution tanks and lines to serve the Morro Valley. Doing so, puts the resource to the fullest extent of beneficial use.
- Could be beneficial to the Morro Bay estuary thereby protecting sensitive habitat for steelhead trout and other species consistent with LU Policy 11.17 of the city's LCP.
- Capable of being consistent with LU Policy 80 of the city's LCP being that the golf course well is just downstream of the city's wells in Chorro Valley.

General Comments:

Environmental Document:

Has the city allowed sufficient time to prepare the Environmental Document in support of both CEQA (EIR) and NEPA(Environmental Assessment) and Permitting? The City proposes to use the CEQA Plus Approach (as used by State Water Resources Control Board on behalf of USEPA and the USDA). The current schedule prepared by JRC has a 30 month timeline.

To better inform the decision makers and members of the community, the current schedule should be further broken down by activities with critical milestones identified (studies, deliverables, document review, circulation, public comment, and approval).

The timeline should include a Risk Register that identifies associated assumptions and risks which are ranked according to sensitivity. The Risk Register is modified and adjusted throughout the life of the project.

The existing schedule appears to be based on preliminary assessment of two potential treatment locations. Is the schedule adequate to take into account the entire project footprint, including the construction of the distribution network necessary for the transport of material from the existing collection facility to the new plant, transport of treated material to use locations, and the distribution of reclaimed water to agricultural properties? Have we accurately captured the cost of collection, treatment options, disposal and reclamation? What portion of the costs associated with the production of highly treated water and its eventual distribution for agricultural purposes will be paid by the residents of Morro Bay? Additional environmental studies will likely be required taking into account the project footprint (transport, treatment, disposal, reclamation and areas of surface and groundwater recharge, etc) not just the treatment site location.

By going forward with a single alternative environmental document (one site location) is the city setting itself up for legal challenges and/or appeals? Should they take more than one alternative forward to determine the least environmental harm? None of the previous feasibility studies or preliminary site assessments fully explore the resource impacts for the two sites currently being considered (Rancho Colina or the CMC). As indicated by Supervisor Bruce Gibson at the November 12, 2014 City Council meeting, he will be there to support whatever alternative the City decides upon, but the City needs to make sure that a range of alternatives were explored.

Are the past studies (e.g. Dudek Fine Screening), combined with the studies conducted for the *New* Water Reclamation Facility in 2013 and 2014 sufficient to support a finding that a variety of alternatives were considered early in the process and after sufficient evaluation they were rejected from further consideration (e.g., based on costs, impacts, site feasibility-geotechnical, etc). Has the City conducted due diligence in support of a single build alternative EIR?

It is likely that the City will receive federal funding for this project. What is the plan for determining federal lead on this project for both the NEPA document and Section 106 compliance? Federal funds are available from the EPA/State Water Board Revolving Fund for low interest loans, the USDA (grant and loan programs), and the Bureau of Reclamation (grant program varies). The USDA funds, which will require congressional approval to exempt the City from the rural population provisions for communities of 10,000 or less. USDA funds were used for the Los Osos treatment facility currently under construction and would likely provide an important source of project funding for Morro Bay.

Summary of Cultural Resources Associated with the Rancho Colina Site and the CMC

Rancho Colina: A total of four archaeological sites are recorded adjacent to the Highway 41 corridor, extending from Highway 1 to the location of the proposed Rancho Colina wastewater treatment facility. One of the sites appears to represent shell material that was transported to that area during previous highway construction.

CA-SLO-165 is located within the city limits adjacent Highway 41 east of the intersection with Highway 1. The site has been the subject of several investigations, and is <u>one of the most important archaeological sites located on the central coast, documenting 8,000 yrs of human occupation</u>. The site represents a highly sensitive location to the Native American community. The SHPO concurred in 1993 with the Federal Highway Administration (FHWA) finding that site <u>*is eligible*</u> for listing in the National Register of Historic Places (NRHP).

CA-SLO-1303 is located on the north side of Highway 41 in the vicinity of the Righetti property. Previous Caltrans archaeological testing revealed a very sparse deposit. The SHPO concurred in 1993 that the site <u>*is not*</u> eligible for listing in the NRHP.

CA-SLO-1304 is located on both sides of Highway 41 in the vicinity of the proposed Rancho Colina wastewater treatment facility. The highway, which cuts through the northern edge of the site, is built on an elevated fill. Surface archaeological material (shell fragments and chert flakes) occur within the highway right of way, however, the primary midden deposit is south of the right of way on private property. A very light scatter of shell was noted north of the right of way fence.

CA-SLO-2041 consists of a very light scatter of shell fragments found entirely within the highway right of way in the vicinity of the Lodge and the north entry to the Rancho Colina property. No shell was found outside of the highway right of way. The shell was probably moved to this location during prior highway construction. Subsurface testing will likely verify that the shell was transported to this location.

Potential construction impacts to the archaeological sites include installation of the pipes necessary for the transport of untreated material to the proposed Rancho Colina treatment facility, piping to transport reclaimed water for use elsewhere, and potential brine transport for disposal at the ocean outfall.

Numerous existing utilities are located within the State right of way, as well as on city property and private property. Utility relocation impacts will need to be considered as part of project planning. Construction of new utility connections and pumping facilities will also need to be considered.

In addition, improvements to the Rancho Colina treatment facility will likely include road widening and turn pockets, which may affect nearby CA-SLO-1304.

In particular, CA-SLO-165 is highly sensitive cultural site. Creative and thoughtful solutions will be necessary to avoid, minimize or mitigate construction impacts.

Development of the proposed Rancho Colina site for the proposed wastewater treatment facility will require coordination and consultation with members of the local Native American community, the Native American Heritage Commission (NAHC), the State Office of Historic Preservation (SHPO) and potentially the Advisory Council on Historic Preservation (ACHP) should they choose to participate.

CMC: North of the Highway 1 corridor, from the city of Morro Bay to the proposed CMC treatment facility location, there are roughly 10 archaeological (one historic) sites located within 200-500 feet of the corridor. South of the highway there is at least one site within 200 feet of the highway corridor. There are an additional 10 sites, if not more located situated 1000 ft or more to the south along the north bank of Chorro Creek.

Please note: The site information presented here *does not* constitute an official records search from the Central Coast Information Center, and it *does not* necessarily capture all of the sites located within the Chorro Valley. Nor, has the entire Chorro Valley or highway right of way been inventoried. An updated records search is *necessary* to substantiate the know distribution of sites located in the Chorro Valley area. The information is intended for general comparative purposes only with that of the proposed Rancho Colina treatment facility site. The proposed SLOCOG bikeway project from Morro Bay to San Luis may have more updated information.

Similar to the Rancho Colina, similar construction impacts apply and the development of the existing CMC site for the proposed wastewater treatment facility will likely require substantial coordination and consultation with members of the local Native American community, the Native American Heritage Commission (NAHC), the State Office of Historic Preservation (SHPO) and potentially the Advisory Council on Historic Preservation (ACHP) should they choose to participate.

WRFCAC THOUGHTS

1. I was first in line for reclaiming MB wastewater. But the devil is in the details.

2. Our consultants tell us we are "too rich" for endowments or grants.

CONCLUSION: THERE IS NO "FREE MONEY" TO HELP PAY FOR THIS FACILITY

3.Morro Bay is in an unusual situation---We have a contract with the State Water Project (SWP) for water. Quoting Cannon's Summary (SLOCo Regional Recycled Water Plan, 11/14) "However, considering the City's priority to maximize deliveries of SWP, to offset already **committed fixed costs of $2 million a year**, it is unlikely that the benefit of additional CVGB (Chorro Valley Groundwater Basin) withdrawals would compare to the probable project cost." I believe this statement applies to the Morro Valley Groundwater Basin, as well.

CONCLUSION: RECHARGING OUR WELLS W/RECLAIMED WATER WON'T BREAK EVEN

4.Quoting Cannon's Summary again: "Any inland discharge within the MVGB or CVGB will **require the development of a Salt and Nutrient Management Plan**" and goes on to say if inland discharges are required, expect the need for advanced water treatment.

To think that inland discharges will not be required from a WRF at either of our considered sites is, at best, wishful thinking.

To be fair, Morro Valley has 56 sites for Irrigation Reuse Opportunities with an Estimated Annual Demand of 2,736 afy (almost all are upstream of Rancho Colina}.
The new WRF is estimated to produce about 1000 afy. So, it "fits" right?

The first question is: Have any of these 56 "sites" stepped up and committed to purchasing WRF reclaimed water? I doubt it. But if so, under what conditions?

OK, let's say we get some commitments. Let's take a rainy day (they will come, folks). WRF output increases because of leaky storm drains in the City. The reclaimed water "sites" don't need reclaimed water because it is raining. The WRF output has to go somewhere. Maybe to a humongous reservoir somewhere? No. Down the creek? Yes.

Discharging reclaimed water into a creek requires the highest level of treatment. The City wouldn't be using this water, it would be going to the ocean.

CONCLUSION: MV OR CV RECLAIMED WATER FOR AG USE WON'T BREAK EVEN

5.Rancho Colina is not in the City. MB has no "sphere of influence" outside the City limits.

CONCLUSION: A SITE OUTSIDE MB CITY LIMITS PUTS US @ THE MERCY OF SLOCo WIMS

6.I have heard of, but not seen a **REQUIRED** mandate to reclaim water in MB.

CONCLUSION: PUT THE NEW FACILITY WHERE RECLAIMING WATER ISN'T REQUIRED BUT THE SITE HAS ENOUGH ROOM TO DO IT IF IT WOULD PAY OFF.

Folks, we have to protect our ratepayers! No more than required! Power Plant Property?