METRO WASTEWATER JPA

METRO TAC AGENDA
(Technical Advisory Committee to Metro JPA)

TO: Metro TAC Representatives and Metro Commissioners

DATE: Wednesday, March 15, 2017

TIME: 11:00 a.m. to 1:30 p.m.

LOCATION: MWWD, 9192 Topaz Way, (MOC II Auditorium) – Lunch will be provided

****PLEASE DISTRIBUTE THIS NOTICE TO METRO COMMISSIONERS AND METRO TAC REPRESENTATIVES****

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1. Review and Approve MetroTAC Action Minutes for the Meeting of February 15, 2016 (**Attachment**)

2. Metro Commission/JPA Board Meeting Recap (Standing Item)

3. **REPORT:** Update from Regional Wastewater Disposal Agreement Flow Commitment Working Group (Yazmin Arellanos)

4. **REPORT:** Update from Sample Rejection Protocol Working Group (Edgar Patino)

5. **ACTION:** Consideration and Possible Action to Approve Pump Station 2 Power Reliability & Surge Protection (Mark Nassar) (**Attachment**)

6. **ACTION:** Consideration and Possible Action to Approve Agreement with CH2M Hill Engineers, Inc. for Design Engineering Services for the North City Metropolitian Biosolids Center (MBC) Improvements (Amy Dorman/Monika Smoczynski) (**Attachment**)

7. **ACTION:** Consideration and Possible Action to Create a Pure Water Facilities Subcommittee an Appointing Members (Greg Humora)

8. **ACTION:** Review and Consideration and Possible Action to Recommend the Metro Comm/Metro Wastewater JPA Approve the JPA Mid Year Budget Review (Karen Jassoy) (**Attachment**)

9. **ACTION:** Review and Consideration and Possible Action to Recommend the Metro Comm/Metro Wastewater JPA Approve the JPA Hypothetical Financing Schedule (Karen Jassoy) (**Attachment**)

10. Metro Wastewater Update (Standing Item) (Edgar Patino)

11. Pure Water Program Update (Standing Item)
    - Announcement: Pure Water Brewing Event, March 16th Stone Brewery Liberty Station

12. Metro Capital Improvement Program and Funding Sources (Standing Item) (Tung Phung) (**Attachment**)

13. Financial Update (Standing Item) (Karyn Keese)

14. IRWMP Update (Standing Item) (Robert Yano)

15. MetroTAC Work Plan (Standing Item) (Greg Humora) (**Attachment**)

16. Point Loma Permit Renewal (Standing Item) (Greg Humora) (**Attachment**)

17. Review of Items to be Brought Forward to the Regular Metro Commission/Metro JPA Meeting (**April 6, 2017**)

18. Other Business of Metro TAC

19. Adjournment (To the next Regular Meeting April 19, 2017)

Metro TAC 2017 Meeting Schedule

January 18	May 17	September 20
February 15	June 21	October 18
March 15	July 19	November 15
April 19	August 16	December 20

Attachment 1

Action Minutes of February 15, 2017

Metro TAC
(Technical Advisory Committee to Metro Commission/JPA)

ACTION MINUTES

DATE OF MEETING: February 15, 2017

TIME: 11:00 AM

LOCATION: MOC II Auditorium

MEETING ATTENDANCE:

Greg Humora, La Mesa
Erin Bullers, La Mesa
Ed Walton, Coronado
Yazmin Arellano, El Cajon
Dennis Davies, El Cajon
Chris Helmer, Imperial Beach
Mike James, Lemon Grove
Dexter Wilson, Lemon Grove
Kuna Muthusamy, National City
Steve Beepler, Otay MWD
Kevin Koeppen, Otay MWD
Al Law, Padre Dam
Mark Niemiec, Padre Dam
Alex Heide, Poway
Mike Obermiller, Poway
Terry Zaragoza, Poway
Dan Brogadir, County of San Diego

John Helminski, City of San Diego
Edgar Patino, City of San Diego
Seth Gates, City of San Diego
Raina Amen, City of San Diego

Scott Tulloch, NV5
Karyn Keese, The Keze Group, LLC
Lori Anne Peoples, Metro Comm/Metro JPA/MetroTAC

1. Review and Approve MetroTAC Action Minutes for the Meeting of November 16, 2016

Mike Obermiller moved approval of the October 16, 2016 minutes. The motion was seconded by Ed Walton, and the minutes were approved unanimously.

2. Metro Commission/JPA Board Meeting Recap (Standing Item)

Chair Humora stated that there were five new JPA Commissioners and Alternates. Councilman Steve Padilla with Mayor Mary Salas from Chula Vista; Mayor Richard

Bailey and Councilman Whitney Benzian of Coronado; Councilmember's Ben Kalasho and Steve Goble of El Cajon; Councilmember's Ed Spriggs and Mark West of Imperial Beach. Also, Alternate Mark Robak is now the Primary for Otay with Gary Croucher as Alternate.

3. DISCUSSION: Fiscal Year Ending 2018 Estimated Metro Sewer Service Charge

Seth Gates stated that the estimated billings for Fiscal Year 2018 had been sent out a couple of weeks ago and were only preliminary numbers. On Table D, he noted that taking the estimated budget, and the forecast trends, the amounts of which are consistent with prior years. On the CIP side, some numbers are offset due to financing, energy, co-generation etc. The $19.6 million is less than shared previously; however, Pure Water CIP offsets will reduce the amount paid to the Metro Fund. The strength allocations are based on Fiscal Year 14 Exhibit E audited numbers and will change when the final outcome of the FYE 2015 audit is released. Based on the 1998 Functional Design Based Cost Allocation Report which determined how the CIP is broken down, they are looking at the allocation with Karyn to make sure things are correctly allocated in the three parameters (Table A). All allocation and flow is based on the 1998 study which the Brown & Caldwell report said this would be reviewed every 5 years. As of now, PUD staff is applying for SRF loans for both baseline CIP and Pure Water Program costs. PUD staff is applying for full funding of Pump Station 2 upgrades and will be going to the Environmental Commission tomorrow. Public Utilities Department staff is currently in extensive communication with SRF staff regarding funding of Pure Water planning and design costs.

Dexter Wilson stated he was trying to compare the figures, but needed additional O & M Pure Water info. Seth stated that he could not share that information until the Mayor releases the budget in April, but based on the spending trends, could comment on lower Public Works O & M portion which has been the same since 2016.

Edgar Patino stated that the PAs annual protocol contribution was increasing from $65 million to $70 million as had been discussed last year. These are currently estimates and could be revised in April once the final budget has been determined.

Karyn Keese elaborated the questions in need of answering which she will be discussing with PUD staff. Karyn requested San Diego bring back next month:

- O & M costs that are not Pure Water
- What is driving the 22% increase (Edgar stated that it was trending from actuals to estimates based on the Fiscal Year 2014 Exhibit E Audit).
- Once the April 15 date is over, can they get a detail of what is in the O & M Pure Water (Seth stated he would be happy to provide this).

Dexter Wilson inquired as to when an agreement on cost allocation would be coming forward? PUD staff stated that cost allocation meetings are now being held monthly with the work group with the goal being that draft cost allocation numbers will be available in May.

4. <u>REPORT</u>: Update from Regional Wastewater Disposal Agreement Flow Commitment Working Group

Yazmin Arellano stated that she needed the PAs to look at the audited flow spread sheet and provide their most updated flow to build out. She will be sending this sheet out again to all members and would like the information back this month.

5. <u>REPORT</u>: Update from Social Media Working Group

Mike Obermiller stated that this item is complete except for final determination of consultant costs which are still pending until the Finance Committee meets to discuss and make recommendations to the Metro Commission/JPA. The policy will be uploaded to the JPA website. The Finance Committee is scheduled to meet to discuss this as well as the rest of the JPA budget over the next several months.

6. <u>REPORT</u>: Update from Sample Rejection Protocol Working Group

Edgar Patino stated that the group had not met but is expected to meet next month so he had no report.

7. Metro Wastewater Update (Standing Item)

No report.

8. Pure Water Program Update (Standing Item)

John Helminski stated that LeAnn had laid out a schedule and was anticipating a subcommittee meeting prior to the March TAC. The schedule was for March 15 TAC review of the project cost and cost allocation; April 19 TAC review of the MWH Task Order and cost allocations issued to them. Initially this was split 50/50, but they want to take the time and determine the best split on those activities. Karyn Keese noted that the auditors listing of all purchase/task orders for the Pure Water program since its inception currently contains 137 activities. John stated he would look into this. At the May TAC they would get feedback from the March and April meetings and get agreement on the cost allocations by the TAC.

Dexter Wilson inquired as to whether the Health Department Regulations were out yet. John responded that they were possibly due out in June. It was noted by several TAC members that they have concerns with PUD proceeding with projects prior to regulation approval.

Dexter Wilson stated that in reviewing the detailed documents such as North City expansion, he was questioning the split between water and wastewater at Secondary Treatment because some of the secondary facilities appear to be oversized to accommodate Pure Water water production. These oversized facilities would not be needed at North City just to meet Pt. Loma Ocean discharge and that the oversizing of these facilities should be paid for by water.

John stated he would consult with Engineering staff. Other items are coming forward such as the Design Contract March 15 improvements at the Metro Bio Solids Center due to additional sludge coming forward from North City that will be produced by the expanded Secondary and Tertiary facilities. This will be a $5 million contract. In January 2018 they will be advertising for Construction Management As-Needed contract to issue design tasks. They are looking at April for the conveyance/pump station and treatment to be awarded December 2017 or January 2018.

John further noted that they had received a letter from the Regional Water Quality Control Board who has issued a revised permit in response to the December 2016 Public Hearing. The Water Board requested more information on the projects in Phase 1 so they could respond to comments. They are proposing putting the accelerated schedule into the permit.

Scott Tulloch stated that they purposely negotiated to NOT put construction dates into the permit and inquired as to who decided it was okay to change that.

John responded that Tom Zeleny thought that the footnote requiring Mayor and council approval prior to construction did not make the milestones legally binding..

Scott stated that JPA General Counsel Paula de Sousa Mills needs to speak with Tom Zeleny regarding this matter because he does not agree..

John stated that it was the RWQCB that decided to add the construction dates into the draft permit. RWQCB staff maintains they received direction from the Chair to go back and revisit why the construction dates were not included in the original schedule. San Diego staff then sent the accelerated schedule to the RWQCB but did not state for information only and that they should not to be incorporated into the schedule.

Discussion ensued regarding the foot note 2 being irrelevant to page 36 7A.

9. Metro Capital Improvement Program and Funding Sources (Standing item)

No report.

10. Financial Update (Standing Item)

Karyn Keese discussed bringing on board the firm of Fieldman & Rolapp. She has prepared a draft proposal and reviewed it with Greg and Paula. Greg wanted a schedule developed as to how long it would take if the JPA were to proceed with a debt issuance. Karyn met with San Diego yesterday regarding firming up a financial plan and developing a long range plan for the entire Pure Water Program. LeAnn Jones-Santos had stated that once the 30% design costs are known in May that a long range financing plan could be completed for the project and a draft would be available in July 2017.

San Diego does not anticipate issuing wastewater debt until February 2020. In their meeting Karyn and Lee Ann discussed San Diego providing and interim financing mechanism for the PAs for FYE 2017 through FYE 2019. In September and October 2016 PUD staff prepared projected cost schedules for the next 5 years with one high and one moderate projections. Karyn is going to take the moderate table and prepare a spreadsheet that will allocate costs to all agencies and check what agencies may need financing in 2017 through 2019 with the idea that 2019 could possibly be dovetailed into bonds with San Diego. Karyn will send out and ask all PAs to look at their individual rate cases to see if they can absorb the costs on a pay-go basis. This will help decide whether Fieldman & Rolapp are needed or not. They are looking at the $61 million to $71 million in 2018. The actual costs could change once San Diego gets 30% design costs in May.

Seth Gates stated that once EIR’s are done, they can also apply for grants. They are working with Washington Federal Lobbyists’ to advocate Pure Water and funds that can provide funding and moving forward to look at financing options to address concerns of the PAs.

11. IRWMP Report (Standing Item)

Roberto stated that his notes were provided as part of the agenda package. Prop 1 funding is available to all PAs but they have to get their projects listed in queue in the database. Al noted that wastewater matching grants were also available but there was a short timeline to apply.

12. MetroTAC Work Plan (Standing Item)

Chair Humora stated that the work plan was attached to the agenda and that the back has a graphic that shows the PAs comparison wastewater user rates. He requested updates from anyone who had any. Karyn Keese has also requested updates from staff at Otay who prepare the annual comparison and will send out a revision once they are received. (See Attachment A to these Minutes).

13. Point Loma Permit Renewal (Standing Item)

Chairman Humora stated that the report was attached to the agenda. (See Attachment B to these minutes). The only change was the cost allocation pie chart from green to yellow as they were behind schedule.

14. Review of Items to be Brought Forward to the Regular Metro Commission/Metro JPA Meeting (March 2, 2017)

None.

15. Other Business of Metro TAC

John Helminski noted that the Lobbyists in Washington advised that things were still upside down with possibly nothing happening until April as appointments have not been completed as of yet.

16. Adjournment to the next Regular Meeting, December 21, 2016

At 12:20 p.m. the meeting was adjourned.

Attachment A

Active Items	Description	Member(s)
Sample Rejection Protocol Working Group	7/16: The sample rejection protocol from the B&C 2013 report has been under discussion between PUD staff and Metro TAC. A working group was formed to deal with this highly technical issue and prepare draft recommendations on any changes to current sampling procedures. The existing protocol is to be used through FY17. If changes are approved to the protocol they will be implemented in FY18. *1/17: Work group continues to meet monthly.*	Dennis Davies Dan Brogadir Al Lau Dexter Wilson SD staff
PLWTP Permit Ad Hoc Work Group	1/17: Greg Humora and Scott Tulloch continue to meet with stakeholders. . Milestones are included in each month Metro TAC and Commission agenda packet.	Greg Humora Scott Tulloch SD staff & consultants Enviro members
Flow Commitment Working Group	6/16: Upon the request of Metro Com Chair Jim Peasley Chairman Humora created a working group to review the Flow Commitment section of the Regional Agreement and make recommendations on the fiscal responsibilities of members who might withdraw their flow from the Metro System. The Work Group held their first meeting June 24, 2016. Yazmin Arellano chairs the work group. *1/17: Work group continues to meet monthly.*	Yazmin Arellano Roberto Yano Eric Minicilli Al Lau SD staff Karyn Keese
Social Media Working Group	6/16: Upon the request of Metro Com Chair Jim Peasley Chairman Humora created a working group to research and provide input on the creation of policies and procedures for Metro JPA social media. Mike Obermiller will chair this work group. He sent out an email to all Metro TAC members requesting copies of their agency's policies. 9/16: A draft policy has been approved by Metro TAC and will be presented to the Commission in October by Alexander Heide. *1/17: Draft policy and consultants contracts to be reviewed by Finance Committee in March 2017.*	Mike Obermiller Alexander Heide
Secondary Equivalency	5/14: Definition of secondary equivalency for Point Loma agreed to be enviros 12/14: Cooperative agreement signed between San Diego and enviros to work together to pass legislation for secondary equivalency (until 8/1/19) San Diego indicated that passage of Federal legislation is not possible under the current political environment. San Diego is exploring options for State legislation 9/15: Letter received from EPA endorsing modified permit for Point Loma 6/16: Pursuit of Federal Legislation will be held off until after the November 2016 election. City of San Diego to consult with DC lobbyists on 2/4/17	Greg Humora Scott Tulloch
Pure Water Program Cost Allocation Ad Hoc Work Group	A working group was formed to discuss Pure Water program cost allocation. 9/16: Concepts to be refined by Metro TAC and San Diego staff for presentation to Commission 1/17.	Greg Humora Scott Tulloch Roberto Yano Karyn Keese SD staff & consultants
Pure Water Program Cost Allocation Metro TAC Work Group	5/14: Draft facility plan and cost allocation table provided to Metro TAC working group 3/15: Draft cost allocation presentation provided to Metro TAC	Greg Humora Scott Tulloch Rick Hopkins Roberto Yano Al Lau Bob Kennedy Karyn Keese
Exhibit E Audit	6/16: FY 2013 audit accepted by Metro Commission; 9/16: FYE 2014 audit accepted by Metro Commission. FYE 2015 audit report to be issued by end of 2016 and then all audits will be caught up. *1/17: FYE 2015 to be issued in February 2017. FYE 2016 fieldwork is underway with anticipated draft 7/17.*	Karyn Keese Karen Jassoy

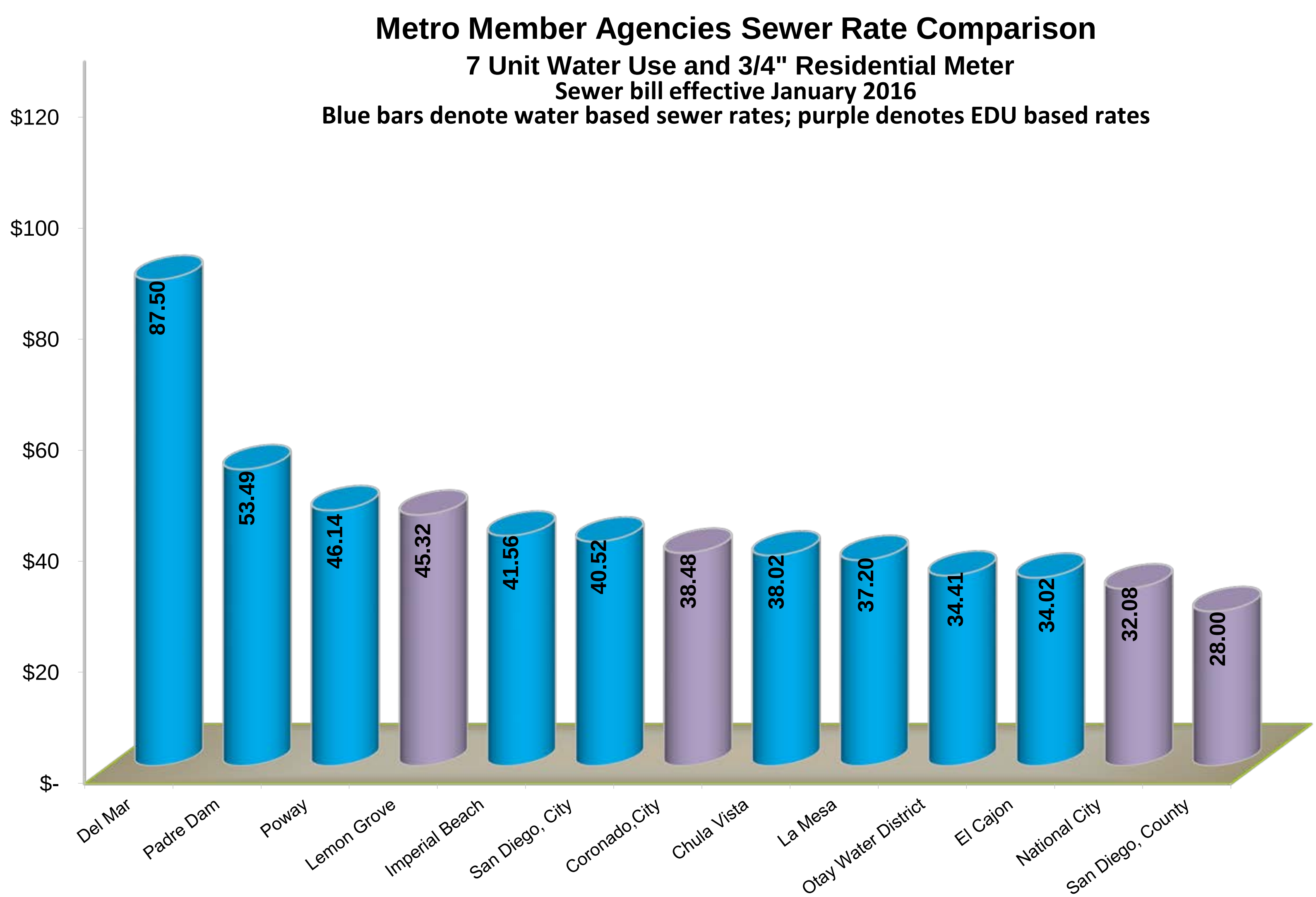
Active Items	Description	Member(s)
Amend Regional Wastewater Disposal Agreement	The addition of Pure Water facilities and costs will likely require the amendment of the 1998 Regional Wastewater Disposal Agreement. The Padre Dam billing errors have led to a need to either amend the Agreement and/or develop administrative protocols to help resolve potential future billing errors. After Pure Water cost allocation had been agreed to this effort will begin.	Greg Humora Roberto Yano Dan Brogadir Paula de Sousa Mills Karyn Keese
Management of Non-Disposables in Wastewater	9/13: Eric Minicilli handed out a position paper prepared by the NEWEA. 6/15 Chairman Humora provided attached from SCAP. 2/16: Chairman Humora distributed Robbins Geller Rudman & Dowd memorandum.	Eric Minicilli
2015/16 Transportation Rate Update	5/14: Metro TAC approved 2014 transportation rate w/caveat that PUD staff hires a consultant to review/revise methodology for 2015.	Al Lau Dan Brogadir Karyn Keese
IRWMP	8/15 RAC minutes included in August Metro TAC agenda. Padre Dam received a $6 million grant for their project. 9/16: June 2, 2016 and August 3, 2016 minutes presented to Metro TAC. *12/16: Roberto Yano and Yazmin Arellano appointed to IRWMP.*	Roberto Yano Yazmin Arellano
"No Drugs Down the Drain"	The state has initiated a program to reduce pharmaceuticals entering the wastewater flows. There have been a number of pharmaceutical collection events within the region sponsored by law enforcement.	Greg Humora
Strength Based Billing Evaluation	San Diego will hire a consultant every three years to audit the Metro metered system to insure against billing errors.	Al Lau Dan Brogadir Karyn Keese
Grease Recycling	To reduce fats, oils, and grease (FOG) in the sewer systems, more and more restaurants are being required to collect and dispose of cooking grease. Companies exist that will collect the grease and turn it into energy.	Eric Minicilli
Point Loma Modified NPDES Permit	1/15: Permit was submitted. EPA has begun their review. 11/16 first possible date at the Regional Board for consideration. *12/16: First hearing of Permit Application held at San Diego Regional Board.*	Greg Humora Scott Tulloch Karyn Keese
Changes in water legislation	Metro TAC and the Board should monitor and report on proposed and new legislation or changes in existing legislation that impact wastewater conveyance, treatment, and disposal, including recycled water issues	Paula de Sousa Mills
Border Region	Impacts of sewer treatment and disposal along the international border should be monitored and reported to the Board. These issues would directly affect the South Bay plants on both sides of the border.	*New Board Members to be Appointed*

Metro TAC
Participating Agencies
Selection Panel Rotation

Agency	Representative	Selection Panel	Date Assigned
Padre Dam	Neal Brown	IRWMP – Props 50 & 84 Funds	2006
El Cajon	Dennis Davies	Old Rose Canyon Trunk Sewer Relocation	9/12/2007
La Mesa	Greg Humora	As-Needed Piping and Mechanical	11/2007
National City	Joe Smith	MBC Additional Storage Silos	02/2008
Otay Water District	Rod Posada	As-Needed Biological Services 2009-2011	02/2008
Poway	Tom Howard	Feasibility Study for Bond Offerings	02/2008
County of San Diego	Dan Brogadir	Strategic Business Plan Updates	02/2008
Coronado	Scott Huth	Strategic Business Plan Updates	09/2008
Coronado	Scott Huth	As-needed Financial, HR, Training	09/2008
PBS&J	Karyn Keese	As-needed Financial, Alternate HR, Training	09/2008
Otay Water District	Rod Posada	Interviews for Bulkhead Project at the PLWTP	01/2009
Del Mar	David Scherer	Biosolids Project	2009
Padre Dam	Neal Brown	Regional Advisory Committee	09/2009
County of San Diego	Dan Brogadir	Large Dia. Pipeline Inspection/Assessment	10/2009
Chula Vista	Roberto Yano	Sewer Flow Monitoring Renewal Contract	12/2009
La Mesa	Greg Humora	Sewer Flow Monitoring Renewal Contract	12/2009
Poway	Tom Howard	Fire Alarm Panels Contract	12/2009
El Cajon	Dennis Davies	MBC Water System Improvements D/B	01/2010
Lemon Grove	Patrick Lund	RFP for Inventory Training	07/2010
National City	Joe Smith	Design/Build water replacement project	11/2010
Coronado	Scott Huth	Wastewater Plan update	01/2010
Otay Water District	Bob Kennedy	RFP Design of MBC Odor Control Upgrade/Wastewater Plan Update	02/2011
Del Mar	Eric Minicilli	Declined PS 2 Project	05/2011
Padre Dam	Al Lau	PS 2 Project	05/2011
County of San Diego	Dan Brogadir	RFP for As-Needed Biological Services Co.	05/2011
Chula Vista	Roberto Yano	North City Cogeneration Facility Expansion	07/2011
La Mesa	Greg Humora	confined space RFP selection panel	10/2011
Poway	Tom Howard	COSS's for both Water and WW	10/2011
El Cajon	Dennis Davies	Independent Accountant Financial Review & Analysis – All Funds	01/2012

Lemon Grove	Mike James	MBC Dewatering Centrifuges Replacement (Passed)	01/2012
National City	Joe Smith	MBC Dewatering Centrifuges Replacement (Passed)	01/2012
Coronado	Godby, Kim	MBC Dewatering Centrifuges Replacement (Passed)	01/2012
Otay Water District	Bob Kennedy	MBC Dewatering Centrifuges Replacement (Accepted)/Strategic Planning Rep	01/2012
Del Mar	Eric Minicilli	New As Need Engineering Contract	02/2012
Padre Dam	Al Lau	PA Rep. for RFQ for As Needed Design Build Services (Passed)	05/2012
County of San Diego	Dan Brogadir	PA Rep. for RFQ for As Needed Design Build Services (Cancelled project)	05/2012
Chula Vista	Roberto Yano	As-Needed Condition Assessment Contract (Accepted)	06/2012
La Mesa	Greg Humora	New programmatic wastewater facilities condition (Awaiting Response)	11/2012
Poway	Tom Howard	Optimization Review Study	01/2013
El Cajon	Dennis Davies	PUD 2015 Annual Strategic Plan	1/15/14
Lemon Grove	Mike James	As-Needed Engineering Services (Passed)	7/25/14
National City	Kuna Muthusamy	As-Needed Engineering Services	7/25/14
Coronado	Ed Walton	Strategic Planning	01/2014
Otay Water District	Bob Kennedy	Strategic Planning (Volunteered, participated last year)	01/2014
Del Mar	Eric Minicilli	Pure Water Program Manager Services	9/1/14
Padre Dam	Al Lau	Pure Water Program Manager Services	9/1/14
County of San Diego	Dan Brogadir	As-Needed Condition Assessment Contract	3/24/2015
Chula Vista	Roberto Yano	Out on Leave	6/10/15
La Mesa	Greg Humora	North City to San Vicente Advanced Water Purification Conveyance System	6/10/15
Poway	Mike Obermiller	Real Property Appraisal, Acquisition, and Relocation Assistance for the Public Utilities Department	11/30/15
El Cajon	Dennis Davies	PURE WATER RFP for Engineering Design Services	12/22/15
Lemon Grove	Mike James	PURE WATER RFP Engineering services to design the North City Water reclamation Plant and Influence conveyance project	03/16/15
National City	Kuna Muthusamy	Passes	04/04/2016
Coronado	Ed Walton	As-Needed Environmental Services - 2 Contracts	04/04/2016
Otay Water District	Bob Kennedy	As Needed Engineering Services Contract 1 & 2	04/11/2016
Del Mar	Eric Minicilli	Pure Water North City Public Art Project	08/05/2016
Padre Dam	Al Lau	Biosolids/Cogeneration Facility solicitation for Pure Water	08/24/2016
County of San Diego	Dan Brogadir	Pure Water North City Public Art Project	08/10/2016
Chula Vista	Roberto Yano	Design Metropolitan Biosolids Center (MBC) Improvements Pure Water Program	9/10/2016
La Mesa	Greg Humora	Design of Metropolitan Biosolids Center (MBC) Improvements	9/22/16
Poway	Mike Obermiller	Electrodialysis Reversal (EDR) System Maintenance	12/7/16
El Cajon	Dennis Davies		

Lemon Grove	Mike James		
National City	Kuna Muthusamy		
Coronado	Ed Walton		
Otay Water District	Bob Kennedy		
Del Mar	Eric Minicilli		
Padre Dam	Al Lau		
County of San Diego	Dan Brogadir		
Chula Vista	Roberto Yano		
La Mesa	Greg Humora		
Poway	Mike Obermiller		
El Cajon	Dennis Davies		
Lemon Grove	Mike James		
National City	Kuna Muthusamy		
Coronado	Ed Walton		



Metro Member Agencies Sewer Rate Comparison
7 Unit Water Use and 3/4" Residential Meter
Sewer bill effective January 2016
Blue bars denote water based sewer rates; purple denotes EDU based rates
$120
$100
$80
$60
$40
$20
$-
87.50
53.49
46.14
45.32
41.56
40.52
38.48
38.02
37.20
34.41
34.02
32.08
28.00
Del Mar
Padre Dam
Poway
Lemon Grove
Imperial Beach
San Diego, City
Coronado,City
Chula Vista
La Mesa
Otay Water District
El Cajon
National City
San Diego, County

Attachment 5

Pump Station 2 Power Reliability & Surge Protection Project

FINAL DRAFT

Task 018

Impacts of North City Water Reclamation Plant Expansion on the Metropolitan Biosolids Center

Prepared For:

City of San Diego

Public Utilities Department

San Diego, California

August 12, 2016

Prepared By:

MWH Americas, Inc.

Brown and Caldwell

BLP Engineers, Inc.

DHK Engineers, Inc.

CityWorks

Prepared for: City of San Diego Public Utilities Department

Project Title: Impacts of North City Water Reclamation Plant Expansion on the Metropolitan Biosolids Center

Project No.: 11122014, DO/TO No. 18, T10508605-1043450OM

Subject: Final Technical Memorandum

Date: August 12, 2016

To: Monika Smoczynski, City of San Diego Public Utilities Department

From: Boris Pastushenko, BLP Engineers, Inc.

Copy to: Amer Barhoumi, Raymond Ngo, City of San Diego Public Utilities Department

Christine Waters, Victor Occiano, Pure Water Program

Prepared by: BLP Engineers Inc., Brown and Caldwell, MWH Americas, Inc., DHK Engineers, Inc., CityWorks

Reviewed by: Keli Balo, Richard Pitchford, Raymond Ngo, Jesse Pagliaro, Monika Smoczynski, Greg Cross, Dwight Correia, City of San Diego Public Utilities Department

Christine Waters, Pure Water Program

William Hartnett, MWH Americas, Inc.

Victor Occiano, and Arthur Molseed, Brown and Caldwell

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List of Acronyms & Abbreviations

ACRONYM	DEFINITION
°F	degree(s) Fahrenheit
A	amp(s)
AACEI	Advancement of Cost Engineering International
APCD	(San Diego County) Air Pollution Control District
AWPF	advanced water purification facility
BC	Brown and Caldwell
BG	biogas
BioP	biological phosphorus removal
BLP	BLP Engineers
BOD	biochemical oxygen demand
CAAWPF	Central Area Advanced Water Purification Facility
CEPT	chemically enhanced primary treatment
cfd	cubic foot/feet per day
cfm	cubic foot/feet per minute
cfs	cubic foot/feet per second
City	City of San Diego
CIP	Capital Improvement Program
CM	construction management
CN	Centrate
CTT	cell turnover time
d	day(s)
DCS	distributed control system
DSL	digested sludge
DWSL	dewatered sludge
EDR	Engineering Design Report
EDS	electrical distribution system
El.	elevation
EOF	Emergency Overflow
EOI	elevation of instrument
ESDC	engineering services during construction
FA	foul air
FC_2	ferric chloride solution
$Fe^{+2}Fe_2^{+2}(PO_4)2{\cdot}8H_2O$	vivianite
$FeCl_2$	ferrous chloride
FOG	fats, oils, and grease
fps	foot/feet per second
FRP	fiberglass-reinforced plastic
ft^2	square foot/feet
ft^3	cubic foot/feet
gpd	gallon(s) per day
gpm	gallon(s) per minute
H_2S	hydrogen sulfide

ACRONYM	DEFINITION
HEX	heat exchanger
hp	horsepower
hr	hour(s)
HRT	hydraulic residence time
HUWHP	Hot Utility Water High Pressure
HUWLP	Hot Utility Water Low Pressure
HWR	Hot Water Return
HWS	Hot Water Supply
I/O	input/output
IPS	influent pump station
kVA	kilovolt-ampere(s)
kW	kilowatt(s)
L	liter(s)
lb	pound(s)
MBC	Metropolitan Biosolids Center
MCAS	Marine Corps Air Station
MCC	motor control center
MER	mass emission rate
mg	milligram(s)
MG	million gallons
mgd	million gallons per day
mm	millimeter(s)
MMBtu	million British thermal unit(s)
MPS	Morena Pump Station
MR	Miramar Reservoir
mt/yr	metric ton(s) per year
MW	megawatt(s)
MWH	MWH Americas, Inc.
NCWPF	North City Pure Water Facility
NCWRP	North City Water Reclamation Plant
NDMA	N-Nitrosodimethylamine
NH_3-N	ammonia-nitrogen
$NH_4Mg_4PO_4 \cdot 6H_2O$	struvite
NSPF	North Solids Processing Facility
OCS	odor control system
OF	overflow
O&M	operations and maintenance
OPC	opinion of probable cost
P	phosphorus
PCM	process control module
PDMWD	Padre Dam Municipal Water District
PEA	anionic polymer
PLC	programmable logic controller
PLWTP	Point Loma Wastewater Treatment Plant

ACRONYM	DEFINITION
PM	project management
POL	polymer solution
ppmv	part(s) per million by volume
PRV	pressure-relief valve
PRW	process water
psi	pound(s) per square inch
psig	pound(s) per square inch gauge
PUD	Public Utilities Department
Pure Water	Pure Water San Diego Program
RAS	return activated sludge
RCTS	Rose Canyon Trunk Sewer
rpm	revolution(s) per minute
RSL	raw sludge
SAM	sample line
SBWRP	South Bay Water Reclamation Plant
scfd	standard cubic foot/feet per day
scfm	standard cubic foot/feet per minute
SDG&E	San Diego Gas & Electric
SHC	sodium hypochlorite
SVR	San Vicente Reservoir
TDH	total dynamic head
TDS	total dissolved solids
TKN	total Kjeldahl nitrogen
TM	technical memorandum
TP	total phosphorus
TS	total solids
TSS	total suspended solids
TSSL	Thickened Raw Sludge
UGR	unit generation rate
USS	unit substation
UWHP	utility water high-pressure
UWLD	Utility Water Low Pressure
V	volt(s)
WWPS	Wastewater Pump Station
VFD	variable-frequency drive
VSS	volatile suspended solids
yd^3	cubic yard(s)
yr	year(s)

1 Memo Information

Task Order/Number: TO18, Task 18

Author: BLP Engineers, Inc., Brown and Caldwell, MWH Americas, Inc., DHK Engineers, Inc, CityWorks.

Date Prepared: August 12, 2016

2 Introduction

2.1 Background

In 2015, the City of San Diego (City) initiated the San Diego Pure Water Program (Pure Water), a comprehensive water and wastewater capital improvement program (CIP) to develop infrastructure for reservoir augmentation (37). Pure Water is leading the effort to plan for the construction of new advanced water purification facilities (AWPFs), wastewater treatment facilities, pump stations, transmission lines, and pipelines. As part of Pure Water, the City plans to construct the North City Pure Water Facility (NCPWF) adjacent to the existing North City Water Reclamation Plant (NCWRP); this in turn requires upgrade and expansion of NCWRP to supply NCPWF with required flow of unchlorinated filtered effluent. Purified water from NCPWF will be conveyed to the Miramar Reservoir (MR) or San Vicente Reservoir (SVR) to augment existing potable water supplies.

Diverting additional flows to NCWRP to support NCPWF ultimately changes the relative contribution of biosolids received at the Metro Biosolids Center (MBC) from NCWRP and the Point Loma Wastewater Treatment Plant (PLWTP). As the City's regional solids-processing facility, MBC receives and processes biosolids from both facilities, and has been in operation since February 1998. NCWRP pumps unthickened primary solids from primary sedimentation tanks and waste solids from its activated sludge treatment process to MBC. The combined raw solids from NCWRP are treated at MBC via the following principal unit processes: grit removal, centrifuge thickening, anaerobic digestion, and centrifuge dewatering.

PLWTP operates its own anaerobic digesters, but pumps digested sludge to MBC where it is blended with digested sludge from the MBC anaerobic digesters at either the biosolids storage tank or biosolids emergency storage tank. The combined flow of digested sludge is then dewatered using centrifuges. The dewatered biosolids cake is transported to silos at the truck-loading area for land application, alternative daily cover at landfills, or landfill disposal. Centrate from dewatering and thickening operations is returned to a drop structure at NCWRP, and is subsequently conveyed by gravity to the Rose Canyon Trunk Sewer (RCTS). Other wastewater generated at MBC is pumped to a nearby sewer.

This technical memorandum (TM) evaluates the impact of the changes in biosolids flows and loadings proposed under Pure Water that will be conveyed to the existing facilities at MBC. In general, projected flows of raw solids from NCWRP will increase while projected flows of digested solids from PLWTP will remain roughly constant such that MBC will be required to provide onsite anaerobic digestion for a greater percentage of the system's biosolids output. In addition to changes in quantity, changes in treatment processes at NCWRP and PLWTP may change the quality, and hence treatability, of the two biosolids streams.

From a planning perspective, Pure Water envisions the startup of the NCWRP Expansion in two phases in conjunction with the startup of NCPWF. In Phase I, NCWRP will provide sufficient unchlorinated filtered effluent to NCPWF to produce 15 million gallons per day (mgd) of purified water for augmentation of MR or SVR; in Phase II, NCWRP and NCPWF will be operated to produce 30 mgd of purified water for augmentation at MR or SVR. Whether the project will be implemented in two phases is not addressed in this TM.

Since commissioning, City staff have done much to streamline and optimize the unit processes at MBC. The overview presented above describes only the unit processes that are in operation at the time of this writing. A general process schematic for the streamlined operations at MBC is shown below in Figure 2-1.

In addition to plans for NCPWF, the City is planning to receive and process fats, oils, and grease (FOG) (39) at a new facility onsite at MBC prior to anaerobic digestion. The FOG facility will increase the organic loading on the anaerobic digesters and all subsequent downstream solids-processing facilities. The resulting increase in digester gas production will increase electricity production at the cogeneration facilities onsite at MBC and available waste heat for use at MBC. The City is also evaluating an emerging biosolids treatment technology, Lystek[1], that has the potential to substantially increase digester gas production in the anaerobic digesters and reduce organic loading on downstream facilities (39). In addition to the impacts of Pure Water, this TM examines the impacts of FOG and Lystek in terms of increased biogas production and the capacity of the existing biogas-handling systems. The costs of implementing Lystek technology are not included in this TM. Potential impacts of offloading other organics from the landfill are also contemplated by the City under a separate cover.

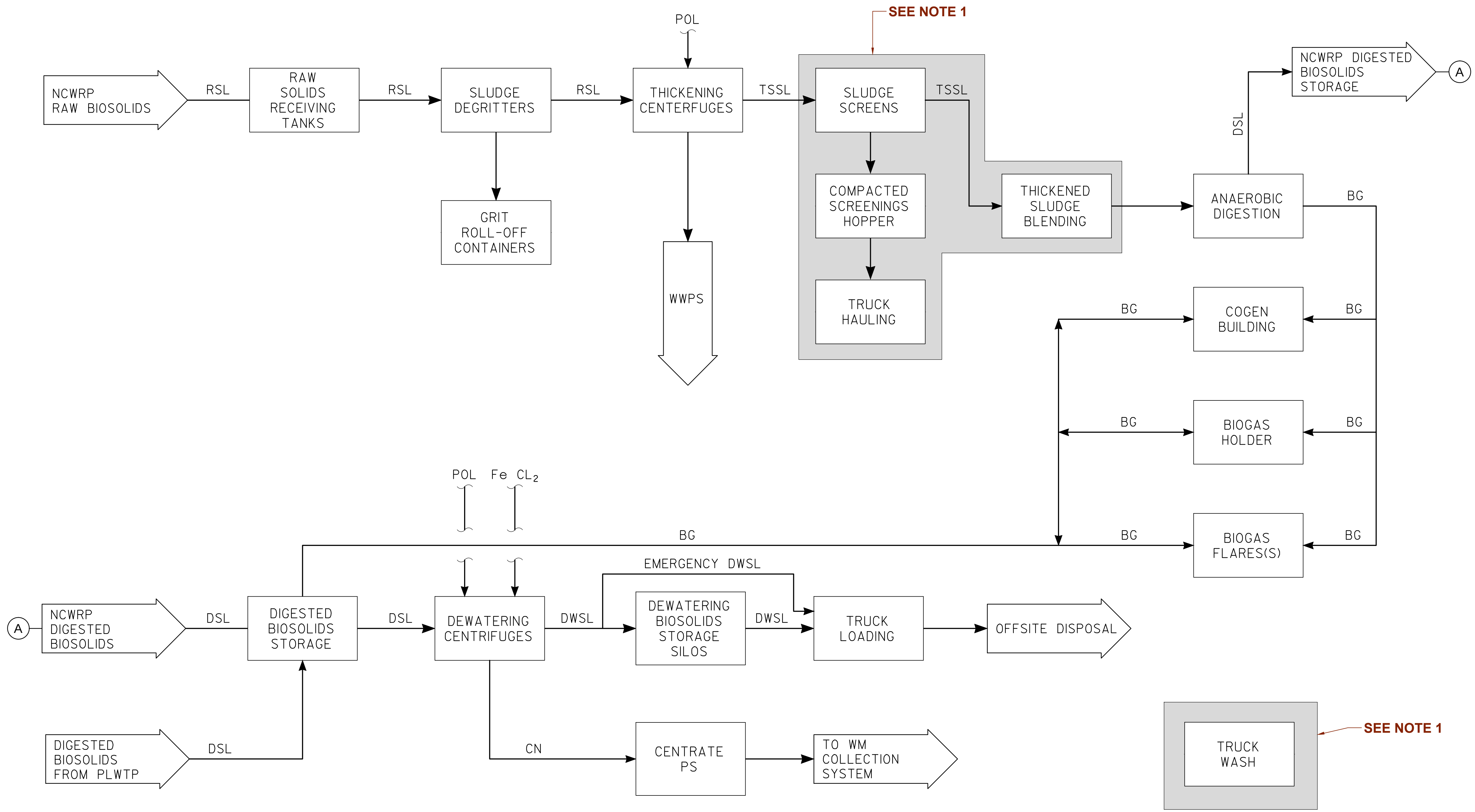
This TM conservatively assumes the wasting of mixed liquor together with primary sludge such that the solids concentration of the combined sludge being sent to MBC does not exceed 0.5%. This mode of operation requires MBC to operate at a higher hydraulic loading rate compared to the option described in the 10% Engineering Design Report (EDR) for the NCWRP Expansion (32). The mode of operation previously described in the EDR involves wasting primary sludge at a solids concentration of 1% and surface wasting of return activated sludge (RAS) using a classifying selector, resulting in a higher net solids concentration of the combined sludge, between 0.85% and 1.00%. Both options produce the same mass and organic loading rates at MBC, but the second option has the lower hydraulic loading rate of the two.

The final design consultant for the NCWRP Expansion may select the option with the higher flow rate and lower solids concentration to establish a constant sludge wasting rate (e.g., mixed liquor wasting) as opposed to surface RAS wasting. Costs presented in this TM are based on the first, more conservative option. However, an approximate percent reduction in equipment costs that would result from choosing the second option (RAS surface wasting) is presented in Section 8. As agreed at the project workshop conducted on May 18, 2016, these savings are not developed to the same level of analysis as the more conservative, high biosolids flow-wasting scenario. The associated cost savings for the low-flow biosolids-wasting scenario are presented as a high-level, order-of-magnitude assessment of potential savings in Section 8. If the first option (mixed liquor wasting) is chosen, the percent reduction in equipment costs does not need to be evaluated.

2.2 MBC and Its Role in Managing Biosolids Inventory

The management of the City's biosolids inventory is a regional, system-wide operation requiring coordination among PLWTP, NCWRP, and MBC. All three facilities produce biosolids; two out of three anaerobically digest biosolids; and MBC alone dewaters and disposes of the anaerobically digested biosolids produced by all three. Although the capacity assessment focused on anaerobic digestion at MBC, the analysis considered aspects of anaerobic digestion at PLWTP because this TM assumes the option of partial bypass of raw solids to PLWTP under specific infrequent conditions discussed in Section 3.2.1. This TM does not evaluate available digester capacity at PLWTP or any future plans (35) for use of this available capacity.

[1] Lystek is a trademark of Lystek International, a subsidiary of R.W. Tomlinson Ltd.



NOTES:

1. CURRENTLY NOT USED

IMPACTS OF NCWRP EXPANSION ON MBC

FIGURE 2-1

MBC CURRENT OPERATING CONFIGURATION

PLWTP is able to recover and anaerobically digest solids from chemically enhanced primary treatment (CEPT) up to a certain limit. This limit is determined by the "equivalence threshold," which establishes an allowable mass emission rate (MER) of 9,942 metric tons/year (mt/yr) (46) based on operation of PLWTP at its rated capacity of 240 mgd, assuming an equivalent secondary treatment discharge limit of 30 milligrams per liter (mg/L) total suspended solids (TSS) (38).

As discussed in Section 5.3 of the TM, existing digester capacity at MBC limits MBC's ability to treat future Pure Water flows and loadings. The constraint raises the question of whether it is more cost-effective to exploit available unused digestion capacity at PLWTP in lieu of constructing a fourth anaerobic digester at MBC and, if so, when. The question is significant because MBC staff [2] have indicated that MBC could be exposed to peak flows and loadings up to twice those processed under average conditions because of construction or operations and maintenance (O&M) activities at PLWTP or NCWRP. The project team and plant staff estimate that the frequency of such events is approximately once every 5 years. The project team has proposed potential mitigating measures for these unusual and infrequent events instead of sizing the facilities based on the elevated 2:1 peaking factor that would incur substantial and unnecessary expenses. These mitigation measures and potential discharge of biosolids to PLWTP are further discussed in Section 3.2.1 of this TM.

As part of the mitigating measures, the project team used a firm capacity approach to assess the sustainable, long-term capacity of a system. See Section 2.3.3 for a more detailed discussion. For the projected biosolids flows and loadings under Phase I and Phase II, the same "firm capacity" approach was used to size any needed upgrades to that same system. Because this approach is system-specific, it allowed the project team to make engineering judgments about system capacity on a case-by-case basis that took into account specific attributes of the equipment and feedback from O&M staff.

2.3 TM Organization and Assessment Method

2.3.1 Objectives

This TM is a concept-level assessment of the proposed changes in solids throughput at MBC, their impact on existing unit processes, and MBC's ability to successfully treat the projected biosolids flows and loads. It also includes an estimate of required and recommended improvements. The objectives of the TM are as follows:

1. Project the changes in solids contributions, in terms of both quantity and quality, from PLWTP and NCWRP
2. Assess the status of selected existing principal unit processes in terms of their firm production capacity
3. Assess the impact of these changes in solids contributions on the selected principal unit processes at MBC
4. Identify any capacity deficiencies in the existing principal unit processes that may result under future conditions
5. Identify required or recommended equipment improvements for a given unit process based on engineering judgment
6. Develop a Class 5 opinion of probable cost (OPC) (36) for the required and recommended improvements
7. Present a concept-level construction schedule that coordinates the MBC upgrades and enhancements with the timeline for expansions and upgrades at NCWRP

[2] Meeting between Dwight Correia and Boris Pastushenko, February 18, 2016.

This TM is not a Facilities Plan in the sense that it does not present and develop multiple alternatives, examine the alternatives based on life-cycle costs and non-economic factors, and select a recommended alternative. The required (driven by Pure Water needs), FOG Program-related, or other recommended improvements oriented on increasing MBC reliability and efficiency represent a logical, conservative extension of what is already installed and operational at MBC. The main goal in identifying improvements is to establish a benchmark approach that is detailed enough to allow for development of a Class 5 OPC. The required/recommended improvements do not (1) rule out other engineering alternatives; (2) compromise the possibility for more innovative approaches; or (3) eliminate the need for a detailed examination of alternatives in the future.

2.3.2 Format

Section 3 of this TM consists of an executive summary covering major findings, projected costs, and construction schedule. Section 4 of this TM addresses Objective 1 and discusses the modeling assumptions that were used to project flows and loads under Phase I and Phase II conditions. Appendix A represents extensive reference to prior reports, studies, manuals, design documents, and broad literature sources. Appendices B and C tabulate the results of modeling for the different scenarios under Phase I and Phase II conditions, respectively.

Section 5 is divided into a number of sub-sections, each addressing a specific unit process at MBC and satisfying Objectives 2 through 5. Each subsection first describes existing operating conditions and establishes the firm capacity of each process relative to its current operating conditions. Once existing conditions are determined, each subsection compares the firm capacity of the existing process to the projected flows and loads to establish its ability to handle future projected flows and loads. Finally, Section 5 of the TM presents the main findings, conclusions, and recommendations related to system improvements.

Within each section is a series of tables designed to organize information so that the reader follows a logical progression. The tables allow for the reader to survey the impacts on MBC without necessarily reading the text in detail. The text and table notes provide additional commentary on the findings summarized in the tables. Although the specifics of each table vary according to the nature of the process, the overall pattern and objective of the tables remain the same. (In the summary below, “X-” is a placeholder to denote any given figure or table such as “Table 2-1.”)

- Table X-1: Summarizes the original design criteria for the process, summarizes the firm capacity (i.e., long-term sustainable capacity) of the existing system, and compares the firm capacity to the current operating conditions.

- Table X-2: Uses the same firm capacity information for the current system and compares the current firm capacity to the projected operating conditions under Phases 1 and 2. Based on the comparison, Table X-2 identifies whether an existing system has sufficient firm capacity to handle projected flows and loads.

- Table X-3: If needed, Table X-3 provides greater detail on the modifications needed to ensure that the firm capacity of the system is increased to meet the projected Phase I conditions.

- Table X-4: If needed, Table X-4 provides greater detail on the modifications needed to ensure that the firm capacity of the system is increased to meet the projected Phase I and Phase 2 conditions.

Additional tables beyond Table X-4 were needed in Section 5.3, Anaerobic Digestion System, to summarize the impacts of FOG, and FOG plus Lystek.

Analysis of utilities extension needs is based on a conceptual assessment of biosolids flows, flow drainage, and electrical and distributed control system (DCS) infrastructure with the load lists presented in Appendix D. Section 5 provides a Class 5 OPC meeting Objective 6 with the basis of estimate memorandum and the estimate summary shown in Appendix E. Section 7 presents a schedule for completion assuming that the required and recommended improvements are confirmed in later stages of the design process (Objective 7). Section 8 lists important assumptions and describes any special limitations of the work done in completing the TM. Section 9 briefly summarizes the impact of constraints on the design of upgrades to MBC imposed by the existing NCWRP raw solids pump station and the existing 16-inch-diameter raw solids force main.

The MBC design documents and O&M manuals include schematic diagrams that depict the configuration of the existing systems being evaluated. These documents are generally referenced throughout the TM. See References (1) through (11).

The draft TM released to the City on May 6, 2016, has gone through an extensive internal quality assurance/quality control review by William Hartnett, MWH Americas, Inc. (MWH); Victor Occiano and Arthur Molseed, Brown and Caldwell (BC); Christine Waters, Pure Water Program; and the City: Keli Balo, Richard Pitchford, Raymond Ngo, Jesse Pagliaro, Monika Smoczynski, Greg Cross, and Dwight Correia. The report findings and the above-referenced comments were discussed at the draft TM workshop on May 18, 2016. All review comments have been incorporated or responded to in the final TM. The workshop PowerPoint presentation slides outlining major TM findings and summary of the workshop discussions and decisions are presented in Appendix F, and a comment log with responses to the City review comments is presented in Appendix G.

2.3.3 Concepts and Terminology

This subsection introduces and develops key concepts and terminology that support the investigative work and the findings of the TM.

2.3.3.1 "Phase I" and "Phase II" Conditions

Future flows and loadings of raw and digested solids received by MBC are a function of projected operating conditions associated with other existing and proposed facilities in the system—primarily the proposed NCPWF, expanded NCWRP, and PLWTP. Section 3 presents, in detail, the projected conditions at the tributary facilities that are used to model the flows and quantities of solids conveyed to MBC. Appendices B and C summarize the results of the modeling.

These sets of projected operating conditions are too numerous to continuously repeat in this TM. As a result, the terms "Phase I" and "Phase II" have been adopted to collectively refer to those projected operating conditions established as future benchmarks for planning. Table 2-1 and Table 2-2, respectively, summarize the Phase I and Phase 2 operating conditions. Although the results in Appendices B and C include projected flows to either MR or SVR, the projected impacts on MBC were always higher for deliveries to MR compared to SVR. As a result, the MR case was used as the most conservative condition with respect to assessing capacity at MBC.

Table 2-1: Summary of Phase I Operating Conditions		
Item No.	**Parameter**	**Description**
1	NCPWF production output (mgd)	15
2	Receiving reservoir for purified water	MR
3	Plant flow conditions at NCWRP	Average daily or peak hourly (maximum) flow
4	Level of non-potable water production at NCWRP	Peak day (maximum) NPR demand

Table 2-2: Summary of Phase II Operating Conditions		
Item No.	**Parameter**	**Description**
1	NCPWF production output (mgd)	30
2	Receiving reservoir for purified water	MR
3	Plant flow conditions at NCWRP	Average daily or peak hourly (maximum)
4	Level of non-potable water production at NCWRP	Peak day (maximum) NPR demand

2.3.3.2 “Rated” Capacity versus “Firm” Capacity

This TM focuses on the capacity of existing process equipment and systems at MBC and their ability to accommodate increased flows and loadings. The rated capacity of an item of equipment is dictated by nameplate data and specifications. In contrast, the firm capacity of a system, or individual item of equipment, is subject to engineering judgment and operational experience. Although general guidance documents (45) outline different approaches to condition assessment, they do not recommend a specific approach, nor do they offer specific guidance on projecting the capacity of a system based on its condition. The project team has adopted an approach that includes a margin of safety to account for contingency events (see Section 3.2.1).

2.3.3.2.a Rated Capacity

“Rated capacity” can be applied to individual items of equipment or to systems including multiple items of equipment.

Applied to individual items of equipment, rated capacity is based on the equipment’s specified duty point: a quantity of product delivered under particular process operating conditions. The duty point can be defined in a specification, listed on the nameplate for the equipment, or provided in equipment O&M manuals.

Applied to systems, the rated capacity of a system depends partly on the types of equipment within the system. For multiple centrifugal pumps in parallel, the capacity of the system is determined by the system curve. Because of non-linearities in system friction losses, the combined output of multiple pumps is less than the arithmetic sum of their individual capacities for a given total dynamic head (TDH).

For positive-displacement, progressive-cavity pumps, the capacity of a system of multiple pumps in parallel is assumed to be additive: the output of each pump is relatively insensitive to pressure assuming that the pump is operating within the torque and horsepower (hp) limitations of the pump and drive assembly.

2.3.3.2.b Firm Capacity

The term “firm capacity” can be applied both to individual items of equipment and to systems that include multiple items of equipment.

For individual items of equipment, the firm capacity is some value less than the rated capacity. This de-rating is the engineer’s assessment of what the equipment’s sustainable performance point is over its lifetime of service.

The de-rating factors applied to rated capacities in this TM are based on characteristics of the equipment and feedback from O&M staff, and based on the actual operating points established for existing equipment and systems at MBC. Table 2-3 below lists the de-rating factors applied throughout this TM to rated capacities to establish sustainable levels of production.

Table 2-3: Summary of Firm Capacity De-rating Multipliers for Items of Process Equipment

Equipment Type	De-rating Multiplier
Centrifugal pump	0.9
Progressive-cavity pump	0.8
Centrifuge	0.8

The multiplier for centrifugal pumps is based on assumed impeller wear and efficiency loss over time. For progressive-cavity pumps, stator wear increases exponentially with rotor speed and, as a result, their firm capacity is assumed to be a smaller percentage of their rated capacity. For centrifuges, the de-rating factor of 0.8 is assigned to provide additional available capacity to respond to contingency events, and to account for high levels of machine wear and attrition at maximum speed. Some items of process equipment, those with few or no moving parts, were not assigned a de-rating factor. “Teacup” degritters are one example of equipment with identical firm and rated capacities.

It is important to note that these de-rating factors may not necessarily have anything to do with the age of equipment. The same de-rating factors used in evaluating existing equipment have also been used in sizing new equipment. This approach is roughly equivalent to the “2:1” safety factor discussed in Section 2.2. It ensures that the equipment within a given system can still function with a margin of safety at the end of its useful life, and handle short-term operational peaks by temporarily running the available units and increasing the output of each unit.

In a system context, the definition of firm capacity refers to the number of items of process equipment out of the total number that are intended to run under maximum conditions. If a system consists of three pumps, and two are intended for continuous duty at maximum conditions, the system firm capacity is based on running the two pumps in parallel. The third pump is a standby pump that operates only if one of the two duty pumps fails.

2.3.3.2.c Redundancy

Redundancy is calculated in percent based on the number of items of standby equipment compared to the number of items of equipment running to deliver the firm capacity. If one backup unit and two units are running at firm system capacity, the redundancy is 50% (1/2).

2.3.3.2.d Duty Cycle

Duty cycle defines the percentage of the time that a system runs. System concepts of capacity (system capacity and firm capacity) are defined above assuming that the units of equipment run continuously. For systems where process flows are less than the system capacity, the system may run intermittently. If a set of process units run for 30 minutes out of any given hour, the system is operating on a 50% duty cycle. The duty cycle concept is frequently associated with constant-speed units that operate in response to high-level and low-level set points in a wetwell.

2.3.4 Acknowledgements

BLP Engineers Inc. (BLP) and BC wish to thank the following for their patience, goodwill, and support during the preparation of this TM: at the City, Dwight Correia, John Medina, Gerow Pitchford, Neil Tran, and the operations staff in Building 76; and at Fortistar, Robert Smith.

3 Executive Summary

3.1 Principal Findings

3.1.1 Phase II Conditions without Addition of FOG and Lystek

This Executive Summary focuses on the findings for Phase II conditions, assuming that the improvements needed at MBC to accommodate 30 mgd of pure water production are the main concern. For additional detail on the Phase I conditions, and their associated impacts on the MBC facilities, see the individual subsections in Section 5. While Phase I required improvements are substantially less extensive compared to Phase II required improvements, they are separated only by a short time span (as shown in Section 4.1). From a construction-scheduling and construction-efficiency standpoint, it would make sense to plan for and proceed straight to Phase II required improvements. This course of action should result in sizable savings for the City versus phasing Phase I and Phase II improvements.

The Phase II condition (see Table 2-2), without consideration of FOG and Lystek, corresponds to the base case. Table 3-1, which appears at the end of Section 3.1.1, summarizes the required and recommended improvements at MBC to accommodate this condition. Figure 3-1 is a site plan that shows the general location of different areas of work associated with the capacity assessment and includes the facilities for Phase II. It does not include the Lystek process.

3.1.1.1 Flows and Loadings

Increased flows and loadings of raw solids from NCWRP have the greatest impact on those unit processes that handle the raw solids flow. These processes are grit-handling facilities (Section 5.1), raw solids thickening (Section 5.2), anaerobic digestion (Section 5.3), and centrate return (Section 5.5). Raw solids flows are expected to increase by a factor of 7 from a current maximum operating flow of 0.89 mgd to a projected flow of 6.55 mgd at Phase II maximum conditions; solids in pounds per day (lb/d) are expected to increase by a factor of 5:1 from 56,000 lb/d (current) to 294,000 lb/d (Phase II maximum conditions). Tables 5-5 and 5-6 present this information.

TM 4, Evaluating Biosolids Management Options (34, 35) prepared by BC and Black & Veatch in May 2014, evaluated biosolids management options for the City on a system-wide basis for future scenarios including NCPWF. TM 4 recommended Solids Option 4. Although the findings of TM 4 serve as a general comparison, a number of recent developments have resulted in higher projected flows and loadings of raw solids at MBC since TM 4 was published.

- For Phase I, TM 4 is based on the assumption that 30 mgd of influent flow at NCWRP is required to produce 15 mgd of purified water. Further work since 2014 indicates that sidestream losses and non-potable reuse (NPR) demands (increased from 9.1 mgd to 11.8 mgd) are higher than initially assumed. To produce 15 mgd of purified water, an influent flow of 32.9 mgd is required.

- For Phase II, TM 4 is based on the assumption that 45 mgd of influent flow at NCWRP is required to produce 27 mgd of purified water. The required average daily influent flow corresponding to the currently proposed NCWRP Expansion, with 33.2 mgd production of pure water and ability to satisfy average NPR demand of 11.8 mgd, is approximately 51.8 mgd. To satisfy peak day NPR demand of 21.6 mgd the system is required to treat approximately 55.5 mgd of flow. These flow rates are based on an assumption that projected dry weather (July–October) NPR demand requirements may sustain peak day demands for several subsequent days exceeding currently anticipated average dry weather NPR demand of approximately 17 mgd.

- TM 4 did not include Pure Water's plan to intercept wastewater flows from trunk sewers near Morena Boulevard and pump them to NCWRP to augment wastewater supplies.

- TM 4 did not factor in the decision to use CEPT at NCWRP, which has an impact on flows and loadings to MBC (lower removal efficiencies were used based on historical data). This decision was made later as part of a process evaluation under development of the 10% EDR for the NCWRP Expansion (32).

3.1.1.2 Grit-Handling Facilities (Section 5.1)

The recommended approach includes continuing with, and expanding, the existing closed-loop grit removal system. The 14-inch-diameter line supplying raw solids to the grit separators and centrifuges will remain as-is, but will operate at higher flow rates. The significant increase in raw solids flows and loadings requires the following upgrades and improvements to the existing closed-loop grit processing system to meet Phase II maximum conditions:

- Installation of three new, higher-capacity, raw solids feed pumps with variable-frequency drives (VFDs)

- Installation of two grit separators

- Installation of two grit clarifiers with grit augers and shaftless screw conveyors

- Expansion of Building 76 to accommodate the additional facilities

3.1.1.3 Raw Solids Thickening Facilities (Section 5.2)

A seven-fold projected increase in raw solids flows from 0.89 mgd to a Phase II maximum of 6.55 mgd under peak day flow conditions requires replacement of the existing thickening centrifuges. See Section 3.1.1.1 and Section 4.1 for a discussion of the projected changes at NCWRP associated with the increased raw solids flows and loadings. It is more practical to completely replace the existing units with newer larger units because (1) this approach avoids increasing the size of the building and other support systems; and (2) newer centrifuges are significantly more energy-efficient than their existing counterparts. A total of six new centrifuges will be installed. In accordance with industry standard practice, the centrifuges were sized so that two units can be kept in reserve at all times, and four units can meet the Phase II maximum conditions. Sizing based on "n+2" for centrifuge installations under maximum conditions is an industry standard given the maintenance-intensive nature of centrifuges. In addition, the units were sized for individual firm capacity based on operating at 80% of output to address contingency events described in Section 3.2.1.

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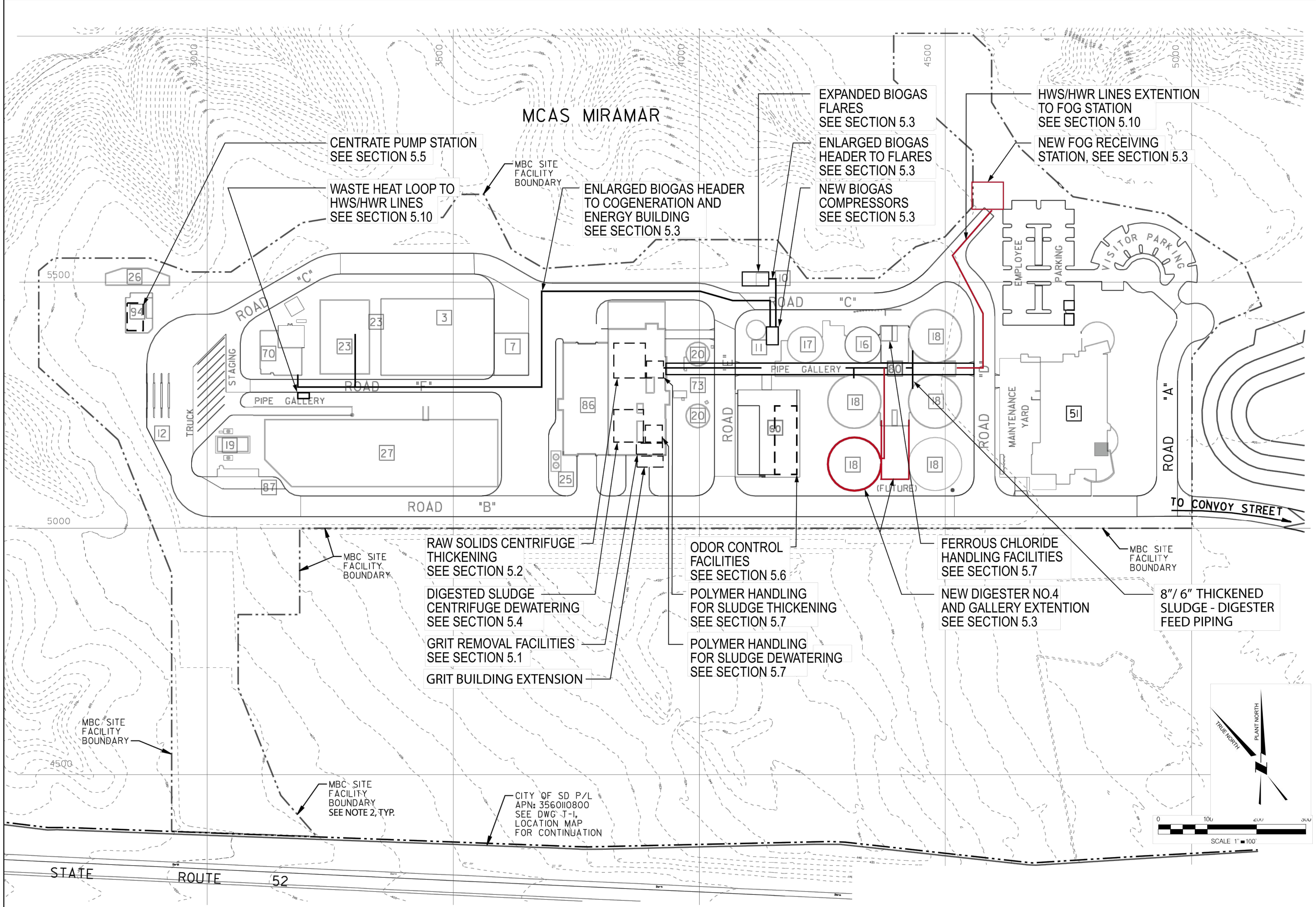


LEGEND:

— PROPOSED FACILITIES FOR FATS, OILS, AND GREASE.

— PROPOSED FACILITIES FOR PURE WATER AND OTHER REQUIREMENTS

MBC FACILITIES

3	FUTURE BIOSOLIDS HEAT DRYING BUILDING
7	FUTURE DRIED BIOSOLIDS STORAGE
10	BIOGAS FLARE FACILITY
11	BIOGAS HOLDING TANK AND COMPRESSORS
12	LIQUID WASTE RECEIVING STATION
16	DIGESTED BIOSOLIDS STORAGE TANK
17	EMERGENCY STORAGE TANK
18	DIGESTER
19	ELECTRIC YARD
20	RAW SOLIDS RECEIVING TANK
23	COGENERATION FACILITY
26	ODOR CONTROL SYSTEM FOR W.W.P.S.
27	FUTURE COMPOSTING BIOSOLIDS FACILITY
51	OPERATIONS BUILDING
60	CHEMICAL BUILDING
70	ENERGY BUILDING
73	RECEIVING TANK COMPLEX
76	CENTRIFUGE BUILDING
80	DIGESTER COMPLEX
86	DEWATERED BIOSOLIDS STORAGE BUILDING
87	TRUCK WASH FACILITY
94	WASTEWATER PUMP STATION (W.W.P.P.)

NOTES:

1. SITE LOCATION AND SPACE REQUIREMENTS FOR LYSTEK NOT SHOWN.
2. MBC SITE BOUNDARY IS SHOWN FOR GENERAL REFERENCE ONLY. FOR SITE BOUNDARY SURVEY INFORMATION, SEE DRAWINGS SF-CB-1 THROUGH SF-CB-3 (27319-0005-D THRU -0007-D)

MWH. Brown AND Caldwell BLP Engineers, Inc.

IMPACTS OF NCWRP EXPANSION ON MBC

FIGURE 3-1

METRO BIOSOLIDS CENTER
SITE PLAN SHOWING REQUIRED AND RECOMMENDED IMPROVEMENTS

Path: P:\Projects\San Diego, City of (CA)\Pure Water Program\T018 – Impact of NCWRP Expansion on MBC\CADD\10-FIGURES
Filename: 3-1 Plot date: Aug. 10, 2016 04:05PM CAD User: Eric Stiles

In conjunction with the thickening centrifuges, this TM recommends replacing the sludge feed pumps, and polymer feed pumps, complete with VFDs, as required upgrades.

Higher solids throughput will result in higher flows of thickened sludge feeding the digesters. The existing thickened sludge pumps will be replaced with larger pumps and, under maximum conditions, three out of four of the pumps will operate in parallel. The required upgrades also include a new 8-inch-diameter thickened sludge force main with 6-inch-diameter laterals supplying the mix pump suction manifolds for the digester mix pumps.

3.1.1.4 Anaerobic Digesters (Section 5.3)

It is possible to operate MBC under Phase II maximum conditions without construction of a fourth digester, but it requires that all three existing digesters perform well at the upper limit of acceptable volatile suspended solids (VSS) loading (29, 30, 31). See Section 3.2.1 for digester management safeguards. If one digester is out of service, a portion of the solids generated at NCWRP can be bypassed to PLWTP under Phase II maximum loading conditions to relieve the loadings on the digesters at MBC. Projections indicate that 13.8% of the NCWRP biosolids output will need to be diverted to PLWTP (at Phase II maximum loading calculated at 2-week peak conditions).

Diverting surplus solids flows from NCWRP to PLWTP under Phase II maximum conditions will increase the MER at PLWTP but the increase will not exceed the allowable limit under the existing discharge permit. The MER numbers were calculated using the Excel spreadsheet system mass balance model developed by BC, showing that the MER will increase from 7,790 mt/yr to 8,241 mt/yr, an increase that is still below the permit limit of 9,942 mt/yr (46). Infrequent diversion of biosolids to PLWTP from NCWRP is a safeguard built into MBC's flow management philosophy that will be maintained by the Public Utilities District (PUD) and used in case one digester is taken out of service at maximum loading conditions. Future MBC predesign and final design consultants will be required to evaluate the NCWRP biosolids diversion infrastructure, PLWTP solids reserve capacity and ability to sustain additional soluble biochemical oxygen demand (BOD) loads, and means and methods of conveying biosolids from MBC to PLWTP without short-circuiting solids flows to the Morena Pump Station (MPS). This could potentially be accomplished via either (1) the existing 54-inch-diameter Rose Canyon sewer, Junction Box 1, 42-inch-diameter sewer down to 45-inch-diameter interceptor with diversion to 60-inch-diameter sewer leading to a 60-inch-diameter interceptor straight to the North Metro Interceptor bypassing the MBS; or (2) pumping flow through the brine line. For all practical purposes, all three digesters will be in constant service during Phase II average and maximum conditions. It is highly doubtful that operations staff will commission and decommission the third digester just to handle peak conditions in a given year. As such, it will not be possible to consider available, unused MBC digesters for storage of off-spec water (42).

Phase II requires upgrades to the digesters include the following: (1) replace the existing digester gas laterals with larger lines and larger gas-handling appurtenances (flame arresters, etc.); (2) replace the existing biogas booster blowers with three new blowers and increase the size of the biogas feed line from the blowers to the cogeneration facility or construct a new biogas header to a new cogeneration facility; and (3) install an additional biogas flare. Table 5-13 presents this information. As indicated in Section 5.3, the enlargement of the biogas laterals and upsizing of the biogas blowers will be required to be implemented at Phase I loading conditions.

3.1.1.5 Digested Sludge Dewatering System (Section 5.4)

There is no substantial difference between current total output of digested sludge and the projected total output of digested sludge under Phase II maximum conditions (peak day assumed). Tables 5-18 and 5-19 present this projected output. Although the City is currently replacing the existing dewatering centrifuges with larger centrifuges, the existing original sludge feed pumps limit the capacity of the system overall. Aging control system components will ultimately limit the availability of the new centrifuges currently being installed. While upgrading the sludge feed pumps and polymer feed pumps is not required, it is recommended to maximize the system capacity and operational flexibility of the system to handle contingency situations regarding digested sludge flows from PLWTP (see Section 3.2.1).

3.1.1.6 Centrate Return System (Section 5.5)

Grit accumulation or precipitate buildup in the existing centrate force main is the likely explanation for high dynamic losses in the system and higher-than-anticipated pump discharge pressures. It is not possible to expand and upgrade the existing pumps for higher return flows of centrate to NCWRP unless the problems associated with maintaining the existing line are addressed first. See Section 3.2.2 for further discussion.

This TM requires installing four new centrate pumps, complete with VFDs, for returning centrate to NCWRP. One pump will occupy the space available, and the other three pumps will replace the existing pumps. Sizing information assumes that full-pipe flow conditions are restored prior to pump replacement.

3.1.1.7 Odor Control Systems (Section 5.6)

No odor control system (OCS) modifications are required.

3.1.1.8 Chemical Feed Systems (Section 5.7)

A fourth off-the-shelf replacement peristaltic pump is recommended.

3.1.1.9 Electric Utilities Extension Needs (Section 5.8)

All electrical upgrades can generally be accommodated within the configuration of the existing power distribution system with required modifications as discussed in Section 5.8.2**.**

The Fortistar cogeneration system has sufficient capacity to accommodate the new maximum demand of approximately 5.6 megawatts (MW).

If the Fortistar cogeneration system is not to be relied upon to supply the entire power to the facility, San Diego Gas & Electric (SDG&E) shall make provisions if necessary to meet the new maximum demand.

3.1.1.10 Additional Siting Considerations (Section 5.9)

Figure 3-1 is a general site plan showing the existing facilities and the areas of the existing site that will be affected by the recommended and required work. Currently, the area allocated for FOG facilities is shown adjacent to the parking area north of the maintenance yard. No provisions for Lystek are shown on the site plan.

3.1.1.11 Waste Heat Utilization (Section 5.10)

The hot water requirements for Phase I and Phase II are estimated to remain within the current hot water heat requirements and well below the hot water design capabilities. Minor reconfigurations of the existing hot water supply (HWS) and hot water return (HWR) piping systems are recommended. See Section 5.10 for the summary of required and recommended improvements.

3.1.1.12 Phase II Summary of Required and Recommended Improvements

Table 3-1 below presents the proposed required and recommended improvements, outlined in Items 3.1.1.1 through 3.1.1.11.

Table 3-1: Phase II Improvements - Base Case without FOG and Lystek

TM Section	Unit Process/ System	Description of Improvements	Designation of Improvements		
			NCWRP Expansion (Pure Water)	FOG Addition	Other
5.1	Grit removal	1) Install three larger raw solids feed pumps with VFDs to supply grit teacups and thickening centrifuges at higher rate.	✓		
		2) Expand Building 76 to facilitate expanded grit system.	✓		
		3) Install two grit separators for a total of five. Install two grit clarifiers with grit augers and shaftless screw conveyors for a total of four.	✓		
5.2	Sludge thickening	1) Install five new larger centrifuges to replace the five existing.	✓		
		2) Install sixth centrifuge in the space available.	✓		
		3) Install six new sludge feed pumps and six polymer feed pumps.	✓		
		4) Install three new larger thickened sludge digester feed pumps to replace existing. Install fourth pump in the space available.	✓		
		5) Install new 8-inch thickened sludge supply line.	✓		

Table 3-1: Phase II Improvements - Base Case without FOG and Lystek

TM Section	Unit Process/ System	Description of Improvements	Designation of Improvements		
			NCWRP Expansion (Pure Water)	FOG Addition	Other
5.3	Anaerobic digestion	1) Consider replacing recirculation pumps, mixing pumps, and axial mixing pumps with chopper-style pumps to improve mixing reliability.			✓
		2) Consider replacing HEXs for digesters 1 and 2.			✓
		3) Consider implementing digester management safeguards (3.2.1).			✓
		4) Construct new biogas laterals and upgrade digester gas-handling equipment (flame arresters, PRVs, etc.).	✓		
		5) Install three larger biogas blowers to replace existing and upsize blower discharge laterals.	✓		
		6) Install one new flare for a total of three.	✓		
		7) Increase the size of the gas line to supply cogeneration or provide header to new cogeneration facility.	✓		
		8) Increase size of the gas header to the flares.	✓		
5.4	Sludge dewatering	1) Install eight new sludge feed pumps and polymer feed pumps to replace existing.			✓
		2) Install two new centrifuges to replace existing centrifuges 1 and 8.			✓

Table 3-1: Phase II Improvements - Base Case without FOG and Lystek					
TM Section	Unit Process/ System	Description of Improvements	Designation of Improvements		
			NCWRP Expansion (Pure Water)	FOG Addition	Other
5.5	Centrate	Install four new centrate pumps with VFDs.	✓		
5.6	Odor control	No planned improvements.			
5.7	Chemical handling	1) Furnish fourth $FeCl_2$ feed pump either as an installed backup, or an off-the-shelf spare pump. 2) Increase tubing size for higher delivery at lower rpm.	✓ (1)		✓ (2)
5.8	Utilities extension	1) Biogas piping covered under 4.3. 2) Thickened Sludge piping covered under 5.2.	✓ (1) ✓ (2)		
5.9	Additional siting considerations	No planned improvements.			
5.10	Waste heat utilization	Modify existing HWS and HWR piping.			✓

Note: Most of the improvements listed in Table 3-1 will require engineering design and preparation of construction documents including design drawings and specifications with exception of recommended replacement of existing (digesters 1, 2, and 3) digester recirculation, mixing, and axial mixing pumps with chopper-style pumps; replacing of existing HEXs for digesters 1 and 2; and providing of the off-the-shelf spare $FeCl_2$ feed pump.

3.1.2 Phase II Conditions with Addition of FOG

Table 3-2 summarizes the required and recommended improvements in addition to those already listed in Table 3-1, assuming that the FOG Program is implemented.

Implementation of the FOG Program (39) will produce additional biogas and provide additional power cogeneration by the City (the City is contemplating to evaluate utilization of other waste streams under a separate project). Although FOG addition to digesters will increase waste heat utilization at MBC, the available waste heat sources are more than sufficient to match demand. Potential future uses of waste heat are generally outlined in this TM based on prior studies performed by the City. It is recommended that these uses be further explored in the future.

Table 3-2: Phase II Improvements - Base Case with FOG					
TM Section	**Unit Process/ System**	**Description of Improvements**	**Designation of Improvements**		
			NCWRP Expansion (Pure Water)	**FOG Addition**	**Other**
5.1	Grit removal	See Table 3-1			
5.2	Sludge thickening	See Table 3-1			
5.3	Anaerobic digestion	1) Construct fourth digester 2) Construct new biogas laterals and upgrade digester gas-handling equipment (flame arresters, PRVs, etc.) 3) Install three new biogas blowers (680 scfm) to replace existing 4) Install two new flares (550 scfm) to match existing for a total of four 5) See Table 3-1		✓ ✓ ✓ ✓	
5.4	Sludge dewatering	See Table 3-1			
5.5	Centrate	See Table 3-1			
5.6	Odor control	No planned improvements			
5.7	Chemical handling	1) Install fourth $FeCl_2$ feed pump with associated piping to feed digester 4 2) Consider fifth off-the-shelf replacement pump 3) Increase tubing size for higher delivery at lower rpm		✓ (1)	✓ (2) ✓ (3)

Table 3-2: Phase II Improvements - Base Case with FOG					
TM Section	**Unit Process/ System**	**Description of Improvements**	**Designation of Improvements**		
			NCWRP Expansion (Pure Water)	**FOG Addition**	**Other**
5.8	Utilities extension	1) See Table 3-1 for biogas and thickened sludge utilities			
		2) Utilities extended to digester 4 in conjunction with gallery construction: UWHP, chemical lines, drain lines		✓	
		3) Utilities extended to FOG including HWS and HWR lines		✓	
5.9	Additional siting considerations	No planned improvements			
5.10	Waste heat utilization	1) Modify existing HWS and HWR piping			✓
		2) Extend HWS and HWR piping to digester 4		✓	
		3) Extend HWS and HWR piping to FOG station		✓	

Note: Most of the improvements listed in Table 3-2 will require engineering design and preparation of construction documents including design drawings and specifications with exception of recommended replacement of existing (digesters 1, 2, and 3) digester recirculation, mixing, and axial mixing pumps with chopper-style pumps; replacing of existing HEXs for digesters 1 and 2; and providing of the off-the-shelf spare $FeCl_2$ feed pump.

3.1.3 Phase II Conditions with Addition of FOG and Lystek

Assuming FOG addition to digesters and Lystek process are implemented, Table 3-3 summarizes the required and recommended improvements in addition to those already listed in Table 3-1. Lystek will increase the output of biogas on site.

Table 3-3: Phase II Improvements - Base Case with FOG and Lystek

TM Section	Unit Process/ System	Description of Improvements	Designation of Improvements		
			NCWRP Expansion (Pure Water)	FOG Addition	Other
5.1	Grit removal	See Table 3-1			
5.2	Sludge thickening	See Table 3-1			
5.3	Anaerobic digestion	1) Construct fourth digester 2) Construct new biogas laterals and upgrade digester gas-handling equipment (flame arresters, PRVs, etc.) 3) Install three new biogas blowers (850 scfm) to replace existing 4) Install two new larger flares (800 scfm) to supplement existing for a total of four 5) See Table 3-1		✓ ✓ ✓ ✓	
5.4	Sludge dewatering	See Table 3-1			
5.5	Centrate	See Table 3-1			
5.6	Odor control	No planned improvements			
5.7	Chemical handling	1) Install fourth $FeCl_2$ feed pump with associated piping to feed digester 4 2) Increase tubing size for higher delivery at lower rpm		✓ ✓	
5.8	Utilities extension	1) See Table 3-1 for biogas and thickened sludge utilities 2) Utilities extended to digester 4 in conjunction with gallery construction: UWHP, chemical lines, drain lines 3) Utilities extended to FOG including HWS and HWR lines		✓ ✓	
5.9	Additional siting considerations	No planned improvements			

Table 3-3: Phase II Improvements - Base Case with FOG and Lystek					
TM Section	Unit Process/ System	Description of Improvements	Designation of Improvements		
			NCWRP Expansion (Pure Water)	FOG Addition	Other
5.10	Waste heat utilization	1) Modify existing HWS and HWR piping			✓
		2) Extend HWS and HWR piping to digester 4		✓	
		3) Extend HWS and HWR piping to FOG station		✓	

Note: Most of the improvements listed in Table 2.1-3 will require engineering design and preparation of construction documents including design drawings and specifications with exception of recommended replacement of existing (digesters 1, 2, and 3) digester recirculation, mixing, and axial mixing pumps with chopper-style pumps; replacing of existing HEXs for digesters 1 and 2; and providing of the off-the-shelf spare $FeCl_2$ feed pump.

3.1.4 Cost and Schedule (Sections 5 and 6)

Table 3-4 and Table 3-5, respectively, summarize the construction costs and total project delivery costs for Phase I and Phase II improvements. The OPC Report, with takeoffs, is included in Appendix E. The costs in Section 6 and Appendix E supersede the OPC presented at the workshop based on the draft submittal (see Appendix F). The construction costs are as follows:

- Construction subtotal of $19.9 million, and total project cost, including contingencies and project delivery costs, of $35.8 million for Phase II improvements for NCWRP Expansion related to Pure Water
- Construction subtotal of $14.8 million, and total project cost, including contingencies and project delivery costs, of $26.7 million for Phase II improvements related to implementation of FOG Program (FOG addition)
- Construction subtotal of $6.2 million, and total project cost, including contingencies and project delivery costs, of $11.1 million for Phase II improvements related to other recommended improvements oriented on improvement MBC reliability and efficiency

Table 3-4: Cost Summary for Upgrades Required for Phase I Conditions [(1)]				
Construction Cost Breakdown	**NCWRP Expansion (Pure Water)**	**FOG Addition**	**Other Recommended Improvements**	**See Note [(3)]**
Grit removal	$0	$0	$0	
Thickening centrifuges	$9,119,000	$0	$0	
Digester system [(2)]	$1,165,000	$4,189,000	$2,206,000	
Dewatering centrifuges	$0	$0	$0	
Centrate system	$0	$0	$0	
Odor control	$0	$0	$0	
Chemical storage	$0	$0	$0	
Evaluation of utilities	$0	$0	$0	
Additional facilities siting	$0	$0	$0	
Waste heat utilization	$0	$73,000	$628,000	
Subtotal construction cost	$10,284,000	$4,262,000	$2,834,000	
Contingency (40%)	$4,114,000	$1,705,000	$1,134,000	
Total construction cost	**$14,398,000**	$5,967,000	$3,968,000	**See Note [(4)]**
Delivery Costs [(5),(6)]				
Predesign (2.1%)	$302,000	$125,000	$83,000	
Detailed design (7.1%)	$1,022,000	$424,000	$282,000	
ESDC (1.4%)	$202,000	$84,000	$56,000	
CM: bid phase (0.4%)	$58,000	$24,000	$16,000	
CM: construction phase (6.8%)	$979,000	$406,000	$270,000	
Environmental: review and permitting (1.4%)	$202,000	$84,000	$56,000	
Environmental: construction compliance (2.1%)	$302,000	$125,000	$83,000	
PM: City project management (3.6%)	$518,000	$215,000	$143,000	
PM: other City departments (1.4%)	$202,000	$84,000	$56,000	
Subtotal delivery costs	**$3,787,000**	**$1,571,000**	**$1,045,000**	
Other Costs [(6)]				
Land acquisition	$0	$0	$0	
Environmental mitigation (2.1%)	$302,000	$125,000	$83,000	
Subtotal other costs	**$302,000**	**$125,000**	**$83,000**	
Total project cost	**$18,487,000**	**$7,663,000**	**$5,096,000**	**Grand Total**

Table 3-4: Cost Summary for Upgrades Required for Phase I Conditions [1]				
Construction Cost Breakdown	**NCWRP Expansion (Pure Water)**	**FOG Addition**	**Other Recommended Improvements**	**See Note [3]**
Without FOG addition, other upgrades included	**$18,487,000**	**$0**	**$5,096,000**	**$23,583,000**
With FOG addition and other upgrades [7]	**$14,896,000**	**$7,663,000**	**$5,096,000**	**$27,655,000**

(1) All numbers presented in the table are construction OPCs without the 40% contingency.

(2) Cost for FOG-receiving station derived from CH2M Hill report, contingency deducted from reported cost.

(3) The total depends on whether FOG addition is selected.

(4) The project construction subtotal depends on whether FOG addition is selected.

(5) Fixed costs are per baseline budget or current Pure Water directive.

(6) Delivery and other costs based on the total construction cost.

(7) The total project cost excludes digester system costs related to NCWRP Expansion because the upgrades associated with FOG addition cover these operating conditions.

Table 3-5: Cost Summary for Upgrades Required for Phase II Conditions [1]				
Construction Cost Breakdown	**NCWRP Expansion (Pure Water)**	**FOG Addition**	**Other Recommended Improvements**	**See Note [3]**
Grit removal	$2,721,000	$0	$0	
Thickening centrifuges	$15,199,000	$0	$0	
Digester system [2]	$1,026,000	$14,764,000	$2,206,000	
Dewatering centrifuges	$0	$0	$3,337,000	
Centrate system	$956,000	$0	$0	
Odor control	$0	$0	$0	
Chemical storage	$0	$0	$0	
Evaluation of utilities	$0	$0	$0	
Additional facilities siting	$0	$0	$0	
Waste heat utilization	$0	$73,000	$628,000	
Subtotal construction cost	$19,902,000	$14,837,000	$6,171,000	
Contingency (40%)	$7,961,000	$5,935,000	$2,469,000	
Total construction cost	**$27,863,000**	**$20,772,000**	**$8,640,000**	**See Note [4]**
Delivery Costs [5],[6]				
Predesign (2.1%)	$585,000	$436,000	$181,000	
Detailed design (7.1%)	$1,978,000	$1,475,000	$613,000	
ESDC (1.4%)	$390,000	$291,000	$121,000	

Table 3-5: Cost Summary for Upgrades Required for Phase II Conditions (1)				
Construction Cost Breakdown	**NCWRP Expansion (Pure Water)**	**FOG Addition**	**Other Recommended Improvements**	**See Note (3)**
CM: bid phase (0.4%)	$111,000	$83,000	$35,000	
CM: construction phase (6.8%)	$1,895,000	$1,412,000	$588,000	
Environmental: review and permitting (1.4%)	$390,000	$291,000	$121,000	
Environmental: construction compliance (2.1%)	$585,000	$436,000	$181,000	
PM: City project management (3.6%)	$1,003,000	$748,000	$311,000	
PM: other City departments (1.4%)	$390,000	$291,000	$121,000	
Subtotal delivery costs	**$7,327,000**	**$5,463,000**	**$2,272,000**	
Other Costs 6				
Land acquisition	$0	$0	$0	
Environmental mitigation (2.1%)	$585,000	$436,000	$181,000	
Subtotal other costs	**$585,000**	**$436,000**	**$181,000**	
Total project cost	**$35,775,000**	**$26,671,000**	**$11,093,000**	**Grand Total**
Without FOG addition, other upgrades included	**$35,775,000**	**$0**	**$11,093,000**	**$46,868,000**
With FOG addition and other upgrades (7)	**$32,184,000**	**$26,671,000**	**$11,093,000**	**$69,948,000**

(1) All numbers presented in the table are construction OPCs without the 40% contingency.

(2) Cost for FOG-receiving station derived from CH2M Hill report, contingency deducted from reported cost.

(3) The digester system total depends on whether FOG addition is selected.

(4) The project construction subtotal depends on whether FOG addition is selected.

(5) Fixed costs are per baseline budget or current Pure Water directive.

(6) Delivery and other costs based on the total construction cost.

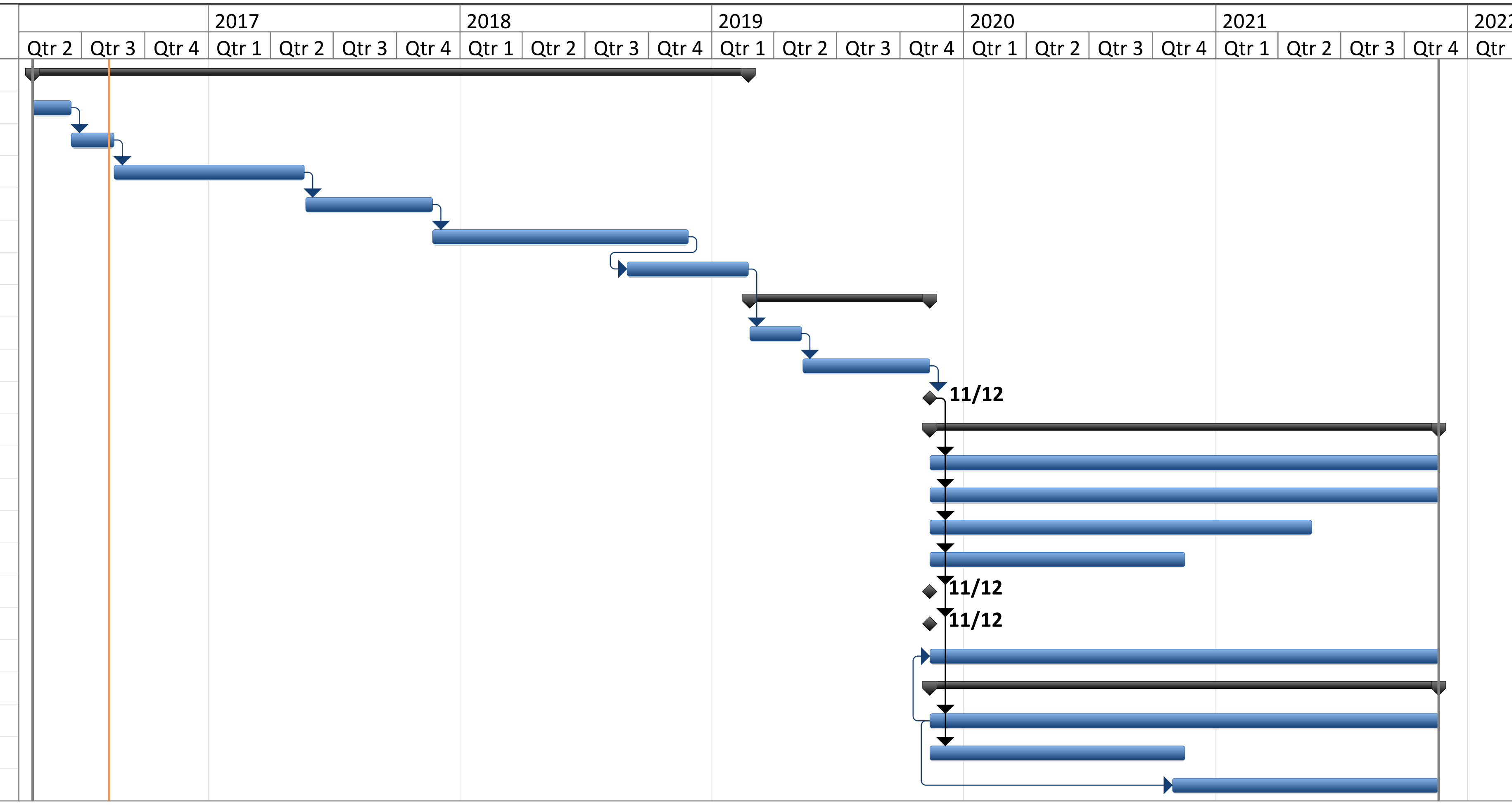
(7) The total project cost excludes digester system costs related to NCWRP Expansion because the upgrades associated with FOG addition cover these operating conditions.

Section 9 describes the potential savings of $6.7 million associated with the adoption of a low-flow solids wasting strategy during peak day conditions with maximum NPR. Table 3-2 is a proposed schedule designed to ensure that the upgrades at MBC are operational prior to the commissioning of the NCWRP Expansion in November 2021. The schedule prepared during the development of the draft TM issued on May 6, 2016, showed that commissioning at MBC would lag the NCWRP construction by approximately 9 months. Based on decisions made at the project workshop on May 18, 2016 (refer to Appendices F and G), the project team was able to shorten the original timeline for completion at MBC by planning for pre-purchasing equipment with a long lead time and streamlining the procurement process for predesign and final design services. Proposed project schedule is presented in Figure 3-2.

PROPOSED PROJECT SCHEDULE FOR IMPROVEMENTS AT MBC REQUIRED DUE TO NCWRP EXPANSION

FIGURE 3-2

ID	Task Name	Duration	Start	Finish
1	**Design**	**742 days**	**Thu 4/21/16**	**Fri 2/22/19**
2	Complete PDR(Study)	40 days	Thu 4/21/16	Wed 6/15/16
3	Procure 10% Designer	44 days	Thu 6/16/16	Tue 8/16/16
4	10% Design Development	198 days	Wed 8/17/16	Fri 5/19/17
5	Procure Final Designer	132 days	Mon 5/22/17	Tue 11/21/17
6	Final Design Development	265 days	Wed 11/22/17	Tue 11/27/18
7	Permitting	126 days	Fri 8/31/18	Fri 2/22/19
8	**Construction Bid and Award**	**187 days**	**Mon 2/25/19**	**Tue 11/12/19**
9	Advertise and Bid	55 days	Mon 2/25/19	Fri 5/10/19
10	Award Construction Contract	132 days	Mon 5/13/19	Tue 11/12/19
11	Contractor NTP	0 days	Tue 11/12/19	Tue 11/12/19
12	**Procure/Construct/Commissioning**	**528 days**	**Tue 11/12/19**	**Fri 11/19/21**
13	Grit Removal	528 days	Wed 11/13/19	Fri 11/19/21
14	Thickening Centrifuges	528 days	Wed 11/13/19	Fri 11/19/21
15	Digester Improvements without FOG	396 days	Wed 11/13/19	Wed 5/19/21
16	Centrate System	264 days	Wed 11/13/19	Mon 11/16/20
17	Odor Control (No Improvements)	0 days	Tue 11/12/19	Tue 11/12/19
18	Chemical Systems (No Improvements)	0 days	Tue 11/12/19	Tue 11/12/19
19	Extension of Utilities	528 days	Wed 11/13/19	Fri 11/19/21
20	**FOG Related & Other Improvements**	**528 days**	**Wed 11/13/19**	**Fri 11/19/21**
21	Digester Improvements with FOG	528 days	Wed 11/13/19	Fri 11/19/21
22	Dewatering Centrifuges	264 days	Wed 11/13/19	Mon 11/16/20
23	Waste Heat Utilization	275 days	Fri 10/30/20	Thu 11/18/21



3.2 General Recommendations

3.2.1 Digester Management Safeguards

As discussed in Section 2.2, MBC staff has indicated that MBC can experience short-term operational conditions when the facility must operate at production rates up to twice those experienced under average conditions. These short-term conditions occur because of construction or O&M activities at PLWTP or NCWRP. MBC must accelerate production in the short term to make facilities available for a shutdown, or accelerate production after a shutdown to reduce biosolids inventory. The frequency of such events is estimated collectively by the project team and plant staff as approximately once every 5 years. Given the susceptibility of digester operations to process upsets under high VSS loading conditions, and the cost of constructing an additional digester, City staff should first consider a broad suite of management safeguards to minimize the risk of high loadings on the MBC digesters under Phase I and Phase II scenarios. Risk management practices should include the following:

- All potential maintenance or construction activities that could result in higher than normal flow or solids peaking factors will need to be conducted under NCWRP minimum biosolids production conditions associated with low NPR demands that coincide with the winter (November through March) season.
- A contractor responsible for construction or maintenance activities that may result in producing excessive flows and loads to digesters should be required to develop, in conjunction with City operations staff, a fail-safe plan to mitigate such impacts and to keep all facilities in safe and steady-state operation. This plan will need to be reviewed and approved by the City prior to commencing any such activities. Such plan should include the following provisions:
  - Means of minimizing peaking condition duration
  - Means of safe biosolids bypass provisions to PLWTP with consideration of potential impacts on the NCWRP biosolids diversion infrastructure, PLWTP solids reserve capacity and ability to sustain additional soluble BOD loads, and means and methods of conveyance biosolids from MBC to PLWTP without shorting flows to MPS
  - Means of equalizing digester diurnal loadings
  - Assurance of proper and efficient digester heating and mixing in accordance with the design criteria
  - Potential means of minimizing load to individual processes, if necessary
  - Continuous process sampling, monitoring, and analyzing peaking factors and digester health and performance characteristics during said construction or maintenance activities
  - Continuous monitoring of mass emission rates for PLWTP to make sure that they do not exceed limits established by the existing permit
- Regardless of any planned outage or contingency event every 5 years, there is still the chance of even rarer events that are unplanned that would fall under the category of emergency response planning. Given that each facility has its own inherent solids-handling restrictions and limitations, the City should examine solids inventory management practices on a system-wide basis, devise strategies that allow the facilities to more effectively support one another, and determine what infrastructure, if any, is needed to improve interdependence and redundancy among the three.

If the project team applies a more conservative approach in assessing the “firm capacity” of MBC, the cost of expanding and upgrading MBC predictably increases in response to the higher flows and loadings under maximum conditions. But as the cost of expanding MBC increases, the value of unused capacity at PLWTP also increases. It raises the question whether it is less costly to rely periodically on available capacity at PLWTP instead of constructing a fourth digester. The cost impacts of modeling assumptions are not linear, which results in the following: higher peaking factors can be absorbed up to a point, but once a process loading threshold is crossed, the cost increases by increments. A 25% increase in peaking factor from 1.6:1 to 2:1 increases the cost of expanding MBC by more than 25% if it entails constructing a fourth digester.

The project team evaluated and confirmed with City staff the surplus available MER at PLWTP based on its system model. For short durations, it appears that the City has the available capacity to bypass a portion of the solids generated by NCWRP to PLWTP during infrequent events. This assumption needs to be further evaluated by predesign and design consultants. It is important to emphasize that this TM does not evaluate this option in detail. It does not evaluate the configuration or capacity of facilities at NCWRP to confirm if the infrastructure is in place to bypass the required solids flows to sewer. This TM does not provide any estimate of costs associated with improvements ultimately determined to be necessary at NCWRP. Similarly, this TM does not assess the digested sludge infrastructure at PLWTP or its capacity (please note that future stages of Pure Water will include biosolids conveyance from the planned Central Area Advanced Water Purification Facility [CAAWPF] to PLWTP). Future predesign and final design consultants will need to confirm that digester capacity is available at PLWTP under projected loading conditions during bypass operations.

3.2.2 Solids Transmission Force Mains

The three existing solids transmission force mains play a critical role in managing the biosolids inventory. These force mains interconnect the three facilities and are summarized below:

- A 12- to 14-inch-diameter digested sludge line delivering unthickened digested sludge from PLWTP to one of the biosolids storage tanks at MBC
- A 16-inch-diameter raw sludge line delivering unthickened raw biosolids from NCWRP to the raw-solids-receiving tanks at MBC
- A 20-inch-diameter force main returning centrate from the centrate pump station at MBC to the drop structure in the influent pump station at NCWRP that directs flow to PLWTP

Although beyond the scope of this TM, it must be noted that these lines are especially important for several reasons. First, the degree of redundancy in the lines is probably less than the degree of redundancy within the facilities themselves. Second, there are already physical limitations and operational problems with the lines—most notably, the 20-inch-diameter centrate force main.

Any condition that results in the shutdown of any one of these lines means that the facilities must either store biosolids on site or divert biosolids to a facility that can store biosolids. In terms of redundancy, the 20-inch-diameter centrate force main appears to be the most critical of the three lines: if it fails, no solids dewatering can take place and therefore the entire system must temporarily shut down[3]:

- NCWRP must divert all raw solids to PLWTP

[3] MBC staff has modified the piping to allow centrate to be circulated through the 16-inch-diameter blended sludge pipeline. This allowed staff to operate it at a higher line velocity in an effort to resuspend settled solids in the sludge line.

- PLWTP must not only handle the increased solids load from NCWRP; it must also temporarily store the resulting increased production of digested sludge until the issues with the force main are addressed
- Once the biosolids storage tank and emergency biosolids storage tanks are full at MBC, all operating MBC digesters will have to discontinue sludge feed because it will not be possible to dewater digested sludge

MBC is already experiencing operational problems with the 20-inch-diameter centrate force main, a concern that is discussed in Section 5.5. Historically low velocities in the force main have resulted in deposition of solids, mineralization (scale deposition), or both. Restrictions in the line have resulted in increased dynamic losses. The same, or similar, problems may exist in the PLWTP digested sludge force main and the NCWRP raw solids force main to varying degrees.

The conclusions and recommendations presented in this TM are based on the assumption that the centrate pump station force main is restored to full-pipe flow conditions before any improvements are made to MBC to handle the increased demands imposed by NCWRP and NCPWF. The proposed centrate pumps are sized to meet the projected head conditions as if the centrate force main were functioning correctly. This TM does not address the means and methods of restoring and maintaining the maximum flow conditions of the centrate piping.

The project team recommends that the City consider the following as a separate effort beyond the scope of this TM; this list of recommendations assumes that none of the items below are already being completed by others:

- Initiate a field investigation and condition assessment to evaluate the centrate force main, raw solids force main, and digested sludge feed line from PLWTP, and assign priorities to problem areas.
- Develop failure scenarios and contingency response plans to mitigate any shortfall in physical redundancy in the system. Identify materials and equipment, if any, that need to be stored in-house as part of a rapid response plan.
- Identify alternatives for restoring the pipes to full flow conditions. These alternatives may include rehabilitation of existing lines, installation of new lines, or both.
- Identify alternative approaches to maintaining the lines, including but not limited to chemical addition facilities and flushing facilities.
- Initiate design and construction of any facilities needed to ensure that MBC can reliably support solids transfer operations from other facilities.

4 Projected Changes in Quantity and Quality of Solids

4.1 Solids and Flow Loadings Associated with NCWRP Expansion

4.1.1 Existing Conditions

NCWRP, located approximately 4 miles northwest of MBC, does not have any solids-processing facilities. Combined unthickened solids from the primary clarifiers and secondary clarifiers are sent to MBC via a 16-inch-diameter pipeline. The raw solids are stored in two raw-solids-receiving tanks (73-T-01 and 73-T-02) before being conveyed by the raw solids feed pumps to the thickening centrifuges feed loop.

NCWRP is slated for expansion as part of Pure Water; in addition, some wastewater treatment process changes are also anticipated. These changes, together with the expansion, will result in an increase of raw solids flows and loadings to MBC, and will also ultimately impact digested solids flows and loadings from PLWTP. These changes need to be analyzed and understood to properly evaluate the capacity of treatment processes and equipment at the MBC.

4.1.1.1 BioWin Modeling

An *Alternatives Analysis* TM for the NCWRP Expansion was prepared by MWH and BC as part of Task 6, Task Order 2 of Pure Water (40). The TM describes various treatment process alternatives for the plant expansion. As part of this effort, the team studied historical data pertaining to influent flows, solids loads, and wastewater quality from mid-2011 through December 2014.

These data were analyzed to establish trends and were used as inputs for setting up the proprietary biological treatment process model (BioWin). The model was then calibrated for field conditions by using both the historical data and field data obtained during stress testing conducted at NCWRP. The key inputs for the analysis included average influent flows, suspended solids and BOD, and peaking factors for these parameters.

4.1.1.2 Flow and Mass Balance Modeling

A Microsoft Excel, spreadsheet-based, flow and mass balance model was also prepared to simulate various scenarios for this work, and was based on an earlier model prepared for the City in 1999. The spreadsheet, which includes several worksheets linked together, uses iterative calculations to predict wastewater characteristics, flows, and loads at each treatment plant. Each treatment plant in the system is represented in a separate worksheet and additional worksheets are provided for inputting data and assumptions. Table 4-1 presents the key input parameter assumptions used in the model.

Several scenarios were modeled, each using a separate spreadsheet. The primary difference between the scenarios was the NPR water demand, which varies based on weather conditions. Three scenarios were modeled: a minimum NPR demand, base-case, and maximum peak day NPR demand. Two other scenarios, named A.1 and A.2, were interposed upon the prior three; the first considered a typical rate of 52% for VSS reduction in the digesters and the second considered a lower VSS reduction of 46% in the digesters.

The current VSS reduction rate of 62.7% at MBC is abnormally high because of long hydraulic residence times (HRTs) in the in-service digester, and do not reflect typical digester performance. In contrast, the VSS reduction rate for the PLWTP digesters is approximately 50% (30), a percent reduction that is consistent with the typical industry average of 52%. Our judgment is that the projected substantial reduction in HRT and increased organic loading will reduce the VSS reduction rate to match the industry average (29, 30, 31). If digester performance is impacted by feed sludge toxicities, sub-optimal digester mixing or process control, the project team estimates that VSS reduction would decline by about 12% down to 46% (39). Both 52% and 46% VSS reduction were used in modeling to project the impact of reduction efficiency on gas production and digested sludge production.

Additionally, each of the previously described scenarios was repeated for three alternatives: no FOG addition, with FOG addition (39), and FOG addition with implementation of the Lystek process (see (39) and Section 4.3). The alternative with FOG and implementation of Lystek assumed an increased the volatile solids destruction of 25% over the base value. FOG addition to digesters at a rate of 60,000 gallons per day (gpd) has been proposed for increasing biogas production in the future as developed in (39).

Table 4-1: Key Assumptions Used in Flow and Mass Balance Modeling		
Parameter	**Value**	**Comments**
Primary Sedimentation		
TSS Removal Efficiency at PLWTP	88%	
TSS Removal Efficiency at NCWRP	78%	
BOD Removal Efficiency	35%	Typical values presented here are used
Chemical Addition (Ferric Chloride)	15 mg/L	Unless a particular plant has different
Chemical Sludge Production	1.10 LB/LB CHEM	Values based on historical sampling data
Solids Concentration in Sludge	0.50%	
VSS:TSS of Sludge	75%	
VSS:TSS of Effluent	78%	
Secondary Sedimentation		
Effluent TSS Concentration	9 mg/L	Typical values presented here are used
Effluent BOD Concentration	9 mg/L	Unless a particular plant has different
VSS:TSS of Sludge	80%	Values based on historical sampling data
Solids Processing		
Thickening Centrifuge Solids Recovery	90%	Typical values presented here are used
Thickened Sludge Solids Concentration	5%	Unless a particular plant has different
Dewatering Centrifuge Solids Recovery	95%	Values based on historical sampling data
Dewatered Sludge Solids Concentration	28%	
VSS Destruction in Digester	VARIES	46% - 65% depending on scenario modeled
Microfiltration/Ultrafiltration		
Backwash Rate	5%	Of feed flow
Backwash Solids Concentration	40-60 mg/L	Varies based on influent concentration
Reverse Osmosis		
Purified Water Output	85%	Of feed flow
Purified Water TDS Concentration	8%	Concentration of feed flow
Flow Loss Due to Clean-In-Place	1%	Of feed flow

All of the scenarios were modeled for Phase I conditions and also Phase II conditions using various parameters as described. Section 2.3 summarizes Phase I and Phase II definitions. In addition, all modeled scenarios represent conveyance of purified water from NCPWF to MR. The scenarios can be summarized as follows:

- **Scenario A.1:** no FOG addition at MBC, volatile solids destruction of 52%, at minimum, base, and maximum NPR demand
- **Scenario A.2:** no FOG addition at the MBC, volatile solids destruction of 46%, at minimum, base, and maximum NPR demand
- **Scenario B.1:** with FOG addition at the MBC, volatile solids destruction of 52%, at minimum, base, and maximum NPR demand
- **Scenario B.2:** with FOG addition at the MBC, volatile solids destruction of 46%, at minimum, base, and maximum NPR demand
- **Scenario C.1:** with FOG addition at the MBC together with the Lystek process, increased volatile solids destruction of 65%, at minimum, base, and maximum NPR demand
- **Scenario C.2:** with FOG addition at the MBC together with the Lystek process, increased volatile solids destruction of 57.5%, at minimum, base, and maximum NPR demand

Because the primary goal of this work is to evaluate the impact of the NCWRP Expansion on MBC, all models were set up to exclude the proposed CAAWPF. This was done to prevent solids from CAAWPF, which would have been conveyed to MBC, from interfering with the analysis. The Padre Dam Municipal Water District (PDMWD) plant was assumed to be in operation (3 mgd influent flow) and returning solids to sewer for processing at PLWTP. This assumption is based on current available information but it is possible that PDMWD could consider a larger water reclamation facility in the future.

If the Padre Dam facility increases capacity from 3 mgd to 15 mgd, this would reduce the overall flow reaching PLWTP. However, it is anticipated that the Padre Dam facility would not include solids treatment and would therefore return solids to the sewer. The net impact at PLWTP is a negligible reduction of about 1% in the total solids (TS) load. If the Padre Dam facility is constructed with solids treatment processes, the TS influent to PLWTP would be reduced by approximately 8%. In both cases, the net impact to MBC is insignificant; improvements required at MBC will not change based on this minor reduction in solids.

Although of no impact to MBC, the increase in capacity of the Padre Dam facility has the potential to divert flow away from MPS, which is one of the primary sources supplying wastewater to NCWRP and NCPWF. The MPS predesign team investigated this scenario during preparation of the 10% EDR for MPS, but the final designer would need to conduct a more detailed analysis of wastewater flows available at MPS. The largest impact to MBC's capacity remains the NCWRP Expansion. The South Bay Water Reclamation Plant (SBWRP) was also assumed to remain operational (approximately 12.8 mgd influent flow) with its solids returned to sewer, but without expansion or addition of NCPWF.

The project team understands that there are differences between the maximum-day flows developed during modeling (see Appendices B and C) and the proposed biosolids-wasting strategy described in the 10% EDR for NCWRP (32). The strategy limits the flow of biosolids from NCWRP back to MBC based on the capacity of the existing pumps and assumes that the pipeline, which is currently displaying high head loss, will be restored to original conditions and reduced head loss. However, the average daily flow estimated by the model is only 2% higher than the maximum flow in the EDR. To be conservative in assessing impacts to MBC, and recognizing that the 16-inch-diameter biosolids conveyance pipeline could be returned to normal operating condition, the model assumes constant solids concentration of 0.5% returning to MBC. If the intent is to cap the flow of biosolids, the selected design consultant for the 10% predesign for MBC should reassess the impacts of lower flows and higher solids concentrations, which results in the same mass-loading rate (refer to Section 9).

Inputs to the model included flow and wastewater quality data. Table 4-2 presents the influent flows at NCWRP based on the results of prior analysis conducted for Pure Water. The wastewater quality data used were the same as those used in the *Alternatives Analysis*, and are based on review of historical data and field sampling data. The input parameters were BOD, TSS, and plant influent flow (average daily flow). All models were run to simulate average daily flow conditions and peaking factors developed during the *Alternatives Analysis*.
Table 4-3 summarizes these peaking factors.

Table 4-2: Wastewater Quality and Flows Used as Modeling Input

Parameter	Phase I	Phase II	Comments
Point Loma Wastewater Treatment Plant			
Flow	179.9 MGD	186 MGD	
TSS Concentration	297 mg/L	297 mg/L	
BOD Concentration	297 mg/L	297 mg/L	
VSS Concentration	223 mg/L	223 mg/L	
North City Water Reclamation Plant			
Flow	32.9 MGD	51.9 MGD	Conditions presented represent base NPR
TSS Concentration	330 mg/L	330 mg/L	Demand. flows are lower at minimum NPR
BOD Concentration	275 mg/L	275 mg/L	Demand and higher at maximum NPR demand
VSS Concentration	271 mg/L	271 mg/L	
Padre Dam Municipal Water District Facility			
Flow	3 MGD	3 MGD	Facility returns solids to sewer for
TSS Concentration	244 mg/L	244 mg/L	Processing at Point Loma Wastewater
BOD Concentration	324 mg/L	324 mg/L	Treatment Plant
VSS Concentration	183 mg/L	183 mg/L	
South Bay Water Reclamation Facility			
Flow	12.4 MGD	12.8 MGD	Facility returns solids to sewer for
TSS Concentration	306 mg/L	306 mg/L	Processing at Point Loma Wastewater
BOD Concentration	354 mg/L	354 mg/L	Treatment plant
VSS Concentration	230 mg/L	230 mg/L	

Table 4-3: Future MBC Hydraulic and Solids Loading Peaking Factors			
Peak Duration	**Hydraulic Peaking Factor**	**Total Solids Loading Peaking Factor**	**Volatile Solids Loading Peaking Factor (1)**
Peak day	1.53	1.57	1.61
Peak 7-day	1.19	1.21	1.22
Peak 14-day	1.11	1.12	1.13
Peak 30-day	1.08	1.08	1.09

(1) No peaking factor; either hydraulic or solids loading is applied to FOG addition.

4.1.2 Projected Conditions: Phase I (15 mgd production at NCPWF)

The City is considering several alternatives for expansion of NCWRP. One of the alternatives is phased expansion. In this approach, Phase I expansion would target production of an average of approximately 16.6 mgd purified water at NCPWF. This includes the target purified water production rate of 15 mgd together with in-plant demands and system-wide losses of 1%. The purified water sent to the reservoir for augmentation would vary seasonally between 13.4 and 19.7 mgd, depending on the NPR demand.

Increased flows following Phase I upgrades at NCWRP would result in a nearly three-fold increase in the solids stream hydraulic load to the thickening and digestion processes at MBC at maximum NPR demand conditions. The total and volatile solids would increase accordingly. The digested biosolids from PLWTP conveyed to MBC would increase moderately by 15% as a result of increased influent flow to the PLWTP.

As stated earlier, the volatile solids loading in the NCWRP raw solids will increase in proportion to the increase in hydraulic loading for all scenarios. However, for scenarios involving FOG addition, the increase will be even greater. It is anticipated that 60,000 gpd of FOG addition will introduce approximately 30,000 lb/d of volatile solids to the digesters (39). This coupled with the increased loading due to NCWRP results in an increase of 350% in volatile solids loading. Results of the modeling for all Phase I conditions are presented in Appendix B. Figure 4-1 presents projected flows and loads under average flow conditions for scenarios A.1 through C.1. Figure 4-2 presents scenarios A.2 through C.2. See Appendix B for values at peak day flows.

Table 4-4 presents selected results of modeling from the *Alternatives Analysis* that show that total phosphorus (TP) in the solids stream is expected to be 112 mg/L during average conditions and 164 mg/L during peak conditions. The phosphorus will be bound to iron because of ferrous chloride ($FeCl_2$) addition in the collection system and ferric chloride addition at the primary clarifiers' and tertiary filters' influent. Struvite ($NH_4Mg_4PO_4{\cdot}6H_2O$) precipitation has not been an issue historically at MBC and is not expected to be issue in the future either.

OUTPUT FROM TEACUPS

	FLOW	TSS	VSS
A.1	2.90	124,600	94,800
B.1	2.90	124,600	94,800
C.1	2.90	124,600	94,800

THICKENING CENTRATE

	FLOW	TSS	VSS
A.1	2.64	12,500	9,500
B.1	2.64	12,500	9,500
C.1	2.64	12,500	9,500

PLWTP DIGESTED SOLIDS

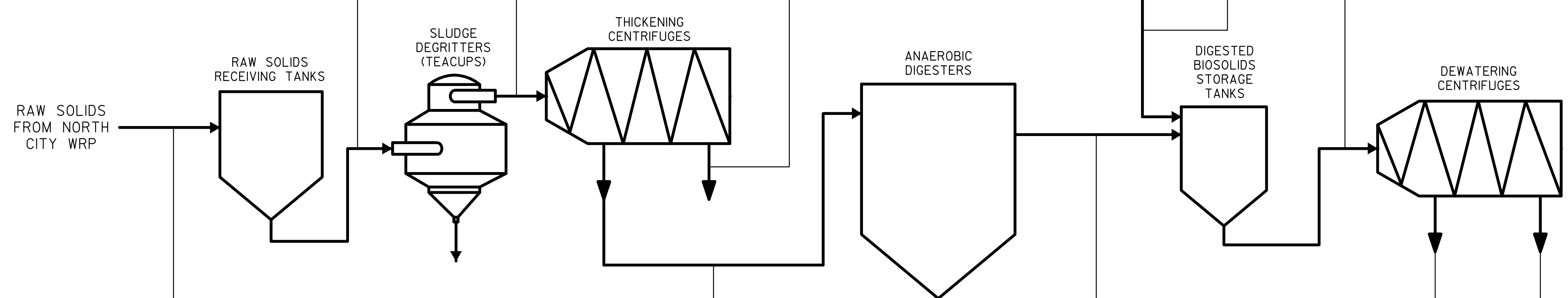
	FLOW	TSS	VSS
A.1	1.24	282,000	139,100
B.1	1.24	282,500	139,400
C.1	1.24	282,100	139,100

RAW SOLIDS TO TEACUPS

	FLOW	TSS	VSS
A.1	2.90	124,600	94,800
B.1	2.90	124,600	94,800
C.1	2.90	124,600	94,800

TO DEWATERING CENTRIFUGES

	FLOW	TSS	VSS
A.1	1.50	349,800	180,100
B.1	1.56	365,700	193,700
C.1	1.56	350,600	178,800



RAW SOLIDS

	FLOW	TSS	VSS
A.1	2.90	124,600	94,800
B.1	2.90	124,600	94,800
C.1	2.90	124,600	94,800

THICKENED SOLIDS

	FLOW	TSS	VSS
A.1	0.26	112,100	85,300
B.1	0.26	112,100	85,300
C.1	0.26	112,100	85,300

NCWRP DIGESTED SOLIDS

	FLOW	TSS	VSS
A.1	0.26	67,800	41,000
B.1	0.32	83,300	54,400
C.1	0.32	68,500	39,600

DEWATERED CAKE TO DISPOSAL

	FLOW	TSS	VSS
A.1	0.13	332,300	171,100
B.1	0.14	347,500	184,100
C.1	0.13	333,100	169,800

DEWATERING CENTRATE

	FLOW	TSS	VSS
A.1	1.36	17,500	9,000
B.1	1.42	18,300	9,700
C.1	1.42	17,500	8,900

NOTES:

1. SCENARIOS A, B, AND C REPRESENT NO FOG ADDITION, FOG ADDITION, AND FOG ADDITION WITH LYSTEK PROCESS RESPECTIVELY.
2. SCENARIO 1 (AS IN A.1 AND B.1) REPRESENTS A MODELING ASSUMPTION OF 52% VSS REDUCTION IN THE DIGESTERS.
3. SCENARIO C.1 REPRESENTS A MODELING ASSUMPTION OF 65% VSS REDUCTION IN THE DIGESTERS. THE RATE IS HIGHER THAN SCENARIOS A AND B ON ACCOUNT OF THE LYSTEK PROCESS.
4. HYDRAULIC LOADING REPRESENTS AN NCPWF PRODUCTION OF 15 MGD. REFER TO SECTION 9 OF THIS MEMORANDUM FOR FURTHER DETAILS.
5. HYDRAULIC LOADING REPRESENTS AN NCPWF PRODUCTION OF 30 MGD. REFER TO SECTION 9 OF THIS MEMORANDUM FOR FURTHER DETAILS.

KEY:

PROCESS STREAM			
	FLOW	TSS	VSS
SCENARIO	IN MGD	IN LB/DAY	IN LB/DAY

Brown AND Caldwell

DATE: AUG 12, 2016

SIMPLIFIED PROCESS FLOW DIAGRAM OF MBC WITH PHASE I, SCENARIO 1 FLOWS AND LOADS AT MAXIMUM NON-POTABLE REUSE, AVERAGE ANNUAL DAILY FLOW MIRAMAR LAKE ALTERNATIVE

FIGURE 4-1

OUTPUT FROM TEACUPS

	Flow	TSS	VSS
A.2	2.90	124,600	94,800
B.2	2.90	124,600	94,800
C.2	2.90	124,600	94,800

THICKENING CENTRATE

	Flow	TSS	VSS
A.2	2.64	12,500	9,500
B.2	2.64	12,500	9,500
C.2	2.64	12,500	9,500

PLWTP DIGESTED SOLIDS

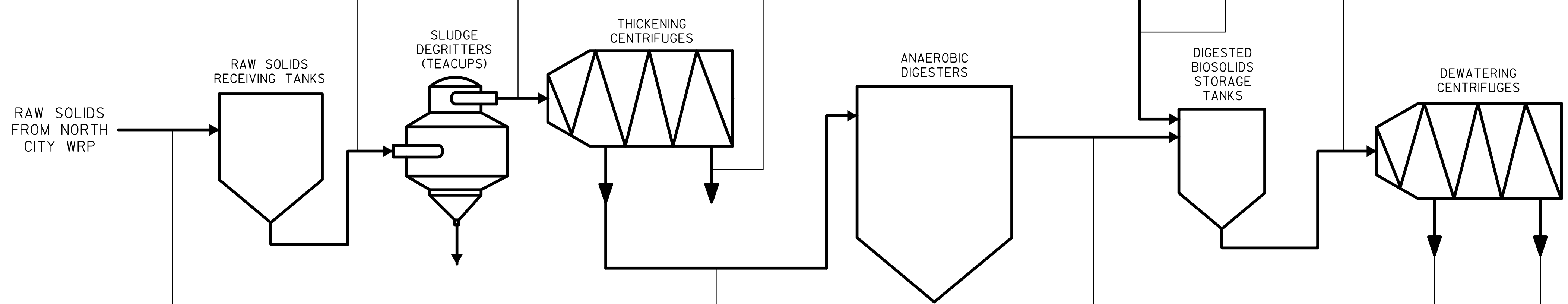
	Flow	TSS	VSS
A.2	1.24	282,200	139,200
B.2	1.24	282,700	139,500
C.2	1.24	282,300	139,300

RAW SOLIDS TO TEACUPS

	Flow	TSS	VSS
A.2	2.90	124,600	94,800
B.2	2.90	124,600	94,800
C.2	2.90	124,600	94,800

TO DEWATERING CENTRIFUGES

	Flow	TSS	VSS
A.2	1.50	355,000	185,300
B.2	1.56	372,700	200,600
C.2	1.56	359,300	187,400



RAW SOLIDS

	Flow	TSS	VSS
A.2	2.90	124,600	94,800
B.2	2.90	124,600	94,800
C.2	2.90	124,600	94,800

THICKENED SOLIDS

	Flow	TSS	VSS
A.2	0.26	112,100	85,300
B.2	0.26	112,100	85,300
C.2	0.26	112,100	85,300

NCWRP DIGESTED SOLIDS

	Flow	TSS	VSS
A.2	0.26	72,900	46,100
B.2	0.32	90,100	61,200
C.2	0.32	77,000	48,100

DEWATERED CAKE TO DISPOSAL

	Flow	TSS	VSS
A.2	0.13	337,300	176,000
B.2	0.14	354,100	190,600
C.2	0.14	341,400	178,000

DEWATERING CENTRATE

	Flow	TSS	VSS
A.2	1.36	17,800	9,300
B.2	1.42	18,600	10,000
C.2	1.42	18,000	9,400

NOTES:

1. SCENARIOS A, B, AND C REPRESENT NO FOG ADDITION, FOG ADDITION, AND FOG ADDITION WITH LYSTEK PROCESS RESPECTIVELY.
2. SCENARIO 2 (AS IN A.2 AND B.2I) REPRESENTS A MODELING ASSUMPTION OF 46% VSS REDUCTION IN THE DIGESTERS.
3. SCENARIO C.2 REPRESENTS A MODELING ASSUMPTION OF 65% VSS REDUCTION IN THE DIGESTERS. THE RATE IS HIGHER THAN SCENARIOS A AND B ON ACCOUNT OF THE LYSTEK PROCESS.
4. HYDRAULIC LOADING REPRESENTS AN NCPWF PRODUCTION OF 15 MGD. REFER TO SECTION 9 OF THIS MEMORANDUM FOR FURTHER DETAILS.
5. HYDRAULIC LOADING REPRESENTS AN NCPWF PRODUCTION OF 30 MGD. REFER TO SECTION 9 OF THIS MEMORANDUM FOR FURTHER DETAILS.

KEY:

PROCESS STREAM			
	FLOW	TSS	VSS
SCENARIO	IN MGD	IN LB/DAY	IN LB/DAY

Brown AND Caldwell

DATE: AUG 12, 2016

SIMPLIFIED PROCESS FLOW DIAGRAM OF MBC WITH PHASE I, SCENARIO 2 FLOWS AND LOADS AT MAXIMUM NON-POTABLE REUSE, AVERAGE ANNUAL DAILY FLOW
MIRAMAR LAKE ALTERNATIVE

FIGURE 4-2

Table 4-4: MBC Influent Nutrient Concentrations		
Parameter	Annual Avg. (mg/L)	Peak Day (mg/L)
Total phosphorus	112	164
Total Kjeldahl nitrogen (TKN)	183	135
Ammonia-nitrogen (NH_3-N)	24	28

All soluble phosphorus in excess of 0.8 mg-P/L is expected to be iron-bound. Struvite is more prevalent with plants that perform enhanced biological phosphorus removal (BioP) because of the higher concentration of phosphorus in the sludge. In addition, BioP sludges will contain higher concentrations of magnesium. However, iron-bound phosphorus is capable of producing vivianite ($Fe^{+2}Fe_2^{+2}(PO_4)2 \cdot 8H_2O$), which might be a potential concern at MBC in the future. When vivianite forms in heat exchangers (HEXs), it is difficult to clean and degrades performance.

The method of iron salts addition is particularly important as it relates to vivianite formation. For instance, if addition occurs in the digester heating recirculation piping, excessive formation in the HEX can result. In contrast, addition of iron salts at the primary clarifier inlet is less likely to result in excessive HEX vivianite formation and is therefore a preferred addition point. Regardless, digester recirculation lines and HEXs should be inspected routinely at any facility where iron salts are employed to determine if excessive vivianite accumulation is occurring.

Modeling results indicate that the TKN in the solids stream will average 183 mg/L, and drop to 135 mg/L during peak hydraulic flow. The ammonia concentration in the solids stream is anticipated to be 24 mg/L during average hydraulic conditions, and will increase to 28 mg/L during peak hydraulic flow conditions. Both these parameters compare favorably with current conditions and do not represent any significant increases in concentration. However, the total load would increase corresponding to the increase in hydraulic loading.

4.1.3 Projected Conditions: Phase II (30 mgd production at NCPWF)

Phase II expansion of NCWRP will target production of an average of approximately 33.2 mgd purified water at NCPWF. This includes the target purified water production rate of 30 mgd together with in-plant demands and system-wide losses of 1%. The purified water sent to the reservoir for augmentation will vary seasonally between 23.4 and 32.8 mgd, depending on the NPR demand.

Increased flows following Phase II upgrades at NCWRP would result in a 50% increase compared to Phase I flows at maximum NPR demand conditions. This represents a five-fold increase in the solids stream hydraulic load at projected peak day flows compared to current conditions. The total and volatile solids would correspondingly increase. The digested biosolids from PLWTP conveyed to MBC would increase slightly from Phase I to about 116% of current values because of increased influent flow to PLWTP. In general, the dewatering process is impacted more by NCWRP flow streams compared to PLWTP streams.

For scenarios involving FOG addition, the volatile solids content of the FOG in addition to higher solids from NCWRP results in an increase of more than 5 times the current value. Results of the modeling for Phase II conditions are presented in Appendix A2. The total phosphorus, TKN, and ammonia concentrations are not anticipated to change during Phase II. Table 4-4 shows that they will remain similar to Phase I values; however, the loading will increase corresponding to the increased hydraulic load.

Results of the modeling for all Phase II conditions are presented in Appendix C. Figure 4-3 shows projected flows and loads under average flow conditions for scenarios A.1 through C.1. Figure 4-4 shows projected flows and loads under average flow conditions for scenarios A.2 through C.2. See Appendix C for values at peak day flows.

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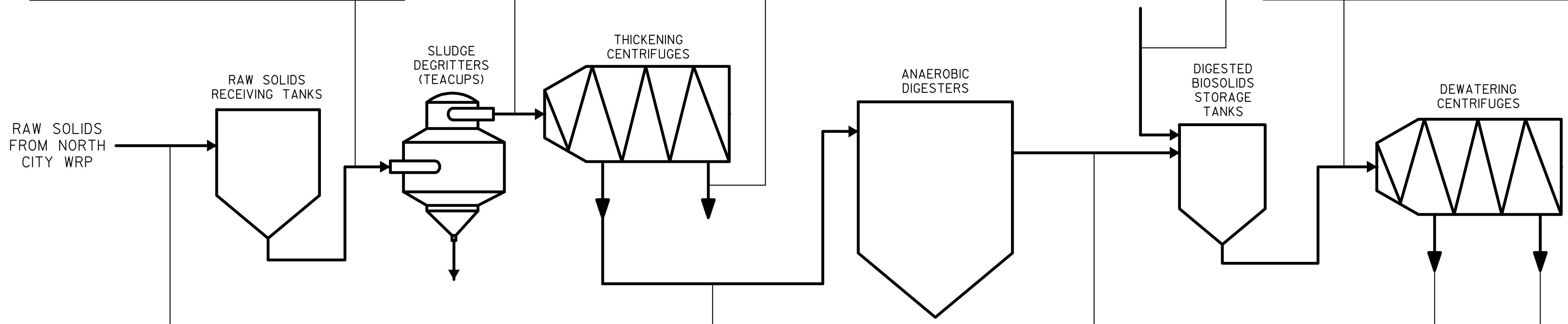
OUTPUT FROM TEACUPS	FLOW	TSS	VSS
A.1	4.28	183,900	140,000
B.1	4.28	183,900	140,000
C.1	4.28	183,900	140,000

THICKENING CENTRATE	FLOW	TSS	VSS
A.1	3.89	18,400	14,000
B.1	3.89	18,400	14,000
C.1	3.89	18,400	14,000

PLWTP DIGESTED SOLIDS	FLOW	TSS	VSS
A.1	1.15	262,300	129,300
B.1	1.15	262,800	129,500
C.1	1.15	262,200	129,200

RAW SOLIDS TO TEACUPS	FLOW	TSS	VSS
A.1	4.28	183,900	140,000
B.1	4.28	183,900	140,000
C.1	4.28	183,900	140,000

TO DEWATERING CENTRIFUGES	FLOW	TSS	VSS
A.1	1.53	362,400	189,800
B.1	1.59	378,300	203,400
C.1	1.59	357,800	183,100



RAW SOLIDS	FLOW	TSS	VSS
A.1	4.28	183,900	140,000
B.1	4.28	183,900	140,000
C.1	4.28	183,900	140,000

THICKENED SOLIDS	FLOW	TSS	VSS
A.1	0.39	165,500	126,000
B.1	0.39	165,500	126,000
C.1	0.39	165,500	126,000

NCWRP DIGESTED SOLIDS	FLOW	TSS	VSS
A.1	0.38	100,000	60,500
B.1	0.44	115,500	73,900
C.1	0.44	95,500	53,900

DEWATERED CAKE TO DISPOSAL	FLOW	TSS	VSS
A.1	0.14	344,300	180,300
B.1	0.14	359,400	193,200
C.1	0.14	339,900	173,900

DEWATERING CENTRATE	FLOW	TSS	VSS
A.1	1.39	18,100	9,500
B.1	1.45	18,900	10,200
C.1	1.46	17,900	9,200

NOTES:

1. SCENARIOS A, B, AND C REPRESENT NO FOG ADDITION, FOG ADDITION, AND FOG ADDITION WITH LYSTEK PROCESS RESPECTIVELY.
2. SCENARIO 1 (AS IN A.1 AND B.1) REPRESENTS A MODELING ASSUMPTION OF 52% VSS REDUCTION IN THE DIGESTERS.
3. SCENARIO C.1 REPRESENTS A MODELING ASSUMPTION OF 65% VSS REDUCTION IN THE DIGESTERS. THE RATE IS HIGHER THAN SCENARIOS A AND B ON ACCOUNT OF THE LYSTEK PROCESS.
4. HYDRAULIC LOADING REPRESENTS AN NCPWF PRODUCTION OF 15 MGD. REFER TO SECTION 9 OF THIS MEMORANDUM FOR FURTHER DETAILS.
5. HYDRAULIC LOADING REPRESENTS AN NCPWF PRODUCTION OF 30 MGD. REFER TO SECTION 9 OF THIS MEMORANDUM FOR FURTHER DETAILS.

KEY:

PROCESS STREAM	FLOW	TSS	VSS
SCENARIO	IN MGD	IN LB/DAY	IN LB/DAY

Brown AND Caldwell

DATE: AUG 12, 2016

SIMPLIFIED PROCESS FLOW DIAGRAM OF MBC WITH PHASE II, SCENARIO 1 FLOWS AND LOADS AT MAXIMUM NON-POTABLE REUSE, AVERAGE ANNUAL DAILY FLOW
MIRAMAR LAKE ALTERNATIVE

FIGURE 4-3

File: 4-3 Path: P:\Projects\San Diego, City Of (CA)\Pure Water Program\TO18 - Impact Of NCWRP Expansion On MBC\CADD\10-FIGURES Date: August 10, 2016 6:28 PM User: Eric Stiles

OUTPUT FROM TEACUPS

	Flow	TSS	VSS
A.2	4.28	183,900	140,000
B.2	4.28	183,900	140,000
C.2	4.28	183,900	140,000

THICKENING CENTRATE

	Flow	TSS	VSS
A.2	3.89	18,400	14,000
B.2	3.89	18,400	14,000
C.2	3.89	18,400	14,000

PLWTP DIGESTED SOLIDS

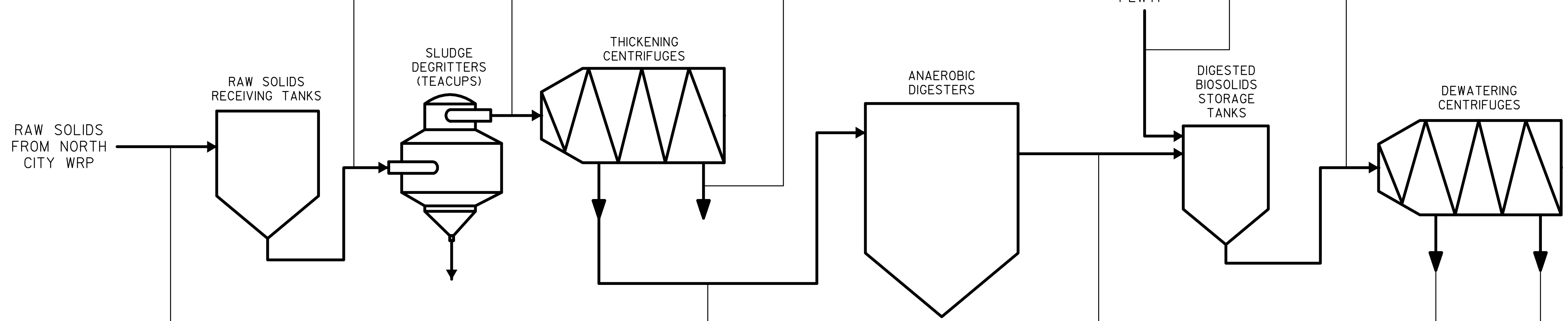
	Flow	TSS	VSS
A.2	1.15	262,600	129,400
B.2	1.15	263,100	129,700
C.2	1.15	262,600	129,400

RAW SOLIDS TO TEACUPS

	Flow	TSS	VSS
A.2	4.28	183,900	140,000
B.2	4.28	183,900	140,000
C.2	4.28	183,900	140,000

TO DEWATERING CENTRIFUGES

	Flow	TSS	VSS
A.2	1.53	370,100	197,400
B.2	1.60	387,800	212,800
C.2	1.59	369,600	194,800



RAW SOLIDS

	Flow	TSS	VSS
A.2	4.28	183,900	140,000
B.2	4.28	183,900	140,000
C.2	4.28	183,900	140,000

THICKENED SOLIDS

	Flow	TSS	VSS
A.2	0.39	165,500	126,000
B.2	0.39	165,500	126,000
C.2	0.39	165,500	126,000

NCWRP DIGESTED SOLIDS

	Flow	TSS	VSS
A.2	0.38	107,600	68,000
B.2	0.44	124,800	83,100
C.2	0.44	107,100	65,400

DEWATERED CAKE TO DISPOSAL

	Flow	TSS	VSS
A.2	0.14	351,600	187,600
B.2	0.15	368,400	202,200
C.2	0.14	351,200	185,100

DEWATERING CENTRATE

	Flow	TSS	VSS
A.2	1.39	18,500	9,900
B.2	1.45	19,400	10,600
C.2	1.45	18,500	9,700

NOTES:

1. SCENARIOS A, B, AND C REPRESENT NO FOG ADDITION, FOG ADDITION, AND FOG ADDITION WITH LYSTEK PROCESS RESPECTIVELY.
2. SCENARIO 2 (AS IN A.2 AND B.2)) REPRESENTS A MODELING ASSUMPTION OF 46% VSS REDUCTION IN THE DIGESTERS.
3. SCENARIO C.2 REPRESENTS A MODELING ASSUMPTION OF 65% VSS REDUCTION IN THE DIGESTERS. THE RATE IS HIGHER THAN SCENARIOS A AND B ON ACCOUNT OF THE LYSTEK PROCESS.
4. HYDRAULIC LOADING REPRESENTS AN NCPWF PRODUCTION OF 15 MGD. REFER TO SECTION 9 OF THIS MEMORANDUM FOR FURTHER DETAILS.
5. HYDRAULIC LOADING REPRESENTS AN NCPWF PRODUCTION OF 30 MGD. REFER TO SECTION 9 OF THIS MEMORANDUM FOR FURTHER DETAILS.

KEY:

PROCESS STREAM			
	FLOW	TSS	VSS
SCENARIO	IN MGD	IN LB/DAY	IN LB/DAY

Brown AND Caldwell

DATE: AUG 12, 2016

SIMPLIFIED PROCESS FLOW DIAGRAM OF MBC WITH PHASE II, SCENARIO 2 FLOWS AND LOADS AT MAXIMUM NON-POTABLE REUSE, AVERAGE ANNUAL DAILY FLOW MIRAMAR LAKE ALTERNATIVE

FIGURE 4-4

5 Projected Impacts on Selected Unit Processes

5.1 Grit Removal System

5.1.1 Existing Conditions

5.1.1.1 Existing Facilities

The Grit Removal Facility is located in Area 76, adjacent to the centrifugation process. The facility receives raw solids from the receiving tanks and separates grit from this stream. The process is important because grit carried over to the centrifuges located downstream can result in excessive wear and tear, requiring expensive replacement parts and excessive time out of service.

In addition, excessive grit accumulation can reduce the effectiveness of the existing anaerobic digesters. Historically, this accumulation has not been a significant concern because surplus available digester capacity has allowed the City to take digesters off line for extended periods for cleaning with minimal impact on plant operations. However, the proposed increases in flows and loads to the digesters will require that all three digesters be in service. If there are no plans for construction of a fourth digester, this constraint will increase the importance of grit removal to maximize digester performance and minimize the frequency of digester cleaning operations.

5.1.1.1.a Raw Solids Feed Pumps

The Receiving Tanks Complex is equipped with three raw solids feed pumps (73-P-21 through 73-P-23) that draw from the tanks and supply a feed loop serving the thickening centrifuges. The custom-engineered horizontal non-clog centrifugal pumps are capable of being operated at variable speeds because they are equipped with VFDs. Each pump has a rated output of 1,563 gallons per minute (gpm) (2.25 mgd) at 91 feet of head when operating at the maximum speed of 1,750 revolutions per minute (rpm). The grit removal process is located at the upstream end of this loop, which eventually discharges back to the receiving tanks. The thickening centrifuge feed pumps draw from this loop and convey solids to the thickening centrifuges.

The piping for the loop consists of a 14-inch-diameter supply pipeline to the teacup grit separators and thickening centrifuges, and an 8-inch-diameter return pipeline from the downstream side of the thickening centrifuges to the raw-solids-receiving tank. Maximum supply velocity to the grit separators with two pumps in service at the rated duty point is approximately 6 feet per second (fps).

5.1.1.1.b Cyclone Grit Separators (Teacups)

Grit removal is accomplished by three Eutek cyclone grit separators (76-GSR-01 through 76-GSR-03), also known as “teacups.” Each unit is 76 inches in diameter, operates at approximately 25 pounds per square inch (psi) pressure, and has a rated capacity of 1.5 mgd. The raw solids stream enters the unit tangentially and the degritted stream exits at the top of the unit. The tangential entry creates a cyclonic flow path within the teacup, causing grit to separate and drop to the conical bottom. The collected grit is then discharged from the cone via an underflow drain. With two duty pumps supplying two duty separators, the maximum return flow to the solids storage tanks is 1.5 mgd. The corresponding velocity in the 8-inch-diameter return line is 6 fps for a return flow of 1.5 mgd.

5.1.1.1.c Grit Dewatering

The separated grit discharged from the cones of the grit separators is conveyed to the grit-dewatering process. This consists of a clarifier where grit is separated from organic material. The grit is moved upward on a conveyor system, also known as a snail, containing a slow-moving conveyor with horizontally oriented slats. As the conveyor moves, water drains from the washed grit and is returned to the clarifier.

The grit is discharged from the snails into a shaftless screw conveyor system. Two clarifiers and snails are installed and together serve the three teacups. Each clarifier and snail is sized to handle approximately 4,550 pounds per hour (lb/hr) of grit, which is the output of each teacup at rated capacity of 1.5 mgd raw solids flow.

5.1.1.1.d Grit Screw Conveyors

The grit discharged by the snails is conveyed by two shaftless screw conveyors (76-GO-01 and 76-GO-02) approximately 25 feet in length each, powered by a 1.5 hp motor with reducing gearbox. The conveyors contain a 16-inch-diameter spiral shaftless screw set for 5 rpm constant speed, inside a U-shaped trough. The trough is covered for controlling odors, but is equipped with inspection doors and removable covers. Each conveyor is capable of discharging to one of two roll-off bins, which have a capacity of 25 cubic yards (yd^3) each.

5.1.1.2 Current Operating Parameters and Performance

During normal operation, one raw solids feed pump is in operation, with the second available for use as a lag pump. The third pump remains in standby. Each pump motor also has a VFD and can thus be operated at different speeds. One grit separator is normally in operation with two units in standby. During peak conditions, two units are in operation with the third in standby mode.

City staff indicated that only one grit separator is currently in service because the second one is out of service for maintenance and the third one is in need of complete refurbishment. The system is also equipped with a means to bypass the grit separators completely; however, this mode is typically not used because of the possibility of damage to the centrifuges. Under normal conditions, the two roll-off bins reach their weight limit over 6 weeks and are then hauled off for disposal of grit. Table 5-1 provides a summary of existing conditions.

City staff has also noted that the grit separators worked very well when newly installed but have experienced a decline in performance over recent years. Inadequate technical support from the manufacturer has been an ongoing issue in properly maintaining the units and getting replacement parts. Another issue noted by staff is the impact of routine cleaning of the grit separators on the raw solids feed loop pressures. High-pressure water cleaning cycles cause spikes in the feed loop pressure, in turn affecting the thickening centrifuge feed pumps.

Table 5-1: Grit Removal Facilities - System Design Criteria and Current Operating Conditions for the Existing System							
Parameter	Unit of Measure	System Design Capacity		Estimated Firm	Current Operating Conditions		Comments
		Avg.	Max.	capacity	Avg.	Max.	
Raw solids feed pumps [1]	MGD	4.3	4.5	4.1	0.87	0.93	Ex. System adequate to handle current loads
	gpm	3,000	3,126	2,813	604	646	
Cyclone separators (Teacups)	MGD	N/A	3.0	3.0	0.87	0.93	Ex. System adequate to handle current loads
	gpm		2,084	2,084	604	646	
Grit dewatering	lb/hr		4,550	4,095	24	46	Ex. System adequate to handle current loads[1]

(1) Based on data from 2012 through April 2014.

5.1.2 Projected Conditions: Phase I (15 mgd production at AWTF) and Phase II (30 mgd production at AWTF)

5.1.2.1 Summary

The flow rate of raw solids from NCWRP is projected to increase significantly following plant expansion. Table 5-2 shows that although the existing raw solids feed pumps would be adequate for handling increased average flows following Phase I expansion, they would be unable to handle peak flows. The solids pumps would also be inadequate for handling average and peak Phase II flows, which are several times higher than current flows. Similarly, the existing grit separators would be adequate for handling Phase I average flows, but not peak flows.

Table 5-2: Grit Removal Facilities - System Design Criteria and Projected Operating Conditions									
Parameter	Unit of Measure	System Design Capacity		Estimated Firm Capacity	Phase I Operating Conditions [1]		Phase II Operating Conditions [1]		Comments
		Avg.	Max.		Avg.	Max.	Avg.	Max.	
Raw Solids Feed Pumps	MGD	4.3	4.5	4.1	2.90	4.43	4.28	6.55	System inadequate for Phase I and Phase II loads
	gpm	3,000	3,126	2,813	2,014	3,076	2,972	4,548	
Cyclone Separators (Teacups)	MGD	N/A	3.0	3.0	2.90	4.43	4.28	6.55	System inadequate for Phase I and Phase II loads
	gpm		2,084	2,084	2,014	3,076	2,972	4,548	

Table 5-2: Grit Removal Facilities - System Design Criteria and Projected Operating Conditions									
Parameter	**Unit of Measure**	**System Design Capacity**		**Estimated Firm Capacity**	**Phase I Operating Conditions (1)**		**Phase II Operating Conditions (1)**		**Comments**
		Avg.	**Max.**		**Avg.**	**Max.**	**Avg.**	**Max.**	
Grit Dewatering (2)	lb/hr		4,550	4,095	80	219	118	324	System inadequate for Phase I and Phase II loads (3)

(1) Flow values based on results of the flow and mass balance modeling. Refer to section 3.1.

(2) Phase i and phase ii operating conditions have been extrapolated from existing operating conditions data and are not based on modeling.

(3) Although system has capacity to handle additional loads, it is typical to have a dedicated grit dewatering system for each cyclone separator.

Auxiliary processes such as grit dewatering are limited by upstream processes such as grit separation. The existing dewatering equipment is capable of handling output from two grit separators but would require additional units in place for handling more flow. The screw conveyors would likewise require additional units to service the new clarifier and dewatering systems. The two new teacups should be provided with a new return pipeline to convey solids back to the receiving tanks, or the existing 8-inch-diameter return line would need to be upsized to handle the increased flows. The raw solids feed pipeline is adequate to handle future loads, but would operate at velocities close to 10 fps during peak events and at approximately 6 fps at average conditions.

5.1.2.2 Required Equipment Improvements

Process improvements will be required for handling future flows from NCWRP. These improvements will upsize existing equipment, or provide additional units to handle the increased flows. Construction of these improvements will require engineering design and preparation of construction documents including design drawings and specifications. Table 5-3 and Table 5-4, respectively, summarize the following improvements:

- Replace all three raw solids feed pumps with new ones of higher capacity during Phase I
- Expand Grit Removal Facility building during Phase I
- Install one new grit separator to handle Phase I flows
- Install one new clarifier, snail, and screw conveyor during Phase I
- Install a second new grit separator during Phase II
- Install a second clarifier, snail, and screw conveyor during Phase II

Because of the requirement to replace all three raw solids feed pumps during Phase I, it would be more efficient to also install both grit separators and their auxiliary equipment during Phase I. The required improvements are shown schematically in Figure 5-1.

Table 5-3: Grit Removal Facilities - Phase I Projected Equipment Improvements and Phase I Operating Conditions												
Equipment Subsystem	**Unit of Measure**	**Phase I Improvements**								**Phase I Operating Conditions**		**Capacity Assessment**
		No. Of units under max conditions				**Capacity**			**Summary of Improvements**			
		Status	**Total**	**Duty**	**Standby**	**Unit Capacity**	**Rated Capacity**	**Firm Capacity**		**Avg.**	**Max.**	
Raw Solids Feed Pumps	gpm	Existing	3	2	1	1563	3,126	2,813				
	gpm	**New**	**3**	**2**	**1**	**2500**	**5,000**	**4,500**	Remove all existing pumps and			
TOTAL	**gpm**		**3**	**2**	**1**			**4,500**	Replace with larger pumps	2,014	3,076	Firm capacity > Phase I max
	MGD									2.90	4.43	
Cyclone Separators	gpm	Existing	3	2	1	1042	2,084	2,084	Expand grit removal facility			
	gpm	**New**	**1**	**1**	**0**	**1042**	**1,042**	**1,042**	Building and add one new			
TOTAL	**gpm**		**4**	**3**	**1**			**3,126**	Cyclone separator	2,014	3,076	Firm capacity > Phase I max
	MGD									2.90	4.43	
Grit Dewatering	lb/hr	Existing	2	2	0	4550	9,100	8,190	Add one clarifier, snail, and			
	lb/hr	**New**	**1**	**1**	**0**	**4550**	**4,550**	**4,095**	Screw conveyor			
TOTAL	**lb/hr**		**3**	**3**	**0**			**12,285**		80	219	Firm capacity > Phase I max (1)

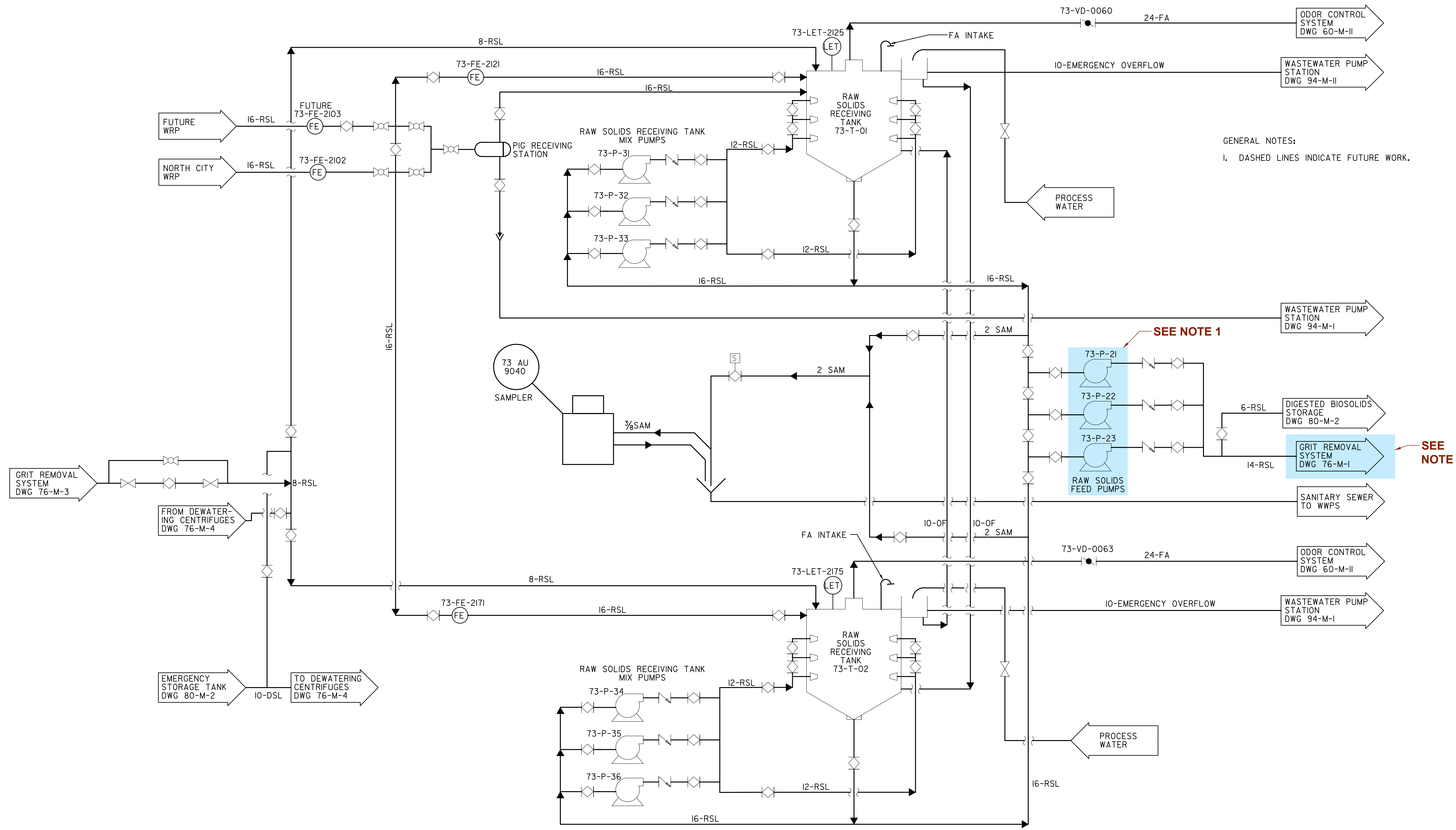
(1) The need for a new grit dewatering system does not depend on capacity. rather, it is typical to provide each cyclone separator with a dedicated grit dewatering system.

Table 5-4: Grit Removal Facilities - Phase II Projected Equipment Improvements and Phase II Operating Conditions

Equipment Subsystem	Unit of Measure	Phase II Improvements								Phase II Operating Conditions		Capacity Assessment
		No. Of units under max conditions				Capacity			Summary of Improvements			
		Status	Total	Duty	Standby	Unit Capacity	Rated Capacity	Firm Capacity		Avg.	Max.	
Raw Solids Feed Pumps	gpm	PH I	3	2	1	2500	5,000	4,500	No improvements needed			Subsystem
TOTAL	**gpm**		**3**	**2**	**1**			**4,500**		2,972	4,548	Firm capacity > Phase II max
	MGD									4.28	6.55	
Cyclone Separators	gpm	PH I, EXIST	4	3	1	1042	3,126	3,126	Expand grit removal facility			
	gpm	**NEW**	**1**	**1**	**0**	**1042**	**1,042**	**1,042**	Building and add one new			
TOTAL	**gpm**		**5**	**4**	**1**			**4,168**	Cyclone separator	2,972	4,548	Firm capacity < Phase II max (1)
	MGD									4.28	6.55	
Grit Dewatering	lb/hr	PH I, EXIST	3	3	0	4550	13,650	12,285	Add one clarifier, snail, and			
	lb/hr	**NEW**	**1**	**1**	**0**	**4550**	**4,550**	**4,095**	Screw conveyor			Firm capacity > Phase II max (2)
TOTAL	**lb/hr**		**4**	**4**	**0**			**16,380**		118	324	

(1) Although maximum flow is higher than firm capacity, cyclone separators can be operated at higher than rated flow for short durations.

(2) The need for a new grit dewatering system does not depend on capacity. rather, it is typical to provide each cyclone separator with a dedicated grit dewatering system.



LEGEND:

- NCWRP EXPANSION (PURE WATER PROGRAM) UPGRADES
- FOG ADDITION UPGRADES
- OTHER RECOMMENDED IMPROVEMENTS

NOTES:

1. REPLACE ALL THREE EXISTING RAW SOLIDS FEED PUMPS WITH HIGHER CAPACITY PUMPS.
2. INSTALL TWO NEW SLUDGE DEGRITTERS (TEACUPS).
3. HYDRAULIC LOADING REPRESENTS AN NCPWF PRODUCTION OF 30 MGD. REFER TO SECTION 9 OF THIS TECHNICAL MEMORANDUM FOR FURTHER DETAILS.

IMPACTS OF NCWRP EXPANSION ON MBC

FIGURE 5-1

RAW SOLIDS FEED LOOP AND GRIT REMOVAL SYSTEM

5.2 Raw Solids Thickening System

5.2.1 Existing Conditions

5.2.1.1 Configuration and Firm Capacity of the Existing System

The raw solids thickening system concentrates (thickens) raw solids after grit removal (see Section 5.1). The system consists of sludge feed pumps, polymer feed pumps, thickening centrifuges, and thickened sludge (digester feed) pumps. Process schematics for the raw solids thickening system and its polymer system are included in Figure 5-2 and Figure 5-3, respectively.

The original design includes five progressive-cavity pumps (76-P-11 through 76-P-15)[4] that are configured to pump raw, degritted, un-thickened sludge to each of the five thickening centrifuges (76-TC-01 through 76-TC-05)[5] from the 14-inch-diameter raw solids distribution header. Each centrifuge is able to operate with its own dedicated sludge feed pump and its own dedicated polymer feed pump (76-P-21 through 76-P-25[6]). Raw un-thickened solids range from 0.50% to 0.75% by weight. Each of the five thickening centrifuges is able to discharge thickened sludge into a thickened solids wetwell at approximately 5% by weight. Centrate is combined with centrate from the dewatering centrifuges (Section 5.4), and the combined centrate flows by gravity to the centrate pump station (Section 5.5). Table 5-5 presents the firm capacities of the existing sludge thickening system.

Table 5-5: Sludge Thickening Facilities - System Design Criteria and Current Operating Conditions for the Existing System

Parameter	Unit of Measure	System Design Capacity		Estimated Firm System Capacity	Current Operating Conditions		Comments
		Avg.	Max.		Avg.	Max.	
Raw Sludge Feed Rate	MGD	N/A	3.24 (1)	2.59 (2)	0.81	0.89	Ex. System adequate to handle current loads.
Total Solids Loading	LB TSS/D	N/A	135,100 (3)	108,000	37,000 (6)	56,000 (6)	Ex. System adequate to handle current loads.
Polymer Feed Rate	gpm	N/A	60 (8)	48	5.03	13.1	Ex. System adequate to handle current loads.
Thickened Sludge Production	gpm	155 (4)	310 (5)	248	59 (6)	84 (6)	Ex. System adequate to handle current loads.
	% Solids	5.5	5.5	N/A	5.23 (6)	6.1 (6)	
	LB/D TSS	107,500	215,000	172,000	33,300 (7)	50,400 (7)	

(1) Raw sludge feed rate determined by thickening centrifuges as the limiting component at 750 gpm each. sludge feed pumps rated at 1000 gpm each

(2) Firm capacity based on running three units at 80% output with two units ready

(3) TSS loadings determined from the percent solids values listed in the operations student study guide: 0.33% to 0.5% max

(4) One pump in operation - lead pump

(5) Two pumps in operation - lead and lag pumps

(6) Based on operations data for 2013/2014

(7) Based on 90% removal efficiency at the centrifuge

(8) Based on running 3 polymer feed pumps at 20 gpm each max

[4] Seepex BN 300-6L, 300–1,000 gpm @ 28.1 psi, 50 hp, 1,780 rpm: gearbox ratio 6.7:1.

[5] Sharples PM-95000AD centrifuge, 750 gpm, main drive motor 300 hp, backdrive motor 60 hp.

[6] Seepex BN 10-6L, 5–20 gpm @ 50 psi, 5 hp, 1,760 rpm: gearbox ratio 7.99:1

Three progressive-cavity pumps (76-P-31 through 76-P-33) are able to take suction from the thickened solids wetwell and pump thickened raw sludge to the anaerobic digesters. The wetwell has an operating volume of 2,050 gallons per foot of depth. The wetwell air space is a Class I, Group D, Division 1 space, but plant operations typically keep the cover open to monitor the level in the wetwell. Wetwell level is a critical concern in operation of thickened sludge centrifuges. In addition, the original foul air connection to the wetwell has been capped to prevent high sludge level conditions from flooding the ductwork with thickened sludge.

One pump operates as a lead pump, one as a lag pump, and the third as a standby. The lead pump turns on at a wetwell depth of 5 feet and off at a depth of 3 feet; the lag pump is called if the depth reaches 10 feet and shuts off at a depth of 6 feet. In addition to the three thickened pumps, the wetwell was constructed with a 6-inch-diameter pipe spool to allow for connection of a fourth future pump.

The original thickened sludge pumps were replaced with units that have a higher pressure rating[7]. This replacement coincided with the City's decision to streamline the feed of thickened raw sludge to the digesters by directly pumping to the suction manifold of the digester mix pumps for each of the digesters. In the process of streamlining thickened sludge handling, the original sludge screens and screenings presses were decommissioned. For a more detailed discussion of this topic, see Section 5.3.

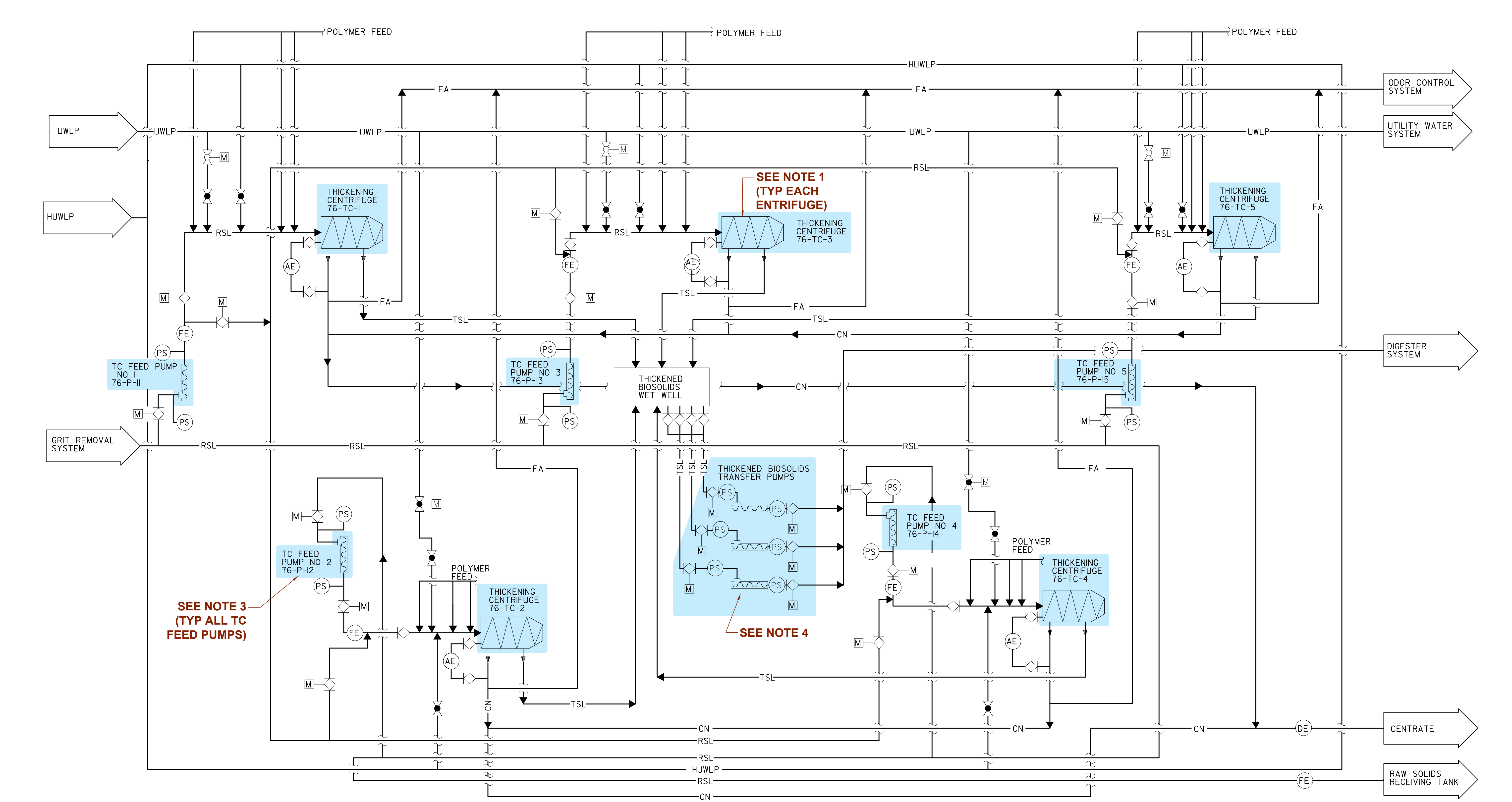
Sludge is fed to each of the three digesters via a combination of one 6-inch-diameter ductile iron line that branches into two parallel 4-inch-diameter lines. The existing piping system was not part of the original design, but was adapted from available piping once the decision was made to directly feed the digesters via the thickened sludge pumps. Each of the two 4-inch-diameter lines branches out to feed the three digesters. Each digester lateral has its own dedicated 4-inch magnetic flow meter for measuring the quantity of solids fed to each digester. Each magnetic flow meter has electrically actuated isolation valves and an electrically actuated bypass valve around the meter.

Each sludge feed pump has the ability to deliver up to 1,000 gpm of sludge, but the pump does not operate at this rate because of the capacity limitations of the centrifuge. Each polymer feed pump can deliver up to 20 gpm of dilute polymer solution to the centrifuge inlet.

5.2.1.2 Current Operating Conditions

The sludge-thickening system currently operates with unused available capacity. Out of the total of five thickening centrifuges available, only one thickening centrifuge is currently needed to process the raw solids pumped from NCWRP. The duty thickening centrifuge and feed pump run continuously (24 hours per day, 7 days per week). At times, one and sometimes two thickening centrifuges have been out of service at one time.

[7] Seepex BN 70-12, 155 gpm max @ 100 psi, 20 hp, 1,765 rpm: gearbox ratio 9.14:1.



LEGEND:

- NCWRP EXPANSION (PURE WATER PROGRAM) UPGRADES
- FOG ADDITION UPGRADES
- OTHER RECOMMENDED IMPROVEMENTS

NOTES:

1. INSTALL 5 NEW, LARGER CENTRIFUGES TO REPLACE EXISTING TO ACCOMMODATE PHASE II CONDITIONS.
2. INSTALL 6TH LARGER CENTRIFUGE IN THE SPACE AVAILABLE TO ACCOMMODATE PHASE II CONDITIONS.
3. INSTALL 5 LARGER TC FEED PUMPS (ONE FOR EACH CENTRIFUGE TO ACCOMMODATE PHASE II CONDITIONS.
4. INSTALL 3 NEW, LARGER THICKENED BIOSOLIDS TRANSFER PUMPS (DIGESTER FEED PUMPS) AND ADD 4TH PUMP IN THE SPACE AVAILABLE TO ACCOMMODATE PHASE II CONDITIONS.
5. HYDRAULIC LOADING REPRESENTS AN NCPWF PRODUCTION OF 30 MGD. REFER TO SECTION 9 OF THIS TECHNICAL MEMORANDUM FOR FURTHER DETAILS.

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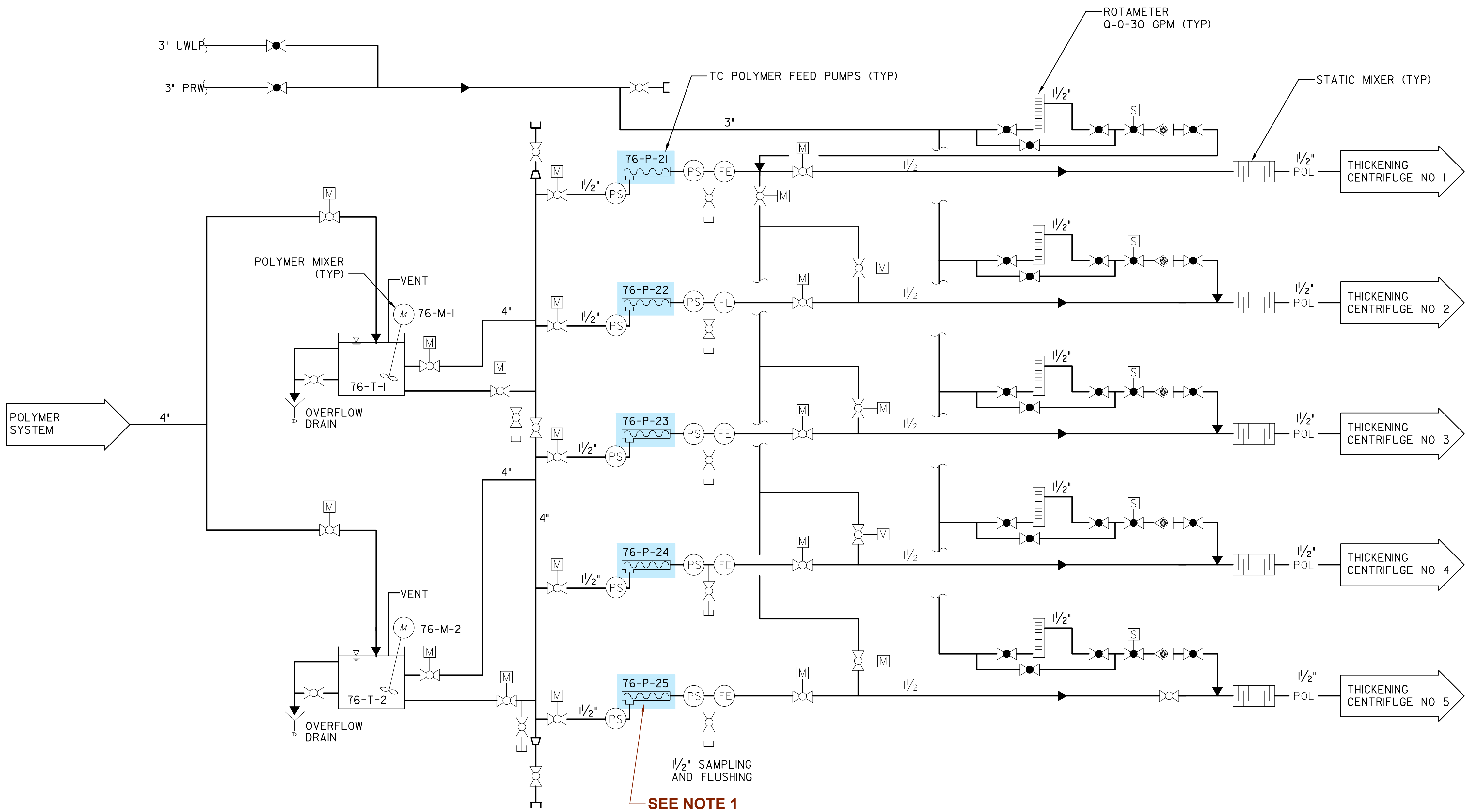
IMPACTS OF NCWRP EXPANSION ON MBC

FIGURE 5-2

RAW SOLIDS THICKENING SYSTEM PROCESS SCHEMATIC



LEGEND:

- NCWRP EXPANSION (PURE WATER PROGRAM) UPGRADES
- FOG ADDITION UPGRADES
- OTHER RECOMMENDED IMPROVEMENTS

NOTES:

1. INSTALL 5 LARGER TC POLYMER FEED PUMPS (ONE FOR EACH CENTRIFUGE) AND ADD 6TH PUMP TO ACCOMMODATE PHASE II CONDITIONS.
2. HYDRAULIC LOADING REPRESENTS AN NCPWF PRODUCTION OF 30 MGD. REFER TO SECTION 9 OF THIS TECHNICAL MEMORANDUM FOR FURTHER DETAILS.

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IMPACTS OF NCWRP EXPANSION ON MBC

FIGURE 5-3

RAW SOLIDS THICKENING POLYMER SYSTEM PROCESS SCHEMATIC

The operating sludge feed pump never exceeded 620 gpm during the 2013/2014 period for which operations data were available. One polymer feed pump operates in the range of 2 to 5 gpm to deliver dilute polymer solution (0.23% dry active ingredient by weight) from the day tank to the centrifuge.

One thickened sludge feed pump operating as lead delivers raw thickened sludge from the wetwell to digester 3, the only digester currently in operation (refer to Section 5.3). The lead pump shuts off at a level of 3 feet and turns on at 5 feet for an operating volume of 4,130 gallons. The lag pump turns on at 10 feet and shuts off at 6 feet. Based on the current level settings, the duty cycle on the lead thickened sludge feed pump is 34% (42 minutes on/80 minutes off) under average conditions; under maximum conditions the duty cycle is 52% (53 minutes on/57 minutes off).

It is important to note that maximum conditions defined in Table 5-5 are based on maximum flows and maximum loads. Although this coincidence of maximum conditions is usually deemed overly conservative (41), it represents a way to account for surcharge loads of solids that are created at NCWRP during the decommissioning and cleaning of primary sedimentation tanks. Decommissioning and dewatering events at NCWRP have been linked to the plugging and forced shutdown of the thickening centrifuge. No clear cause-and-effect relationship has been established at this time.

5.2.2 Constraints

5.2.2.1 Phase I Operating Conditions

Under the Phase I operating conditions, the projected average and maximum flows of raw sludge to thickening centrifuges are 2.9 mgd and 4.43 mgd, respectively; both exceed the firm capacity of 2.6 mgd for the existing system.

5.2.2.2 Phase II Operating Conditions

Although the firm capacity of the existing sludge-thickening system is nearly three times the current operating condition with one centrifuge currently in service, the projected flows and loads of raw sludge under the Phase II conditions exceed the available firm capacity. Table 5-6 shows a firm capacity of 2.6 mgd with three existing centrifuges running at a firm capacity of 600 gpm each compared to future raw solids flows as high as 6.55 mgd under Phase II maximum conditions. Projected TSS loads increase from 56,000 lb/d to 300,000 lb/d for an existing system with a firm capacity of only 108,000 lb/d.

Because of the substantial increases in hydraulic and solids loading under Phase I or Phase II conditions, it is not possible to operate the three existing centrifuges in parallel, with two as backups, and keep pace with projected loads. None of the existing sludge-thickening process equipment is able to handle Phase I or Phase II projected loads. Flows of raw solids from NCWRP to the thickening centrifuges are anticipated to vary diurnally to some degree. Although the flows of raw secondary solids are relatively constant because of equalization of primary effluent, flow through the primary sedimentation tanks is not constant. The thickening centrifuges capture 90% of the solids and thicken it by a factor of 10. As a result, there is relatively little diurnal fluctuation in flows of thickened sludge on the downstream side of the centrifuges because most of the diurnal variability is taken up by the return flow of centrate.

Table 5-6: Sludge Thickening Facilities – Existing System Design Criteria and Projected Operating Conditions for the Thickening System									
Parameter	**Unit of Measure**	**System Design Capacity (1)**		**Estimated Firm**	**Phase I Operating Conditions**		**Phase II operating Conditions**		**Comments**
		Avg.	**Max.**	**Capacity (2)**	**Avg.**	**Max.**	**Avg.**	**Max.**	
Raw Sludge Feed Rate	MGD	2.03	3.24	2.59	2.90	4.43	4.28	6.55	System inadequate for Phase I and Phase II loads
Total Solids Loading	LB TSS/D	60,000	135,000 (3)	108,000	125,000	199,000	184,000	294,000	System inadequate for Phase I and Phase II loads
Polymer Feed Rate	gpm	N/A	80	64	N/A	47.6 (5)	N/A	70 (6)	System inadequate for Phase II max loads
Thickened Sludge Production	gpm	155	310	248	181	278	271	410	System inadequate for all but Phase I avg loads
	% Solids	5.5	5.5	N/A					
	LB/D TSS	107,500	215,000	172,000 (4)	112,000	179,000	165,000	265,000	System inadequate for Phase I and Phase II max loads

(1) Existing thickening centrifuges are the limiting component at 750 gpm each.

(2) Firm capacity based on running three units at 80% output with two units ready.

(3) TSS loadings determined from the percent solids values listed in the Operations Student Study Guide: 0.33% TO 0.5% MAX

(4) Max capacity assumes that the pumps run continuously with no cycle time in the wetwell.

(5) Under Phase I, three new larger centrifuges are proposed to replace two of the existing centrifuges with a sixth larger centrifuge being installed in the available space. Two of the existing centrifuges will run with poly feed pumps running at 9.3 gpm each; two of the new centrifuges will run with poly feed pumps at 14.5 gpm each for a total of 47.6 gpm. It may be possible to run the existing polymer feed pumps with the new centrifuges at Phase I depending on the inlet pressure conditions and pressures at the polymer feed pumps.

(6) Under Phase II, the remaining three original centrifuges are replaced with three larger centrifuges so that all 6 centrifuges are upgraded. Four centrifuges run with 17.5 gpm of dilute polymer addition for a total of 70 gpm. This tm assumes that all polymer feed pumps are replaced at phase ii due to higher inlet pressures at the upper end of the operating range of each centrifuge.

5.2.3 Required Equipment Improvements

5.2.3.1 Sludge-Thickening Operations

Because the proposed modifications to the thickening centrifuge system are all ultimately geared to the Phase II maximum conditions, it makes the most sense to first discuss the required improvements to meet Phase II conditions. Once this alternative is established, the proposed modifications for Phase I conditions are simply an intermediate step toward the ultimate scheme proposed for Phase II. This approach does not imply that there will be no phasing; it indicates only that the Phase II conditions ultimately dictate individual centrifuge capacity under all other conditions. The improvements outlined herein are shown in Figures 5-2 and 5-3 and identify specific improvements related to the NCWRP expansion (Pure Water Program), FOG addition, and other recommended improvements focused on improving process reliability and performance.

Table 5-7 and Table 5-8, respectively, summarize the proposed equipment sizing for the Phase I operating conditions and Phase II operating conditions, respectively. Although the runtimes on the existing centrifuges are low, the approach recommended in this TM for the required improvements entails demolishing and replacing all of the existing centrifuges with newer, larger units. The main reasons for this approach are:

- Space within the building is limited and, as a result, it is important to maximize firm capacity within the available space. If the project team installed additional centrifuges with a firm capacity of 600 gpm each to supplement the existing units, a total of 8 centrifuges would need to be running and 2 additional backups for a total of 10. Implementing this alternative would incur significant additional cost in expanding the existing building or relocating existing equipment.

- The existing centrifuges are nearly 20 years old. Retaining the old centrifuges limits the City's ability to take advantage of improvements in the energy efficiency of centrifuge technology. Although availability of spare parts and long lead times would normally be a factor in aging equipment, MBC maintenance staff have largely mitigated this concern with a proactive in-house maintenance program and locally sourced repair services. MBC staff eliminated the cost of manufacturer-furnished maintenance and long lead times.

- Installing newer, larger centrifuges minimizes the cost of support systems that would otherwise be a factor if the existing centrifuges remain: an additional electrical room, building modifications, and electrical infrastructure plus additional sludge feed and polymer feed pumps.

To minimize the individual capacity of each of the proposed centrifuges for Phase II, the upgrade assumes that a total of six thickening centrifuges are installed to replace the existing five, and that the available space for a sixth centrifuge is used. The centrifuges are sized so that the firm capacity of four units is sufficient to meet Phase II conditions with two units available as standby units. The proposed thickening centrifuges are rated for 1,460 gpm each and, applying a firm capacity multiplier of 0.8, the resulting firm capacity of each proposed centrifuge is 1,168 gpm. Four thickening centrifuges running in parallel will have a firm capacity of 4,672 gpm (6.7 mgd approximately). See Section 8.8 for additional clarification. Each of the new sludge feed pumps will be similarly rated. Based on the current dosage range, the projected firm polymer feed rate is 16 gpm. It may be possible to fit new gearboxes and drive motors to the existing polymer feed pumps instead of installing an entirely new pump assembly. The selected design firm for subsequent phases of design may need to evaluate this alternative. Each proposed centrifuge has a rated capacity of 1,460 gpm[8] and a firm capacity of 1,168 gpm. With four online and two backups, the proposed

[8] Aldec G3-165. Main drive 350 hp, backdrive 40 hp. On a nominal, horsepower per 1,000 gpm basis, the Aldec G3-165 centrifuges are 44% more efficient than the existing centrifuges: 267 hp per 1,000 gpm versus 480 hp per 1,000 gpm.

system would provide the needed 6.55 mgd of firm capacity. The sludge and polymer pumps would also be replaced[9].

For the Phase I operating conditions, three of the proposed six centrifuges would be installed to provide the needed firm capacity. City staff would operate two out of three of the existing centrifuges in tandem with two out of three proposed centrifuges.

Construction of these improvements will require engineering design and preparation of construction documents including design drawings and specifications.

Several significant design issues with the replacement centrifuges may need to be addressed during subsequent stages of design:

- The Aldec G3-165 centrifuges are furnished with an in-line main drive motor configuration, which adds to the overall length of the installation. Alfa Laval Thermal Company (Alfa Laval) no longer provides side-mounted main drive motors as an option. The in-line motor configuration ensures that the main motor base is part of the centrifuge base that is better from the standpoint of vibration and rotational dynamics.
- The Aldec G3-165 will fit in the space available based on preliminary field measurements and layouts assuming that the positions of the thickened solids discharge connections remain the same. Approximately 30 inches of available floor space will be lost on the east and west sides of the building, but approximately 72 inches of room will be available between the ends of the backdrive motors and the face of the existing columns. It may not be possible to use the existing bridge crane to remove the backdrive motors. As a result, other provisions may be required to remove the backdrive motors. The east-west limits of hook travel at the thickened centrifuge area need to be confirmed by field tests.
- At 40,000 lb each, the Aldec G3 centrifuges are comparable to the existing Sharples PM-95000 AD, which have a total weight of 45,940 lb. As a result, any structural modifications needed to handle the new centrifuges will be primarily a function of current codes.
- The power conduits for the existing main drive motors are off to the side of each existing centrifuge because of the side-mount belt drive arrangement. These conduits will need to be reconfigured for the new motor arrangement.
- Section 8 discusses the potential for lower flows to the thickening centrifuges. Even if the flows are reduced, it appears likely that the Aldec G3 frame size would still apply. This issue needs to be addressed in subsequent stages of design by the predesign consultant.

[9] The larger sludge feed pumps will require the use of right-angle gear drive assemblies, and motors mounted in the vertical position, to fit in the space available. Suction and discharge piping for each pump will also need to be revised to match the pump inlet and discharge connections for the proposed pump.

Table 5-7: Sludge Thickening Facilities – Phase I Projected Equipment Improvements and Phase I Operating Conditions												
Equipment Subsystem	Unit of Measure	Phase I improvements								Phase I Operating Conditions		Capacity Assessment
		No. Of units under max conditions				Capacity			Summary of Improvements			
		Status	Total	Duty	Standby	Unit Capacity	Rated Capacity	Firm Capacity		Avg.	Max.	
Thickening Centrifuge Sludge Feed Pumps	gpm	Existing	3	2	1	1,000	2,000	1,600				Subsystem
	gpm	**New**	**3**	**2**	**1**	**1,460**	**2,920**	**2,336**	Remove three existing pumps and replace with three larger pumps			
TOTAL	**gpm**		**6**	**4**	**2**			**3,936**		2,014	3,076	Firm capacity > Phase I max
	MGD									2.90	4.43	
Thickening Centrifuges	gpm	Existing	3	2	1	750	1,500	1,200	Remove three ex. Centrifuges and Replace with three larger centrifuges Run two larger centrifuges and run two smaller units one backup of each			
	gpm	**New**	**3**	**2**	**1**	**1,460**	**2,920**	**2,336**				
TOTAL	**gpm**		**6**	**4**	**2**			**3,536**		2,014	3,076	Firm capacity > Phase I max
	MGD									2.90	4.43	
	LB TSS/D	Existing	3	2	1	49,500	99,000	79,200				
	LB TSS/D	**New (1)**	**3**	**2**	**1**	**122,700**	**245,400**	**196,320**				
	LB TSS/D		6	4	2			**275,520**		125,000	199,000	
Thickening Centrifuge Polymer Feed Pumps	gpm	Existing	6	4	2	20	80	64	Note – may be able to operate with existing polymer pumps in Phase I		47.6	Firm capacity > Phase I max operating condition
	gpm						**0**	**0**				See detailed discussion in memo for further clarification; see Note 5 in Table 5-6
TOTAL	**gpm**		**6**	**4**	**2**			**64**				
Thickened Sludge Feed Pumps	gpm	**New**	**4**	**3**	**1**	**270**	**810**	**648**	Remove existing three pumps and replace with larger pumps Add 4th pump in space available			Firm capacity > Phase I max operating condition
	gpm											See detailed discussion in memo for further clarification
TOTAL	**gpm**		**4**	**3**	**1**			**648**				

Table 5-8: Sludge Thickening Facilities – Phase II Projected Equipment Improvements and Phase II Operating Conditions												
Equipment Subsystem	Unit of Measure	Phase II Improvements								Phase Ii Operating Conditions		Capacity Assessment
		No. Of units under max. Conditions				Capacity			Summary of Improvements			
		Status	Total	Duty	Standby	Unit Capacity	Rated Capacity	Firm Capacity		Avg.	Max.	
Thickening Centrifuge Sludge Feed Pumps	gpm	**New-Ph2**	**6**	**4**	**2**	**1,460**	**5,840**	**4,672**	Replace 5 original sl. Feed pumps with larger sl. Feed pumps Install 6th additional pump.			Subsystem
TOTAL	**gpm**		**6**	**4**	**2**			**4,672**		2,972	4,548	Firm capacity > Phase II max operating condition
	MGD								to match larger pumps	**4.28**	**6.55**	
Thickening Centrifuges	gpm	**New-Ph2**	**6**	**4**	**2**	**1,460**	**5,840**	**4,672**	Replace 5 original centrifuges with larger centrifuges Add 6th larger centrifuge			
TOTAL	**gpm**		**6**	**4**	**2**			**4,672**		2,972	4,548	Firm capacity > Phase II max operating condition
	MGD									**4.28**	**6.55**	
	LB TSS/D	**New-Ph2**	**6**	**4**	**2**	**122,700**	**491,000**	**392,600**				
	LB TSS/D		**6**	**4**	**2**			**392,600**		**184,000**	**294,000**	
Thickening Centrifuge Polymer Feed Pumps	gpm	**New**	**6**	**4**	**2**	**22**	**88**	**70**	Replace all 5 poly feed pumps in Phase II Add 6th poly feed pump		70	Firm capacity > Phase II max operating condition See detailed discussion in memo for further clarification; see Note 5 in Table 5-6
TOTAL	**gpm**		**6**	**4**	**2**			**70**				
Thickened Sludge Feed Pumps	gpm	**New**	**4**	**3**	**1**	**270**	**810**	**648**	remove existing 3 pumps and replace with 3 larger pumps Add 4th pump in space available			Firm capacity > Phase II max operating condition See detailed discussion in memo for further clarification
TOTAL	**gpm**		**4**	**3**	**1**			**648**				

5.2.3.2 Thickened Sludge Transfer/Digester Feed Operations

For thickened sludge pumping, the required improvements entail (1) replacing the existing thickened sludge pumps with larger pumps; (2) installing a fourth pump in the space provided to match the capacity of the new pumps; and (3) installing a new 8-inch-diameter lined ductile iron force main with feed valves and new tie-ins to the suction side of the existing digester mix pumps.

Each new thickened sludge pump will be designed to deliver 217 gpm. This represents an increase of 40% over each of the existing pumps, which are rated for 155 gpm. The existing wall spool for each pump suction connection is a 6-inch-diameter pipe. Suction velocities will increase from 1.6 fps to 2.2 fps, which may be on the low side for 5% raw solids. It appears that suction manifold piping was installed when the original thickened sludge pumps were replaced. If one of the sludge inlets plugs at the wall spool, suction line velocities and suction losses will increase significantly and line losses may be unacceptable. This question will need to be evaluated in greater detail by the design consultant selected for 10% design effort.

A second issue that has been raised by City staff is whether the thickened solids in the wetwell from multiple centrifuges will require mixing to maintain a homogeneous feedstock to the digesters. Any form of mixing may increase the generation of odors and require that the air space above the solids be re-connected to the foul air ductwork. Once in continuous operation, the thickened solids produced by one centrifuge should be relatively comparable to the solids produced by others so that mixing may not be a priority. Any off-spec thickened solids generated during centrifuge startup will be diverted to the centrate system. If mixing is required, the challenge will be to mix the solids while minimizing surface turbulence and generation of odors. Submersible mixers will be difficult to access and will require opening up a classified space that will still be in operation while a mixer is being removed for maintenance. Chopper pumps could provide closed-loop mixing with safer access for maintenance, but space for pump installation is limited. The chopper pump carries the added benefit of macerating the raw solids, which may reduce clogging in the HEXs over time. This question will need to be evaluated in greater detail by the design consultant selected for the 10% design effort.

One of the primary challenges in pumping thickened sludge to the digesters is balancing two competing objectives: (1) keeping sludge pipeline velocities in an optimum range versus; and (2) maintaining a continuous digester feed to minimize fluctuations of the digester organic loading and their impact on digester performance resulting in fluctuations in digester gas production.

The velocity of thickened sludge at 5% solids should be between 3 and 5 fps to avoid high friction losses caused by the viscosity of the sludge due to non-Newtonian nature of concentrated undigested solids (15). The simplest way to provide this is to design the thickened sludge pumps to pump at a constant rate from the thickened sludge wetwell on a fill-and-draw basis. Under Phase II maximum conditions, three of the four digester feed pumps operate in parallel to deliver solids to the digesters at 650 gpm. An 8-inch-diameter line, or its equivalent[10], will be required to keep the pipeline velocity in the optimum range under these conditions. Under Phase II maximum conditions, three of the four thickened sludge pumps operate in parallel to pump sludge to the digesters. By adjusting the level set points for pump start/stop operations, the duty cycle for the pumping system is 63% with pumps off for 10 minutes followed by a runtime of 17 minutes. This corresponds to a cycle time of 27 minutes and 2.2 starts per hour.

[10] Two 6-inch-diameter ductile iron lines, running in parallel, provide a total equivalent cross-sectional area equal to one 8-inch-diameter ductile iron line. Specific pipeline routing options, and reuse/integration of existing piping into the digester-feeding scheme, are not addressed in this TM. Multiple parallel lines offer flexibility in maintaining acceptable pipe velocities under conditions when the thickened sludge flow is less than the Phase II maximum conditions.

But operation on a fill-and-draw basis necessarily causes pulses of solids loadings into each online digester and fluctuations in gas production. The best compromise entails feeding each online digester in small increments at any given time. Assuming that the digester feed pumps start on high level, the last digester feed valve open from the prior cycle will receive sludge first. By feeding the digesters 1-2-3 in one cycle, and digesters 3-2-1 in the second cycle, it is possible to cut the number of valve operations per pump cycle from three to two by leaving valve 3 open between pump cycles.

The rate at which each digester is fed also has an impact on the overflow system for each digester and the rate at which solids are displaced and conveyed by gravity to the emergency biosolids storage tanks. It seems that with the modification to the emergency overflow weir in each digester made by the plant staff, the two 6-inch-diameter lines (normal overflow and emergency overflow) at each digester are now available for conveyance of overflow from each digester via two 10-inch-diameter lines. This increased hydraulic capacity should be able to accommodate higher rates of overflow, but should be analyzed in detail by the predesign consultant. The budget pricing for the upgraded thickened sludge pumping system also includes 800 feet of new 8-inch-diameter ductile iron force main and three 6-inch-diameter laterals with 6-inch magnetic flow meters, to deliver thickened solids to the digesters. The goal of the new force main is to maintain optimum velocities for the maximum pumping rate needed while minimizing discharge pressures at the pump. An entirely new force main offers the greatest flexibility in maintaining current digester feed operations while new pumps are being installed and commissioned.

5.3 Anaerobic Digestion System

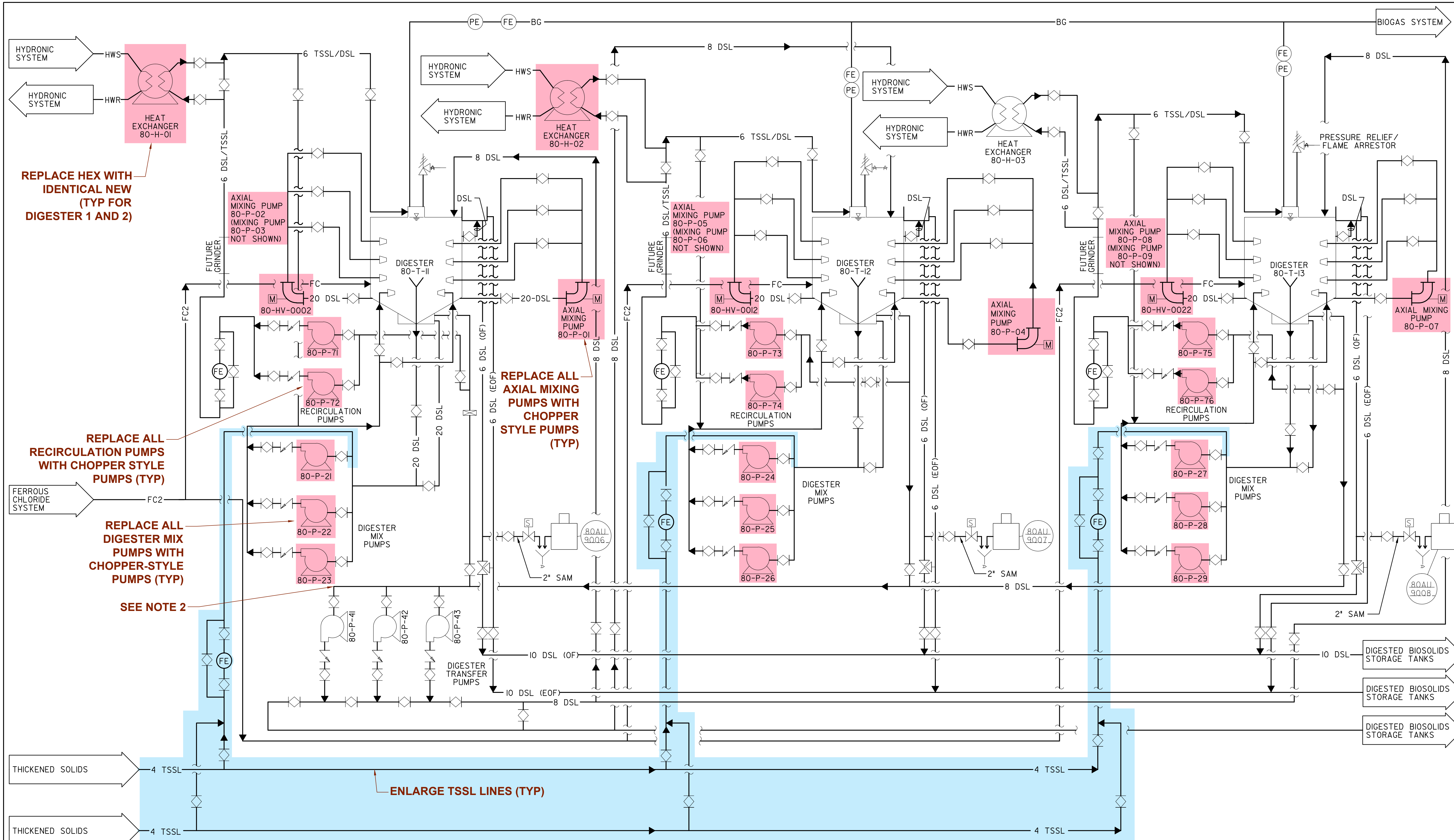
5.3.1 Existing Conditions

5.3.1.1 Existing Facilities

Process schematics for the anaerobic digester system, digester biosolids storage system and biogas system are shown in Figure 5-4, Figure 5-5, and Figure 5-6, respectively.

5.3.1.1.a Anaerobic Digesters

The anaerobic digestion system at MBC currently consists of three digesters (80T11–80T13). Each digester is a mesophilic, heated, primary, pump mixed circular, prestressed concrete digester, 105 feet in diameter with a normal operating level of 45 feet (level sensor reading shows 35-foot level, as the sensor has been installed 10 feet above the top of the cone level) and an operating capacity of 2.91 million gallons (MG). Currently MBC operates only one digester, digester 3, which has been in continuous operation for almost 8 years without cleaning. Previously digester 1 was operated continuously for 6 years. When digester 1 was cleaned after 6 years, it was found that grit deposition was reasonable and within limits of the cone, an indication of acceptable grit removal at NCWRP's grit chambers and at the MBC grit teacup removal.



LEGEND:

- NCWRP EXPANSION (PURE WATER PROGRAM) UPGRADES
- FOG ADDITION UPGRADES
- OTHER RECOMMENDED IMPROVEMENTS

NOTES:

1. CONSTRUCTION OF DIGESTER NO.4 (80-T-14) WILL BE REQUIRED TO ACCOMMODATE PHASE II CONDITIONS WITH ADDITION OF FOG.
2. CROSS-CONNECT TO DIGESTER NO.4 BIOSOLIDS DRAW-OFF.
3. HYDRAULIC LOADING REPRESENTS AN NCPWF PRODUCTION OF 30 MGD. REFER TO SECTION 9 OF THIS TECHNICAL MEMORANDUM FOR FURTHER DETAILS.

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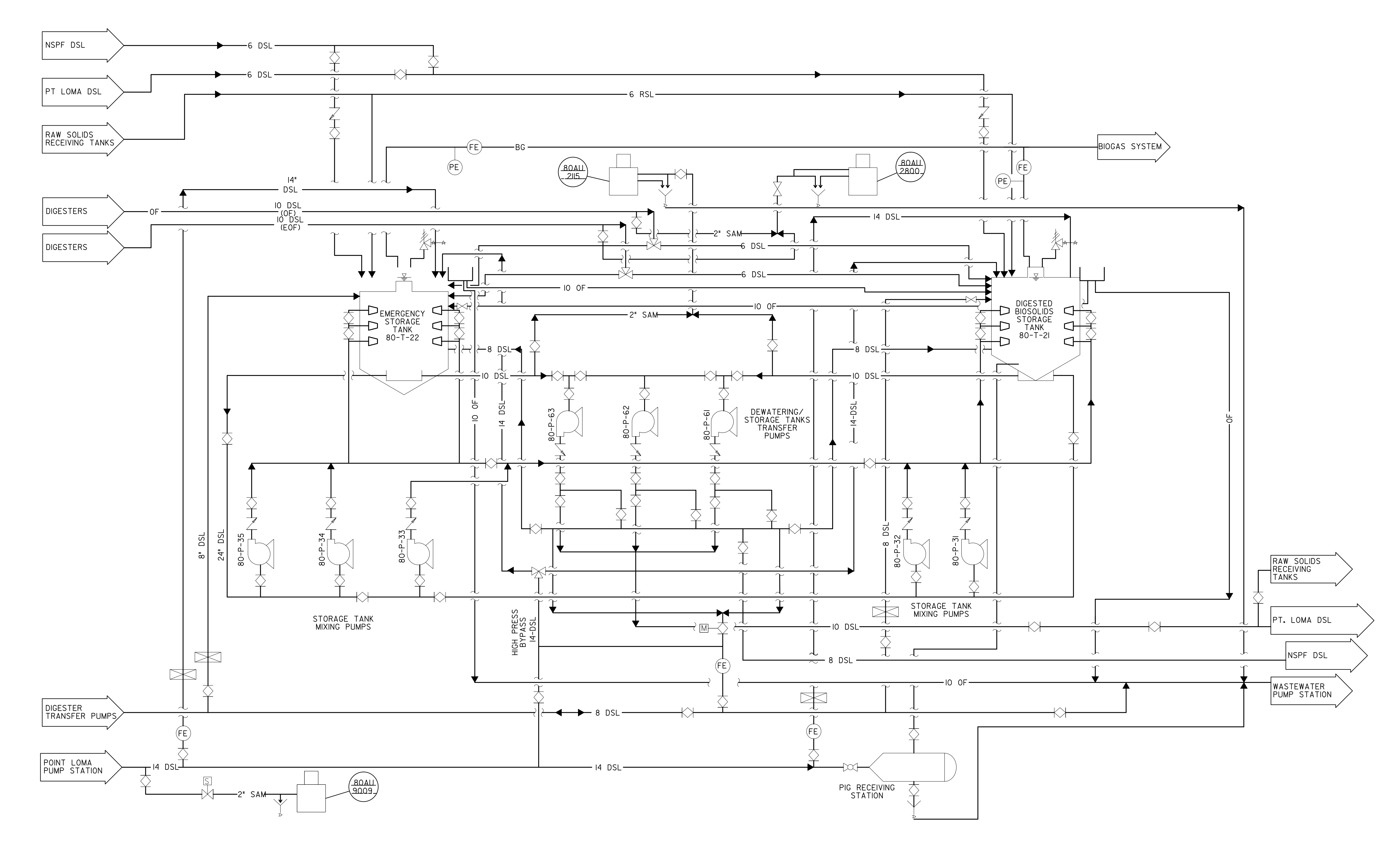
IMPACTS OF NCWRP EXPANSION ON MBC

FIGURE 5-4

DIGESTER SYSTEM PROCESS SCHEMATIC



LEGEND:

- NCWRP EXPANSION (PURE WATER PROGRAM) UPGRADES
- FOG ADDITION UPGRADES
- OTHER RECOMMENDED IMPROVEMENTS

NOTES:

1. HYDRAULIC LOADING REPRESENTS AN NCPWF PRODUCTION OF 30 MGD. REFER TO SECTION 9 OF THIS TECHNICAL MEMORANDUM FOR FURTHER DETAILS.

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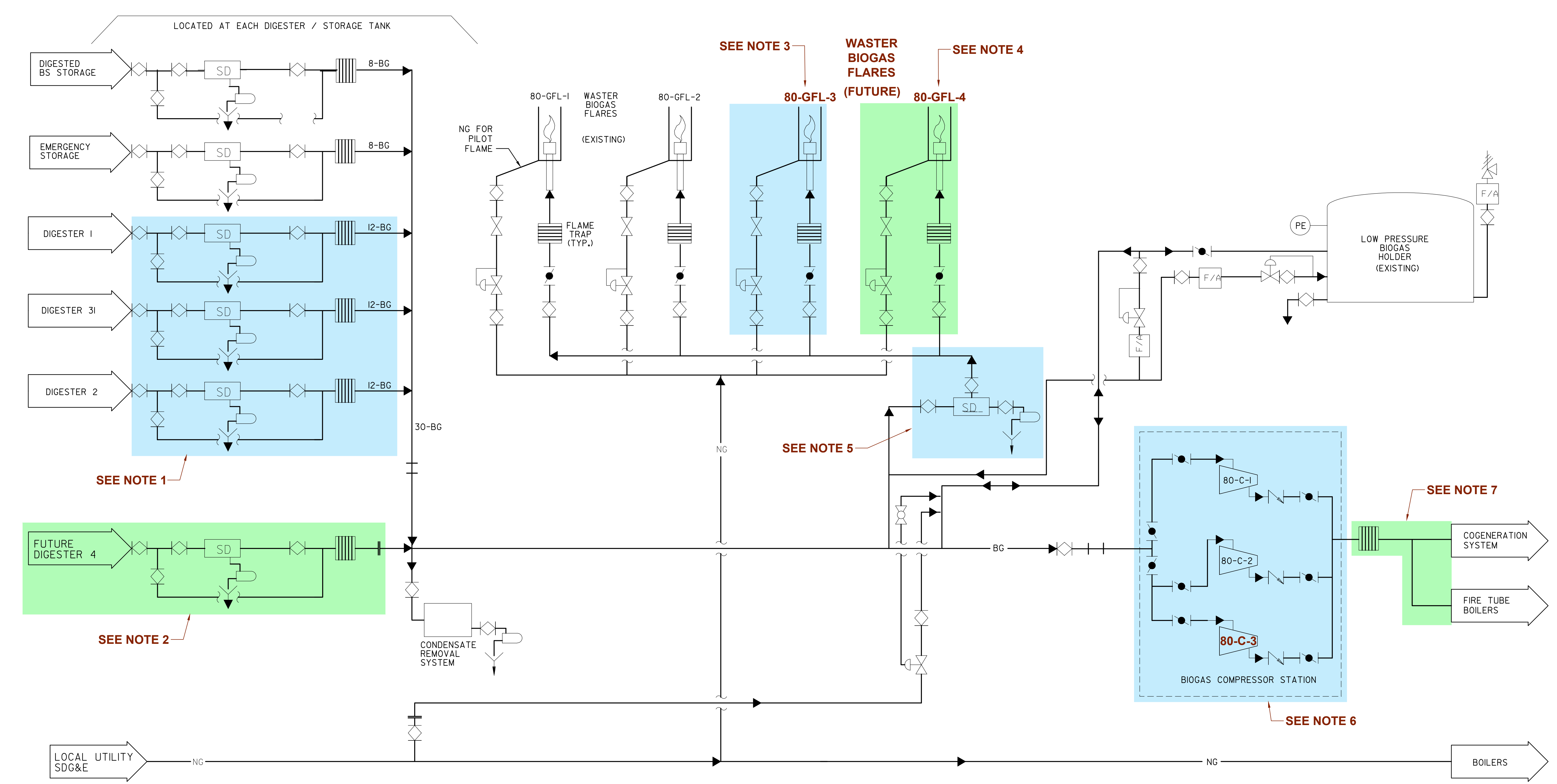
IMPACTS OF NCWRP EXPANSION ON MBC

FIGURE 5-5

DIGESTER BIOSOLIDS STORAGE SYSTEM PROCESS SCHEMATIC



LEGEND:

- NCWRP EXPANSION (PURE WATER PROGRAM) UPGRADES
- FOG ADDITION UPGRADES
- OTHER RECOMMENDED IMPROVEMENTS

NOTES:

1. ENLARGE BIOGAS LATERALS FOR EACH EXISTING DIGESTER.
2. CONSTRUCTION OF DIGESTER NO.4 WILL BE REQUIRED TO ACCOMMODATE PHASE II CONDITIONS WITH ADDITION OF FOG.
3. CONSTRUCTION OF FLARE NO.3 WILL BE REQUIRED TO ACCOMMODATE PHASE II CONDITIONS WITHOUT ADDITION OF FOG.
4. CONSTRUCTION OF FLARE NO.4 WILL BE REQUIRED TO ACCOMMODATE PHASE II CONDITIONS WITH ADDITION OF FOG.
5. ENLARGE BIOGAS LATERALS TO FLARES.
6. REPLACING OF EXISTING COMPRESSORS WITH LARGER UNITS AND ADDING AN ADDITIONAL COMPRESSOR WILL BE REQUIRED FOR PHASE II CONDITIONS.
7. ENLARGE BIOGAS HEADER TO COGENERATION FACILITY AND TO FIRE TUBE BOILERS.
8. HYDRAULIC LOADING REPRESENTS AN NCPWF PRODUCTION OF 30 MGD. REFER TO SECTION 9 OF THIS TECHNICAL MEMORANDUM FOR FURTHER DETAILS.

IMPACTS OF NCWRP EXPANSION ON MBC

FIGURE 5-6

BIOGAS SYSTEM PROCESS SCHEMATIC

5.3.1.1.b Biosolids Recirculation and Mixing

Each digester is provided with the following pump recirculation and mixing equipment:

- Two digester recirculation pumps (80P71–80P76)[11] take suction from the digester cone and provide recirculation of biosolids through a HEX back to the digester. One pump is normally kept in service with the other on standby mode.
- Three digester mixing pumps (80P21–80P29)[12] take suction from the digester cone and provide injection of return sludge back to the digester for mixing. Two pumps are normally kept in service with the third in standby mode.
- Three digester axial mixing pumps (80P01–80P09)[13] take suction just above the digester cone and inject biosolids back to the digester at different points for mixing. Currently all pumps are out of service because of hair clogging of the impellers and inability to isolate the pumps due to leaking isolation valves.

The original design intent was to operate one recirculation pump, two mixing pumps, and three axial mixing pumps continuously. The design allowed for two modes of operation for mixing: normal mode and “scum breakup” mode. This system was designed to provide a mixing flow of 18,150 gpm in a normal mode of operation and result in cell turnover time (CTT) of 160 minutes. Considering that all three axial mixing pumps are out of service, the actual mixing flow is 4,950 gpm, which results in a CCT of 588 minutes.

5.3.1.1.c Digester Heating

A temperature of 98 degrees Fahrenheit (°F) to 100°F is maintained in the digesters by heating recirculating biosolids in the HEXs. One HEX is provided for each digester (80H1–80H3). Each HEX is a spiral HEX, manufactured by Alfa Laval with a heat transfer capacity of 2.5 million British thermal units per hour (MMBtu/hr), hot water flow rate: 250 gpm, sludge flow rate: 550 gpm, HWS/HWR temperatures of 160°F–170°F/145°F respectively; sludge temperatures at inlet/outlet of 70°F/104°F respectively; and nominal pressure drop of 5 feet.

5.3.1.1.d Digester Feed

Thickened sludge from the thickening centrifuges wetwell is conveyed directly to the digesters[14] via a single 6-inch-diameter line and two 4-inch-diameter lines. A 4-inch-diameter branch line with an automated shutoff valve connects to the suction manifold of the mixing pumps for the digesters. Each branch line also includes a magnetic

[11] Each pump is an Aurora Model 651A centrifugal, non-clog horizontal flow pump, 550 gpm, 65-foot TDH, 1,765 rpm, constant-speed supplied with a 20 hp motor.

[12] Each pump is an Aurora Model 611A centrifugal, non-clog horizontal flow pump, 2,200 gpm, 41-foot TDH, 1,200 rpm, constant-speed supplied with a 40 hp motor.

[13] Each pump is a Lawrence Pump, Model LAOZ, size 12-by-12-by-11.9-inch centrifugal, non-clog horizontal flow pump, 4,400 gpm, 26-foot TDH, 1,775 rpm, constant-speed supplied with a 40 hp motor.

[14] The original design included facilities for screening and preheating thickened sludge prior to digester feed. Problems with plugging of the blending tank HEXs prompted operations staff to bypass the screens, HEXs, and blending tanks, and feed the digesters directly from the thickened sludge wetwell with unheated sludge. Dwight Correia pointed out that many other problems prompted bypassing the screens and the blending tanks, including unreliable operations of the screens because of the non-continuous flow from the thickened solids wetwell, unbalanced mixing flows in the blending tanks that resulted in all of the sludge being transferred to one blending tank only, undersized original digester feed pumps that tripped offline frequently (pumps were sized for static head only; no pipeline head losses were included in hydraulic calculations), and no check valve or reliable motorized valve to prevent high backflows from the digesters when the pumps tripped offline. High backflows to the low-elevation blending tanks overwhelmed the small blending tanks overflow pipes, causing spills from the blending tanks, which are located at the low point of the plant and adjacent to storm drain inlets. Plant staff have considerably reduced the level of required operator attention and maintenance labor by streamlining the system.

flow meter for tracking the sludge feed to each digester. The single digester is fed on a volumetric basis (1,000–10,000 gallons). See Section 4.2 for additional discussion on digester feed and the thickened sludge feed pumps.

5.3.1.1.e Digested Biosolids Draw-Off

Digested biosolids overflow by gravity from each in-service digester via an overflow box to one of the biosolids storage tanks (biosolids storage tank or emergency biosolids storage tank; 80T21, 80T22), where it is blended with digested sludge from PLWTP. Each storage tank is a 70-foot-diameter, 1.3 MG, prestressed concrete tank with a maximum operating level of 45 feet. One tank has been kept in service for 11 years with the other on standby mode. Five mixing pumps are provided (two-speed) for two tanks to keep solids in suspension. Each pump is a centrifugal, non-clog horizontal flow pump, 3,600 gpm/4,000 gpm capacity, 40-foot TDH, supplied with a 50 hp motor. The pumps are cross-connected and two pumps are operated for the in-service tank.

Section 5.4 discusses the current scheme for pumping blended digested sludge from the storage tanks to feed the dewatering centrifuges. The original pumps designated for feed to the centrifuges are no longer used in this capacity.[15]

5.3.1.1.f Digester Biogas System

Each digester is provided with an individual 12-inch-diameter biogas lateral connecting to a buried biogas collection header system. Each of these lateral connections includes flow and pressure monitoring, flame arrester, isolation valves, drip traps, and drain assemblies. The biogas collection headers consist of an 18-inch-diameter header (servicing digester 2) and a 30-inch-diameter header servicing digesters 1 and 3, the biosolids storage tank, and the biosolids emergency storage tank. The gas collection system is equipped with four condensate traps and two condensate collection sumps provided with sump pumps for pumping condensate to the wastewater pump station.

The biogas headers converge at the biogas holding tank and split into three transmission mains: a 30-inch-diameter header connected to the biogas holding tank, a 12-inch-diameter header supplying the biogas compressors, and an 8-inch-diameter header connected to the biogas flares.

The biogas holding tank (80GH01) is a 25,000-cubic-foot (ft^3) storage-capacity, low-pressure cylindrical steel tank with an internal water-sealed floating piston (floating cone) that rises as surplus gas is produced and falls as biogas consumption exceeds biogas production. The tank is sized to hold approximately 45 minutes of peak gas production of 550 standard cubic feet per minute (scfm). Two biogas compressors (80C01 and 80C02)[16] are provided to deliver biogas to the Fortistar cogeneration facility or to the Energy Building boilers. The latter option, provided as part of the original design, is not used anymore and all biogas is sent to the Cogeneration Facility. The boilers are used as standby units in case the Cogeneration Facility is taken out of service, and operate on natural gas only.

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[15] Blended digested biosolids from the in-service biosolids storage tank could be transferred to the digesters or to the dewatering centrifuge pump feed loop using the dewatering transfer pumps (80P61–80P63). Three dewatering transfer pumps are provided at MBC. Each is a centrifugal, chopper pump, Vaughan, Model HE4P6CS-114, 810 gpm, 97-foot TDH, 1,750 rpm, supplied with a 50 hp constant-speed motor. Design intent was to operate these pumps in a lead/lag/standby mode to maintain a set point pressure and flow rate through the dewatering centrifuge feed loop. Currently, these pumps are not used for transferring biosolids to the dewatering centrifuge feed loop and used only rarely to transfer biosolids between the storage tanks.

[16] Each biogas compressor is a Hoffman multistage centrifugal blower, Model 4207A3 rated for 300 scfm capacity at 5 psig static pressure, 3,600 rpm, with 6-inch discharge/12-inch suction connections, and equipped with a 20 hp motor. A 6-inch discharge header from the compressors is further connected to an 8-inch header leading to the Fortistar cogeneration facility and to the Energy Building.

Two biogas flares (80GFL01 and 80GFL02)[17] are provided. The flares are used to burn unused biogas, if necessary, and routinely run for maintenance testing.

5.3.1.1.g Digester Chemical Addition System

Ferrous chloride is added to digester 3 to control sulfide formation. For a detailed description of the $FeCl_2$ addition system, see Section 5.7.

5.3.1.2 Current Operating Parameters and Performance

Table 5-9 summarizes the existing design and current capacity-related operating parameters for major equipment components and performance characteristics of the digester system. As shown in Table 5-9, current digester facilities are generally adequate to handle current flows and loads with the exception of digester mixing. Based on our analysis of the existing conditions, in-service digester 3 does not satisfy design and industry-recognized mixing criteria. At minimum, the existing axial mixing pump isolation valves on digester 3 need to be refurbished and the axial mixing pumps need to be placed back in operation to ensure proper mixing in the digester (new isolation valves have been already installed on digesters 1 and 2). Our recommendation is to replace the existing recirculation, mixing, and axial mixing pumps on all existing digesters with the chopper-style pumps. In addition, we recommend to replace spiral HEXs on digesters 1 and 2 with new units. These recommendations are reflected in our OPC as “other recommended improvements.”

5.3.2 Projected Conditions: Phase I (15 mgd production at NCPWF) and Phase II (30 mgd production at NCPWF) without FOG and/or Lystek

5.3.2.1 Summary

Projected NCWRP biosolids flows and loads for different operating scenarios have been analyzed based on the mass balance data discussed in Section 4.1. The results of the modeling for Phase I (15 mgd production at NCPWF) and Phase II (30 mgd production at NCPWF) are summarized in the tables included in Appendices B and C. Scenario A.1 is the worst-case scenario from the standpoint of impacts on the capacity of the anaerobic digestion facilities, without consideration of potential addition to digesters of FOG or implementation of the Lystek process (low-temperature biosolids hydrolysis process to increase biogas production in the digesters) currently considered by the City (refer to (39) *and* Section 5.3.3 below). Tables 5-5 and 5-5 show that the anaerobic digestion facilities will have to process a five-fold increase in flows and loads. In accordance with industry standard anaerobic digester sizing practice described in references (29), (30), and (31), projected peak flows and loads have been calculated based on 14-day hydraulic and solids loading peaking factors described in Section 4. As directed by the City, MBC digesters will not be used in the future for wet weather storage or for NCPWF off-spec water diversion considering digester capacity limitations at MBC.

Table 5-10 summarizes the existing system design criteria and projected operating conditions without FOG addition or implementation of Lystek process. The cells in the table with numbers shown in bold represent conditions where projected conditions will approach or exceed the assumed process design criteria or estimated firm capacity. Table 5-10 shows that the existing system is adequate to handle the projected flows and loads with one digester out of service under Phase I operating conditions.

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[17] Each biogas flare is a Flare Industries, 72-foot-by-24-inch EGF flare, 420–550 scfm capacity, 1,400°F temperature, 450–650 British thermal units (Btu)/ft^3 heat content, 11.34–21.45 MMBtu/hr heat loading.

Under Phase II operating conditions, the existing system is adequate to handle the projected flows and loads with all digesters in service, but will require a temporary, partial bypass of flows to PLWTP under maximum flows/loadings if one digester is taken out of service. The portion of the NCWRP biosolids flow that needs to be temporarily bypassed to PLWTP is shown in Table 5-10 and it could reach 13.8% of NCWRP biosolids flow under Phase II maximum loading conditions. Based on our calculations using the mass balance model developed by BC, this increase in the MER at PLWTP from 7,790 mt/yr to 8,241 mt/yr is still below the MER limit of 9,942 mt/yr established by the current permit (46).

Assuming there is a system to track any unused capacity in the MER, this short-term strategy would allow the City to handle the projected loads with its existing digesters and avoid substantial capital expenditures associated with building an additional digester. To accommodate such high loading conditions, all axial mixing pumps should be refurbished and placed back in service to maintain proper mixing in the digesters (the isolation valves for digester 1 and 2 pumps have already been replaced, so the pumps could be isolated and serviced; when digester 3 is taken out of service all of its valves will be replaced so that in the future the axial mix pumps can be isolated and repaired when needed).

A stress test of the digester system must be conducted to analyze the system's ability to respond to fairly high loads. The predesign consultant should be required to develop a stress test protocol and conduct a test that should include holding a portion of biosolids load within NCWRP and in the raw-solids-receiving tanks to develop an inventory necessary for the stress test. The predesign consultant should be required to evaluate whether the digester stress test is possible to accomplish until multiple digesters are in service. The biogas conveyance headers appear to be adequate to handle Phase I and Phase II flows/loads. However, digester biogas laterals, biogas compressors, and biogas flares will need to be upsized (biogas lateral should be upsized at Phase I).

Biogas production numbers shown in Table 5-10 are slightly higher than biogas production values shown in the FOG Project Draft TM (39) (for example, there are 1,084,000 standard cubic feet per day [scfd] vs. 944,000 scfd under annual average conditions) because data in (39) were calculated under lower NCWRP flows and biosolids production and assuming substantially lower VSS reduction rates than historically observed at MBC.

As pointed out by City staff, taking one digester out of service for cleaning or repairs has historically been a lengthy process at MBC because of procurement logistics within the City. Although industry-wide it is possible to expedite digester cleaning in 4 to 6 months, City staff have indicated that digester cleaning may take up to 18 months.

Table 5-9: Anaerobic Digestion System - System Design Criteria and Current Operating Conditions for the Existing System

Parameter	Unit of Measure	System Design Capacity (1)(2)		Estimated Firm Capacity	Current Operating Conditions(8)		Comments
		Avg.	Max.		Avg.	Max.	
Digester Feed Rate							
All units in-service(3)	MGD	0.27	0.41	0.49			
One unit out of service(4)	MGD	0.18	0.27	0.39			
Two units out of service(4)	MGD			0.19	0.08	0.12	System is adequate to handle current loads
Volume of In-Service Digesters(13)							
All units in-service	MGALS	8.73	8.73	8.73			
One unit out of service	MGALS	5.82	5.82	5.82			
Two units out of service	MGALS	2.91	2.91	2.91	2.91	2.91	System is adequate to handle current loads
VSS Feed Rate(5)							Peaks of digester feed and solids loading occur at different times
All units in-service (5)	LB VSS/D			175,067			
One unit out of service (6)	LB VSS/D	51,116	76,674	140,053			
Two units out of service(6)	LB VSS/D			70,027	30,000	43,269	System is adequate to handle current loads
VSS Rereduction Rate(7)(8)	%	50	50	52	62.7	62.7	System is adequate to handle current loads
Biosolids Recirculation Capacity (each digester)(9)	GPM	550	550	495	550	550	2 pumps in-service System is adequate to handle current loads
Biosolids Mixing Capacity (each digester)(9)	GPM	4,400	4,400	3,960	4,400	4,400	2 pumps in-service System is adequate to handle current loads
Axial Mixing Capacity (each digester)(9)(12)	GPM	13,250	13,250	11,925	0	0	Pumps are currently out of service System is adequate to handle current loads with refurbishement of existing pumps
Total Digester Mixing Capacity (each digester)(9)	GPM	18,150	18,150	16,380	4,950	4,950	Axial mixing pumps are currently out of service System is adequate to handle current loads with refurbishement of existing pumps
Cell Turnover Time (each digester)	MIN	160	160	178	588	588	System is adequate to handle current loads with refurbishement of existing pumps
Heat Exchanger Capacity(14)	MMBTU/HR	2.50	2.50	2.50	2.50	2.50	System is adequate to handle current loads
Capacity of Biosolids Storage and Emergency Biosolids Storage Tanks(10)	MGALS	1.30	1.30	1.17	1.30	1.30	System is adequate to handle current loads

Table 5-9: Anaerobic Digestion System - System Design Criteria and Current Operating Conditions for the Existing System

Parameter	Unit of Measure	System Design Capacity [1][2]		Estimated Firm Capacity	Current Operating Conditions[8]		Comments
		Avg.	Max.		Avg.	Max.	
Biogas Production[11]	CFD	387,370	575,056	1,365,521	245,520[8]-283,637[10]	283,637	System is adequate to handle current loads
Biogas Production Rate	CF/LB VSS DESTR	15	15	15	13.1[7] -15.1[8]	10.5[7]	System is adequate to handle current loads
Biogas Holding Tank	CF	25,000	25,000	25,000	25,000	25,000	System is adequate to handle current loads
Biogas Compressors[10]	SCFM	300	300	270	171	197	System is adequate to handle current loads
Biogas Flares[12]	SCFM	1,100	1,100	990	1,100	1,100	System is adequate to handle current loads

(1) Reference X

(2) Design hydraulic and solids peaking factors of 1.5

(3) Firm capacity is calculated based on 18-day HRT with all units in-service

(4) Firm capacity is calculated based on 15-day HRT with one unit out of service

(5) Firm capacity is calculated based on 0.15 lbs VSS/D-CF loading

(6) Firm capacity is calculated based on 0.18 lbs VSS/D-CF loading

(7) Based 0n 2013-2014 plant data; tow digesters out of service

(8) Based on PUD Operations Optimization Study TMS (References 39 and 44)

(9) Firm capacity of existing equipment is assumed at 90% of nominal capacity

(10) 1 unit is out of service

(11) Firm capacity is calculated based on 15 cf/lb VSS DEST and 52% VSS Digester VSS Reduction Rate

(12) All units in-service

(13) Based on digester cleaning history and recorded low grit deposition limited to the cone, digester firm capacity is assumed to be 100% of cylindrical active volume

(14) Based on heat exchanger cleaning history, its firm capacity is assumed to be 100% of nominal capacity

Table 5-10: Anaerobic Digestion Facilities - Existing System Design Criteria and Projected Operating Conditions for the Anaerobic Digestion System (without FOG and/or Lystek)

Parameter	Unit of Measure	System Design Capacity [1]		Estimated Firm Capacity[1][2]	Phase I Operating Conditions[3][4]		Phase II Operating Conditions[3][4]		Comments
		Avg.	Max.		Avg.	Max.	Avg.	Max.	
Volumetric VSS Loading									
All units in-service	LB VSS/CF-D			0.15	0.07	0.08	0.11	0.12	System is adequate for Phase I and Phase II loads.
One unit out of service	LB VSS/CF-D	0.07	0.10	0.18	0.11	0.12	0.16	**0.18**	At maximim loading condition, the digesters are just at borderline of the estimated VSS loading. All axial mixing pumps are required to be operated, digester stress activities to be conducted, or partial bypass to PLWTP to be established.
Detention Time[2]									
All units in-service	DAYS			18	34	30	22	20	System is adequate for Phase I and Phase II loads.
One unit out of service	DAYS	32	22	15	22	20	**15**	**13**	15 days is a minimum Hrt allowed by 40 CFR, Part 503 Regulations. All axial mixing pumps are required to be operated, digester stress activities to be conducted, and temporary bypass of system to PLWTP is required to accommodate taking one digester out of service.
Percent of Flow to be Bypassed to Meet Firm Capacity Criteria									
All units in-service	%				0	0	0	0	Bypass is not required.
One unit out of service	%				0	0	0	**13.8**	Bypass is required for Phase II maximum loading conditions.
Biogas Production[1][2][5]	CFD	383,370	575,056	1,365,521	764,749	864,166	1,080,127	1,220,543	System is adequate for Phase I loads and for Phase II loads. digester biogas laterals need to be upsized[8].
Biogas Conveyance/Handling[1][2][5]	CFD	1,100,155	1,650,233	1,650,233	764,749	864,166	1,080,127	1,220,543	System is adequate for Phase I and Phase II loads.
Short-term Peak[6]	CFD			1,650,233	**1,911,871**	**2,160,415**	**2,700,317**	**3,051,359**	System is in adequate for Phase I and Phase II loads, and inadequate to handle short term peaks. digester biogas laterals need to be upsized[8].
Flare Peak[7]	CFD			1,584,000	1,147,123	1,296,249	**1,620,190**	**1,830,815**	System is adequate for Phase I and borderline for Phase II with two flares in service. For Phase II maximum condition, additional flares and upsizing of biogas header to flares should be considered[8].

(1) Reference 19

(2) Refer to Table 5-9

(3) Refer to Tables B.1 and C.1

(4) Maximum system capacity is based on a peak 2-week hydraulic and VSS loading factors of 1.11 and 1.13, respectively

(5) Biogas production calculated at 15CF/LB VSS DESTR at 52% VSS reduction in digesters and at 10CF/LB VSS DESTR at 52% reduction in biosolids storage tanks

(6) Calculated at 2.5 short term peaking factor (Brown and Caldwell Design Guidelines)

(7) Calculated at 1.5 flare peaking factor (Brown and Caldwell Design Guidelines)

(8) Reference 39 (PUD Operations Optimization Study)

BOLD FONT indicates that operating conditions are borderline or exceed assumed design criteria or firm capacity.

In addition, having no standby digester would put substantially higher pressure on the O&M staff and would not allow the City to use the standby digester in a strategy of indirect diversion of NCPWF's off-spec water as described in (42). Table 5-11 summarizes the general pros and cons of adding an additional digester.

Table 5-11: Advantages and Disadvantages of Adding a Digester at MBC at Phase II Operating Conditions without Addition of FOG and/or Lystek Process

Advantages	Disadvantages
Additional reliability of digester operation by having one standby digester	High capital cost for construction of an additional digester with auxiliary equipment and piping
Reserve capacity at MBC for NCPWF off-spec water diversion	
Less operational attention and control required over the digester process	
Easier digester cleaning scheduling and maintenance procedures	

Based on the above pros and cons, the City should consider reaching consensus among engineering, planning, and O&M staff, which may result in selecting the more conservative and safer approach of building an additional digester and eliminating concerns cited above.

Operating digesters at the elevated organic loads outlined above in Table 5-10 for conditions without FOG and Lystek and further in the text may require substantial modification of the digester mixing system for the existing and future required digesters. These modifications are not necessarily required at this stage of evaluation but should be considered during predesign and final design efforts.

The current standard of a good digester mixing design has a nameplate mixing power of about 0.25 hp/ 1,000 ft^3 and input power of about 0.16 hp/1,000 ft^3—this is about 100 hp nameplate and 60 hp input for a digester of this size. These designs have about a 20- to 30-minute turnover rate of the digesters. In practice, these systems are often rotated so that the in-service operating turnover rate is around 60 minutes. These designs are gas mixing or draft tubes, where most of the input energy is imparted on the sludge (very little line losses).

This mixing horsepower/volume input level cannot be applied directly to pumped mixing where there is a lot of suction and discharge piping and nozzles that use up a significant amount of the input energy—this is the case for the MBC digesters. Drawings show significant piping and 6-inch nozzles. Suction is from multiple points in the cone bottom and discharge is radial at various points and elevations along the sidewall. We believe that the layout of suction and discharge is good and with proper mixing input will provide good mixing. However, the energy used will provide significantly more efficient cell turnover if one of the known packaged systems is implemented. Jet mixing manufacturers (such as Vaughan) argue that much of the pumped mixing energy goes into high-velocity jets that impart good mixing. This is partially true, but not a sufficient argument for less turnover.

Based on our evaluation, existing digesters have 280 hp per digester connected, 220 of which is from "duty" pumps. This represents 0.72 hp/1,000 ft^3 connected and 0.57 hp/1,000 ft^3 duty. Currently, only 100 hp is running because of clogged pumps. If all mixing pumps were running, CTT would be 139 minutes, and if duty pumps were running, CTT would be 160 minutes. Based on current pumps operating, CTT is 588 minutes (9.8 hours). Based on energy input there should be enough mixing energy, but the CTTs are low and the current situation with 588 minutes of CTT should be considered less than optimum to sustain required organic loads of 0.15 lb or even 0.18 lb VSS per day per cubic foot (cfd) of active digester volume.

Predesign and final design consultants should consider digester stress testing, developing a stress test protocol considering that a portion of NCWRP should be held at NCWRP and in the raw-solids-receiving tanks as indicated above, and evaluating the opportunity to modify the digester mixing systems.

City staff have pointed out to the project team that under certain conditions, MBC occasionally needs to process stored flows at twice those under average conditions. In advocating for a 2:1 peaking factor, City staff are accounting for unusual circumstances because of construction or maintenance activities, or emergencies (based on anecdotal history). Section 3.2.2 provides a discussion of different ways of managing such unusually high peaking conditions.

5.3.2.2 Required Equipment Improvements

Figures 5-4 and 5-6 present required or recommended improvements to the digester and biogas systems and identify specific improvements related to the NCWRP expansion (Pure Water Program), FOG addition, and other recommended improvements focused on improving process reliability and performance.

Table 5-12 and Table 5-13, respectively, show the projected operating conditions and improvements without FOG addition or Lystek under Phase I and Phase II, respectively. It is shown that construction of a new digester will not be required to accommodate projected Phase I or Phase II conditions, as described above. Axial mixing pump isolation valves of digester 3 (this work has already been completed for digesters 1 and 2) will need to be refurbished, and the pumps will need to be refurbished and placed back in service.

However, the following improvements will need to be implemented:

- Upsize digester gas laterals and the digester-handling equipment associated with these laterals, as outlined in (39)
- Upsize digester feed lines and modifying digester feed strategies (see Section 4.2)
- Replace existing two biogas compressors with two (for Phase I) and three (for Phase II) larger centrifugal biogas compressors
- Upsize biogas laterals from the biogas compressors, and the biogas header to the cogeneration facility, or provide a new, enlarged header to new cogeneration facility that is planned to be constructed by the City
- Add one additional biogas flare for Phase II conditions, and upsize the header to flares

Under the “no FOG/no Lystek” case, it appears that no modifications to the biogas headers will be required between the digesters and the biogas holding tank. Biogas holding tank capacity will decrease to 29 minutes (from current 45 minutes) at Phase II maximum loadings, which appears to be adequate considering that gas production is expected to become more stable because of more consistent digester feed.

Consideration should be given to replacing all aged recirculation, mixing, and axial mixing pumps for three existing digesters with new Vaughan chopper pumps or equals to enhance biosolids mixing system performance and reliability, and to replacing spiral HEXs on digesters 1 and 2 with new units. However, these modifications are not absolutely required at this time, and should be seen as part of required routine maintenance/repair activities.

The capacity of the overflow pipes should be analyzed in detail by the predesign consultant. It seems that with the modification to the emergency overflow weir made by plant staff, two 6-inch-diameter lines (normal overflow and emergency overflow) are now available for conveyance of overflow from each digester via two 10-inch-diameter lines.

Table 5-12: Anaerobic Digestion Facilities - Phase I Projected Equipment Improvements and Phase I Operating Conditions (no FOG and/or Lystek)												
Equipment Subsystem	Unit of Measure	Phase I Improvements								Phase I Operating Conditions		Capacity Assessment
		Number of Units				Capacity			Summary of Improvements			
		Status	Total	Duty	Standby	Unit Capacity	Rated Capacity	Firm Capacity		Avg.	Max.	
Anaerobic Digesters[2][3]	MGALS	Existing	3	2	1	2.91	8.73	5.82				
		New	0	0	0							New digesters are not required
TOTAL	**MGALS**		**3**	**2**	**1**			**5.82**		4.68	5.19	Firm capacity > Phase I max required based on 18-day HRT
Biosolids Recirculation Pumps (each digester)[1]	gpm	Existing	2	1	1	550	1,100	495				
		New	0	0	0							New pumps are not required
TOTAL	**gpm**		**2**	**1**	**1**			**495**		550	550	Firm capacity close to Phase I max
Biosolids Mixing Pumps (each digester)[1]	gpm	Existing	3	2	1	2200	4,400	3,960				
	gpm	New	0	0	0							New pumps are not required
TOTAL	**gpm**		**3**	**2**	**1**			**3,960**		4,400	4,400	Firm capacity close to Phase I max
Biosolids Axial Mixing Pumps (each digester)[1]	gpm	Existing	3	3	0	4400	13,200	11,880	Replace isolation valves, refurbish and place pumps back in service			
	gpm	New	0	0	0							New pumps are not required
TOTAL	**gpm**		**3**	**3**	**0**			**11,880**		13,200	13,200	Firm capacity close to Phase I max
Digester Heat Exchangers (each digester)[1]	MMBTU	Existing	1	1	0	2.5	3	2.5				
	MMBTU	New	0	0	0							New heat exchangers are not required
TOTAL	**MMBTU**		**1**	**1**	**0**			**2.5**		2.5	2.5	Firm capacity close to Phase I max
Biosolids Storage and Emergency Biosolids Storage Tanks	MGALS	Existing	2	1	1	1.3	2.6	1.3				
	MGALS	New	0	0	0							New biosolids storage tanks are not required
TOTAL	**MGALS**		**2**	**1**	**1**			**1.3**		1.3	1.3	Firm capacity close to Phase I max

Table 5-12: Anaerobic Digestion Facilities - Phase I Projected Equipment Improvements and Phase I Operating Conditions (no FOG and/or Lystek)

Equipment Subsystem	Unit of Measure	Phase I Improvements								Phase I Operating Conditions		Capacity Assessment
		Number of Units				Capacity			Summary of Improvements			
		Status	Total	Duty	Standby	Unit Capacity	Rated Capacity	Firm Capacity		Avg.	Max.	
Biosolids Storage Tank Mixing Pumps (each tank)(1)	gpm	Existing	3	2	1	3600/4000	10,800/12,000	6,480/7,200				Five pumps are provided for two tanks, two pumps per each tank with a swing standby pump
	gpm	New	0	0	0							New pumps are not required
TOTAL	**gpm**		**3**	**2**	**1**			**6,480/7,200**		7,200	8,000	Firm capacity close to Phase I max
Biosolids Transfer Pumps(1)	gpm	Existing	3	2	1	750	2,250	1,350				See Note (4)
	gpm	NEW	0	0	0							New pumps are not required
TOTAL	**gpm**		**3**	**2**	**1**			**1,350**		1,500	1,500	Firm capacity close to Phase I max
Biogas Holding Tank(1)	CFD	Existing	1	1	0	25,000	25,000	22,500				
	CFD	New	0	0	0							New biogas holding tanks are not required
TOTAL	**CFD**		**1**	**1**	**0**			**22,500**		25,000	25,000	Firm capacity close to Phase I max
Biogas Compressors(1)	SCFM	Existing	2	1	1	300	600	270	Remove existing compressors			
	SCFM	New	2	1	1	600	1,200	600	Replace with new, larger units			New biogas compressors are required
TOTAL	**SCFM**		**2**	**1**	**0**	**600**	**1,200**	**600**		531	600	Firm capacity close to Phase I max
Biogas Flares(1)	SCFM	Existing	2	2	0	550	1,100	1,100				
	SCFM	New	0	0	0							New biogas flares are not required
TOTAL	**SCFM**		**2**	**2**	**0**			**1,100**		797	900	

(1) firm capacity is assumed at 90% of nominal capacity

(2) Required detention time is calculated at 18-day HRT

(3) One digester is on standby mode

(4) Pumps are rarely used to transfer biosolids between digesters

Table 5-13: Anaerobic Digestion Facilities - Phase II Projected Equipment Improvements and Phase II Operating Conditions (no FOG and/or Lystek)

Equipment Subsystem	Unit of Measure	Phase II Improvements								Phase II Operating Conditions		Capacity Assessment
		Number of Units				Capacity			Summary of Improvements			
		Status	Total	Duty	Standby	Unit Capacity	Rated Capacity	Firm Capacity		AVG	MAX	
Anaerobic Digesters[(1)(2)]	MGALS	Existing	3	2	1	2.91	8.73	5.82				
		New	0	0	0							New digesters are not required.
TOTAL	**MGALS**	**Modified**	**3**	**3**	**0**			**8.73**	Three digesters to be kept in-service most of the time. If one digester is taken out of service, bypass of NCWRP biosolids flow to PLWTP is required at maximum flow condition and maybe required at average condition.	7.02	7.79	Firm capacity > Phase II max required based on 18-day HRT with all units in-service.
Biosolids Recirculation Pumps (each digester)[(1)]	gpm	Existing	2	1	1	550	1,100	495				
		New	0	0	0							New pumps are not required.
TOTAL (each digester)	**gpm**		**2**	**1**	**1**			**495**		550	550	Firm capacity close to Phase II max.
Biosolids Mixing Pumps (each digester)[(1)]	gpm	Existing	3	2	1	2200	6,600	3,960				
	gpm	**New**	**0**	**0**	**0**							New pumps are not required.
TOTAL (each digester)	**gpm**	**Modified**	**3**	**2**	**1**			**3,960**		4,400	4,400	Firm capacity close to Phase II max.
Biosolids Axial Mixing Pumps (each digester)[(1)]	gpm	Existing	3	3	0	4400	13,200	11,880	Replace isolation valves, refurbish and place pumps back in service.			New pumps are not required.
	gpm	**New**										
TOTAL	**gpm**		**3**	**3**	**0**			**11880**		13,200	13,200	Firm capacity close to Phase II max.
Digester Heat Exchangers (each digester)[(1)]	MMBTU	Existing	**1**	**1**	**0**	**2.5**	**2.5**	**2.5**				
	MMBTU	**New**	0	0	0							New heat exchangers are not required
TOTAL	MMBTU		**1**	**1**	**0**			**2.5**		2.5	2.5	Firm capacity close to Phase II max.
Biosolids Storage and Emergency Biosolids Storage Tanks[(1)]	MGALS	Existing	**2**	**1**	**1**	**1.3**	**1.3**	**1.3**				
	MGALS	**New**	0	0	0							New biosolids storage tanks are not required.
TOTAL	MGALS		**2**	**1**	**1**			**1.3**		1.3	1.3	

Table 5-13: Anaerobic Digestion Facilities - Phase II Projected Equipment Improvements and Phase II Operating Conditions (no FOG and/or Lystek)												
Equipment Subsystem	Unit of Measure	Phase II Improvements								Phase II Operating Conditions		Capacity Assessment
		Number of Units				Capacity			Summary of Improvements			
		Status	Total	Duty	Standby	Unit Capacity	Rated Capacity	Firm Capacity		AVG	MAX	
Biosolids Storage Tank Mixing Pumps (each tank)(1)	gpm	Existing	3	2	1	3600/4000	10,800/12,000	6,480/7,200				5 PUMPS ARE PROVIDED FOR TWO TANKS, TWO PUMPS PER EACH TANK WITH A SWING STANDBY PUMP.
	gpm	**New**	**0**	**0**	**0**							New pumps are not required.
TOTAL	**gpm**		**3**	**2**	**1**			**6,480/7,200**		7,200	8,000	Firm capacity close to Phase II max.
Biosolids Transfer Pumps(1)	gpm	Existing	3	2	1	750	2,250	1,350				Note(3)
	gpm	**New**	**0**	**0**	**0**							New pumps are not required.
TOTAL	**gpm**		**3**	**2**	**1**			**1,350**		1,500	1,500	Firm capacity close to Phase II max.
Biogas Holding Tank(1)	CFD	Existing	**1**	**1**	**0**	**25,000**	**25,000**	**22,500**				
	CFD	**New**	0	0	0							New biogas holding tanks are not required.
TOTAL	CFD		**1**	**1**	**0**			**22,500**		25,000	25,000	
Biogas Compressors(1)	SCFM	Existing	**2**	**1**	**0**	**300**	600	**270**	Remove existing compressors and replace with larger units.			
	SCFM	**New**	3	2	1	600	1,800	1,200	Install three new compressors.			Provide new biogas compressors and biogas main to cogeneration facility.
TOTAL	SCFM		**3**	**2**	**1**	**600**	1,800	**1,200**		750	848	
Biogas Flares(1)	SCFM	Existing	**2**	**2**	**0**	**550**	1,100	1,100				
	SCFM	**New**	**1**	**1**	**0**	**550**	**550**	**550**	Provide one additional flare of the same size as existing units.			Add one new biogas flare.
TOTAL	SCFM		**3**	**3**	**0**	**550**	**1,650**	**1,650**		1125	1271	

(1) Firm capacity is assumed at 90% of nominal capacity

(2) Required detention time is calculated at 18-day HRT

(3) Pumps are rarely used to transfer biosolids between digesters

The additional biogas flares will be tied into the emergency power supply.

Construction of these improvements will require engineering design and preparation of construction documents including design drawings and specifications, with exception of recommended replacement of existing (digesters 1, 2, and 3) digester recirculation, mixing, and axial mixing pumps with chopper-style pumps, and replacing existing HEXs for digesters 1 and 2.

5.3.3 Projected Conditions: Phase I (15 mgd production at NCPWF) and Phase II (30 mgd production at NCPWF) with FOG and Lystek

5.3.3.1 Summary

As described in (39), the proposed FOG receiving station could include two 350 gpm capacity rock/sediment traps, two 3 hp in-line grinders, two 300–350 gpm FOG unloading pumps, one 300 gpm FOG recirculation pump (two pumps will be added for further expansion), one 750 MMBtu/hr HEX (two HEXs could be added for future expansion), one 40,000-gallon FOG storage tank (two additional tanks could be added for further expansion), one 5 hp storage tank mixer (two additional mixers will be added for further expansion), two 2–20 gpm digester feed pumps (one additional pump could be added for further expansion), and potentially a future OCS. The facility is proposed to be located at the intersection of Plant Roads "C" and "D" at the northeast corner of MBC and immediately northwest from the parking lot, occupying an approximately 61-by-55-foot space next to the Miramar Landfill.

As reported in (39), the City is considering adding the Lystek process to treat biosolids, which could increase digester gas production by approximately 25%. Lystek is a new, low-temperature hydrolysis process owned by R.W. Tomlinson, Ltd. The potential option of implementation of this new, embryonic technology of biosolids treatment was considered in (39) and in this analysis.

Projected NCWRP biosolids flows and loads for different operating scenarios have been analyzed based on the mass balance data discussed in Section 3.1. The results of the modeling for Phase I (15 mgd production at NCPWF) and Phase II (30 mgd production at NCPWF) are summarized in the tables included in Appendices B and C. FOG addition and/or Lystek process implementation, as defined in (39), is considered in this section. For the tables pertaining to FOG addition and Lystek, refer to the tables in Appendix B and Appendix C for scenarios B.1, B.2, C.1, and C.2 for Phase I and Phase II conditions; scenarios B.1 and C.1 serve as the worst-case scenarios. As shown in Appendix C, Tables C5 and C6 the anaerobic digestion facilities will have to process substantially increased flows and loads. In accordance with industry standard practice for sizing anaerobic digesters (29), projected peak flows and loads have been calculated based on the 14-day hydraulic and solids loading peaking factors described in Section 3.1.

Table 5-14 summarizes the existing system design criteria and projected operating conditions with FOG addition and implementation of the Lystek process. The cells in the table with numbers shown in bold represent conditions where projected conditions will approach or exceed the assumed process design criteria or estimated firm capacity. As evident from Table 5-14, the existing system is adequate to handle the projected flows and loads for Phase I conditions while one digester is out of service. For Phase II conditions, the system is only marginally able to handle maximum projected flows/loads with all digesters in service, and it is inadequate if one digester is taken out of service under either average or maximum flow/loads.

Decommissioning a digester (for cleaning or maintenance/repairs) will require a temporary, partial bypass of flows to PLWTP under Phase II average or maximum flows/loadings. Table 5-13 shows that a significant portion of the NCWRP biosolids flow needs to be temporarily bypassed to PLWTP (13.3% and 21.2% of NCWRP biosolids flow under Phase II average and maximum flows, respectively). Predesign and final design consultants should further evaluate the NCWRP biosolids diversion infrastructure, PLWTP solids reserve capacity and ability to sustain additional soluble BOD loads, and means and methods of conveying biosolids from MBC to PLWTP without shorting flows to MPS.

Based on our calculations using the mass balance model developed by BC, the bypass operation will increase the MER at PLWTP from 8,134 mt/yr to 8,518 mt/yr under Phase II average conditions, and from 7,777 mt/yr to 8,474 mt/yr under Phase II maximum conditions—an increase that is still below the MER limit established by the current permit of 9,942 mt/yr (46). All axial mixing pumps need to be fully operational to maintain proper mixing in the digesters. A stress test of the digester system will need to be conducted to analyze the system's ability to respond to fairly high loads.

Considering that the partial bypass of solids from NCWRP would be required most of the time to accommodate Phase II loads with FOG and Lystek, it is recommended that the City add a digester for the MBC anaerobic digestion facilities.

The biogas conveyance headers appear to be adequate to handle Phase I flows only under average conditions for FOG-only case, and are inadequate to handle any Phase II flows/loads. For the FOG plus Lystek scenarios, it is inadequate for all Phase I and Phase II conditions. The digester biogas laterals, biogas compressors, biogas flares, and biogas headers leading to the cogeneration facility and to the flares will need to be upsized.

As referenced above, City staff have pointed out to the project team that certain unusual and rare peak hydraulic and solids conditions could be experienced by MBC because of construction or maintenance activities, events requiring the use of peaking factors as high as 2:1 in design. Section 3.2.2 provides a discussion of the ways of managing such unusually high peaking conditions.

5.3.3.2 Required Equipment Improvements

Figures 5-4 and 5-6 present required or recommended improvements to the digester and biogas systems and identify specific improvements related to the NCWRP expansion (Pure Water Program), FOG addition, and other recommended improvements focused on improving process reliability and performance.

Table 5-15 and Table 5-16, respectively, show Phase I and Phase II projected operating conditions and improvements with FOG addition and with FOG plus Lystek, respectively. Construction of one additional new digester will be required to accommodate projected Phase II conditions. Axial mixing pump isolation valves for the existing digesters will need to be refurbished, and the existing axial mixing pumps will need to be refurbished and placed back in service.

The following improvements, shown in Figures 5-4 and 5-6 will need to be implemented:

- Add one digester of the size and design similar to the existing units including all associated piping, valving, recirculation, mixing, and axial mixing equipment; heating, digester gas piping, and safety equipment; and all required appurtenances and specialty items. New digester recirculation, mixing, and axial mixing pumps are recommended to be Vaughan chopper pumps, or equal versus existing horizontal non-clog centrifugal pumps. Predesign and design consultants should also include a digester transfer equipment for the new digester, and incorporate cost-efficient means of connecting it to the existing digester transfer pumps.
- Extend digester gallery to accommodate placement of additional equipment.
- Increase the capacity of digester gas laterals and the digester-handling equipment associated with these laterals, as outlined in (39).

Table 5-14: Anaerobic Digestion Facilities - Existing System Design Criteria and Projected Operating Conditions for the Anaerobic Digestion System (with FOG and/or Lystek)

Parameter	Unit of Measure	System Design Capacity [1]		Estimated Firm Capacity[2]	Phase I Operating Conditions [3][4]		Phase II Operating Conditions[3][4]		Comments
		Average	Maximum		Average	Maximum	Average	Maximum	
Volumetric VSS Loading									
- All units in-service	LB VSS/CF-D			0.15	0.10	0.11	0.13	**0.15**	System is adequate for Phase I and borderline for Phase II loads. all axial mixing pumps should be operated.
- One unit out of service	LB VSS/CF-D	0.07	0.10	0.18	0.15	0.16	**0.20**	**0.22**	At maximum loading condition, system is inadequate to handle the estimated VSS loading. all axial mixing pumps are required to be operated, digester stress activities to be conducted, and temporary partial bypass to PLWTP to be established.
Detention Time[2]									
- All units in-service	DAYS			18	27	25	19	**18**	System is adequate for Phase I and bordeline for Phase II loads
- One unit out of service	DAYS	32	22	15	18	17	**13**	**12**	15 days is a minimum HRT allowed by 40 CFR, Part 503 Regulations. At maximum loading condition, system is inadequate to handle the estimated flows. all axial mixing pumps are required to be operated, digester stress activities to be conducted, and temporary partial bypass of system to PLWTP is required to accommodate taking one digester out of service.
Percent of Flow to be Bypassed to Meet Firm Capacity Criteria									
- All units in-service	%				0	0	0	0	Bypass is not required.
- One unit out of service	%				0	0	**13.3**	**21.2**	Bypass is required for Phase II conditions based on highest of detention time or VSS loading criteria, if fog addition is maintained.
Biogas Production[1][5]	CFD	383,370	575,056	1,650,233					
- With FOG Only					1,353,296	1,485,852	**1,759,386**	**1,946,608**	System is inadequate for Phase I and borderline for Phase II loads. Digester biogas laterals need to be upsized[8].
- With FOG and Lystek					**1,691,620**	**1,857,315**	**2,199,233**	**2,433,260**	System is adequate for Phase I loads and slightly exceeds bordeline for Phase II loads. digester biogas laterals need to be upsized[8].

Table 5-14: Anaerobic Digestion Facilities - Existing System Design Criteria and Projected Operating Conditions for the Anaerobic Digestion System (with FOG and/or Lystek)

Parameter	Unit of Measure	System Design Capacity (1)		Estimated Firm Capacity(2)	Phase I Operating Conditions (3)(4)		Phase II Operating Conditions(3)(4)		Comments
		Average	Maximum		Average	Maximum	Average	Maximum	
Biogas Conveyance/Handling(1)(5)	CFD	1,100,155	1,650,233	1,650,233					
- With FOG Only					1,353,296	1,485,852	**1,759,386**	**1,946,608**	System is adequate for Phase I and borderline for Phase II loads. replacing of biogas compressors with larger units and adding additional compressor is required for Phase II.
- With FOG and Lystek					**1,691,620**	**1,857,315**	**2,199,233**	**2,433,260**	System is adequate for Phase I and slightly exceeds borderline for Phase II loads. replacing of biogas compressors with larger units and adding additional compressor is required for Phase II.
Biogas Short-Term Peak(6)	CFD			1,650,233					
- With FOG Only					**3,383,240**	**3,714,631**	**4,398,466**	**4,866,521**	System is inadequate for Phase I and Phase II loads. System is inadequate to handle short term peaks. Digester biogas laterals need to be upsized.(8)
- With FOG and Lystek					**4,229,050**	**4,643,288**	**5,498,082**	**6,083,151**	System is inadequate for Phase I and Phase II loads. System is inadequate to handle short term peaks. Digester biogas laterals need to be upsized.(8)
Biogas Flare Peak(7)	CFD			1,584,000					
- With FOG Only					**2,029,944**	**2,228,778**	**2,639,079**	**2,919,912**	System is inadequate for Phase I and Phase II loads and requires additional gas flares and upsizing of gas lateral to flares.(8)
- With FOG and Lystek					**2,537,430**	**2,785,973**	**3,298,849**	**3,649,890**	System is inadequate for Phase I and Phase II loads and requires additional gas flares and upsizing of gas lateral to flares.(8)

(1) Reference 19

(2) Refer to table 4.3-1

(3) Refer to tables b.4 and c.4

(4) Maximum system capacity is based on a peak 2-week hydraulic and VSS loading factors of 1.11 and 1.13, respectively, for NCWRP biosolids loadings and no peaking factor for fog loadings

(5) Biogas production calculated at 15cf/lb VSS DESTR at 52% VSS reduction in digesters and at 10cf/lb VSS DESTR at 52% reduction in biosolids storage tanks

(6) Calculated at 2.5 short term peaking factor (Brown and Caldwell Design Guidelines)

(7) Calculated at 1.5 flare peaking factor (Brown and Caldwell Design Guidelines)

(8) Reference 39

BOLD FONT indicates that operating conditions are borderline or exceed assumed design criteria or firm capacity.

Table 5-15: Anaerobic Digestion Facilities - Phase I Projected Equipment Improvements and Phase I Operating Conditions (with FOG and/or Lystek)												
Equipment Subsystem	**Unit of Measure**	**Phase I Improvements**								**Phase I Operating Conditions**		**Capacity Assessment**
		Number of Units				**Capacity**			**Summary of Improvements**			
		Status	**Total**	**Duty**	**Standby**	**Unit Capacity**	**Rated Capacity**	**Firm Capacity**		**Avg.**	**Max.**	
Anaerobic Digesters[(1)]	MGALS	Existing	3	2	1	2.91	8.73	5.82				
		New	0	0	0							New digesters are not required
TOTAL at Average Conditions	**MGALS**		**3**	**2**	**1**			**5.82**		5.76		Firm capacity > Phase I max required based on 18-day HRT
TOTAL at Maximum Conditions	**MGALS**		**3**	**2**	**1**			**5.82**			5.93	Firm capacity equals to Phase I max required based on 17-day HRT
Biosolids Recirculation Pumps (each digester)[(1)]	gpm	Existing	2	1	1	550	1,100	495				
		New	0	0	0							New pumps are not required
TOTAL	**gpm**		**2**	**1**	**1**			**495**		550	550	Firm capacity close to Phase I max
Biosolids Mixing Pumps (each digester)[(1)]	gpm	Existing	3	2	1	2,200	4,400	3,960				
	gpm	**New**	**0**	**0**	**0**							New pumps are not required
TOTAL	**gpm**		**3**	**2**	**1**			**3,960**		4,400	4,400	Firm capacity close to Phase I max
Biosolids Axial Mixing Pumps (each digester)[(1)]	gpm	Existing	3	3	0	4,400	13,200	11,880	**Replace isolation valves, refurbish and place pumps back in service**			
	gpm	**New**	**0**	**0**	**0**							New pumps are not required
TOTAL	**gpm**		**3**	**3**	**0**			**11,880**		13,200	13,200	Firm capacity close to Phase I max
Digester Heat Exchangers (each digester)[(1)]	MMBTU	Existing	**1**	**1**	**0**	2.5	2.5	2.5				
	MMBTU	**New**	0	0	0							New heat exchangers are not required
TOTAL	**MMBTU**		**1**	**1**	**0**			**2.5**		2.5	2.5	Firm capacity close to Phase I max
Biosolids Storage and Emergency Biosolids Storage Tanks[(1)]	MGALS	Existing	**2**	**1**	**1**	1.3	1.3	1.3				
	MGALS	**New**	0	0	0							New biosolids storage tanks are not required
TOTAL	**MGALS**		**2**	**1**	**1**			**1.3**		1.3	1.3	Firm capacity close to Phase I max
Biosolids Storage Tank Mixing Pumps (each tank)[(1)]	gpm	Existing	3	2	1	3,600/4,000	10,800/12,000	6,480/7,200				Five pumps are provided for two tanks, two pumps per each tank with a swing standby pump
	gpm	**New**	**0**	**0**	**0**							New pumps are not required
TOTAL	**gpm**		**3**	**2**	**1**			**6,480/7,200**		7,200	8,000	Firm capacity close to Phase I max

Table 5-15: Anaerobic Digestion Facilities - Phase I Projected Equipment Improvements and Phase I Operating Conditions (with FOG and/or Lystek)												
Equipment Subsystem	Unit of Measure	Phase I Improvements								Phase I Operating Conditions		Capacity Assessment
		Number of Units				Capacity			Summary of Improvements			
		Status	Total	Duty	Standby	Unit Capacity	Rated Capacity	Firm Capacity		Avg.	Max.	
Biosolids Transfer Pumps(1)	gpm	Existing	3	2	1	750	2,250	1,350				See Note (2)
	gpm	**New**	**0**	**0**	**0**							New pumps are not required
TOTAL	**gpm**		**3**	**2**	**1**			**1,350**		1,500	1,500	Firm capacity close to Phase I max
Biogas Holding Tank(1)	CFD	Existing	**1**	**1**	**0**	**25,000**	**25,000**	**22,500**				
	CFD	**New**	0	0	0							New biogas holding tanks are not required
TOTAL	**CFD**		**1**	**1**	**0**			**22,500**		**25,000**	**25,000**	Firm capacity close to Phase I max
Biogas Compressors(1)	SCFM	Existing	2	1	0	300	600	540.0	**Remove existing compressors and replace with new**			Firm capacity is less than Phase I required
- With FOG Only	SCFM	**New**	**3**	**2**	**1**	**600**	**1,800**	**1,200**	**Install 3 larger units**			
- With FOG and Lystek	SCFM	**New**	**3**	**2**	**1**	**600**	**1,800**	**1,200**	**Install 3 larger units**			
TOTAL w/FOG Only	**SCFM**		**3**	**2**	**1**	**600**	**1,800**	**1,200**		**940**	**1,032**	Two in-service units will be able to satisfy 1290 scfm maximum capacity
TOTAL w/FOG and Lystek	**SCFM**		**3**	**2**	**1**	**600**	**1,800**	**1,200**		**1,175**	**1,290**	Two in-service units will be able to satisfy 1290 scfm maximum capacity
Biogas Flares(1)	SCFM	Existing	2	2	0	550	1,100	1,100				Firm capacity is less than Phase I required
- With FOG Only	SCFM	**New**	**1**	**1**	**0**	**550**	**550**	**550**	**Add 1 flare of size of existing flares**			
- With FOG and Lystek	SCFM	**New**	**2**	**2**	**0**	**550**	**1,100**	**1,100**	**Add 2 flares of size of existing flares**			
TOTAL w/FOG Only	**SCFM**		**3**	**3**	**0**	**550**	**1,650**	**1,540**		**1,410**	**1,548**	Three in-service flares will be able to satisfy 1548 scfm maximum capacity
TOTAL w/FOG and Lystek	**SCFM**		**4**	**4**	**0**	**550**	**2,200**	**2,090**		**1,762**	**1,935**	Four in-service flares will be required

(1) Firm capacity for existing equipment is assumed at 90% of nominal capacity

(2) Pumps are rarely used to transfer biosolids between digesters

Table 5-16: Anaerobic Digestion Facilities - Phase II Projected Equipment Improvements and Phase II Operating Conditions (with FOG and/or Lystek)												
Equipment Subsystem	Unit of Measure	Phase II Improvements								Phase II Operating Conditions		Capacity Assessment
		Number of Units				Capacity			Summary of Improvements			
		Status	Total	Duty	Standby	Unit Capacity	Rated Capacity	Firm Capacity		Avg	Max	
Anaerobic Digesters(1)(2)	MGALS	Existing	3	2	1	2.91	8.73	5.82				
		New	1	1	0	2.91	2.91	2.91	Add one digester of the same size/design as existing digester			Additional digester is required
TOTAL at Average Conditions	**MGALS**		**4**	**3**	**1**			**8.73**		8.10		Firm capacity < Phase I max required based on 18-day HRT
TOTAL at Maximum Conditions	**MGALS**		**4**	**3**	**1**			**8.73**			8.38	Firm capacity < Phase I max required based on 17-day HRT
Biosolids Recirculation Pumps (each digester)(1)	gpm	Existing	2	1	1	550	1,100	495				
		New	2	1	1	550	1,100	495	Two pumps will need to be provided for new digester			
TOTAL (each digester)	**gpm**		**2**	**1**	**1**	**550**	**1,100**	**495**		550	550	Firm capacity close to Phase I max
Biosolids Mixing Pumps (each digester)(1)	gpm	Existing	3	2	1	2,200	4,400	3,960				
	gpm	**New**	**3**	**2**	**1**	**2,200**	**4,400**	**3,960**	Three pumps will need to be provided for new digester			
TOTAL (each digester)	**gpm**		**3**	**2**	**1**	**2,200**	**4,400**	**3,960**		4,400	4,400	Firm capacity close to Phase I max
Biosolids Axial Mixing Pumps (each digester)(1)	gpm	Existing	3	3	0	4,400	13,200	11,880	Replace isolation valves and place pumps back in service			
	gpm	**New**	**3**	**3**	**0**	**4,400**	**4,400**	**11,880**	Three pumps will need to be provided for new digester			
TOTAL	**gpm**		**3**	**3**	**0**	**4,400**	**4,400**	**11,880**		13,200	13,200	Firm capacity close to Phase I max
Digester Heat Exchangers (each digester)(1)	MMBTU	Existing	**1**	**1**	**0**	**2.5**	**2.5**	**2.3**				
	MMBTU	**New**	1	1	1	2.5	2.5	2.5	One heat exchanger will be provided for new digester			
TOTAL	MMBTU									2.5	2.5	
Biosolids Storage and Emergency Biosolids Storage Tanks(1)	MGALS	Existing	**2**	**1**	**1**	**1.3**	**1.3**	**1.3**				
	MGALS	**New**	0	0	0							New biosolids storage tanks are not required
TOTAL	MGALS		**2**	**1**	**1**			**1.3**		1.3	1.3	

Table 5-16: Anaerobic Digestion Facilities - Phase II Projected Equipment Improvements and Phase II Operating Conditions (with FOG and/or Lystek)												
Equipment Subsystem	Unit of Measure	Phase II Improvements								Phase II Operating Conditions		Capacity Assessment
		Number of Units				Capacity			Summary of Improvements			
		Status	Total	Duty	Standby	Unit Capacity	Rated Capacity	Firm Capacity		Avg	Max	
Biosolids Storage Tank Mixing Pumps (each tank)(1)	gpm	Existing	3	2	1	3,600/4,000	10,800/12,000	6,480/7,200				Five pumps are provided for two tanks, two pumps per each tank with a swing standby pump.
	gpm	**New**	**0**	**0**	**0**							new pumps are not required
TOTAL	**gpm**		**3**	**2**	**1**			**6,480/7,200**		7,200	8,000	Firm capacity close to Phase I max
Biosolids Transfer Pumps(1)	gpm	Existing	3	2	1	750	2,250	1,350				Pumps are rarely used to transfer biosolids between digesters
	gpm	**New**	**0**	**0**	**0**							New pumps are not required
TOTAL	**gpm**		**3**	**2**	**1**			**1,350**		1,500	1,500	Firm capacity close to Phase I max
Biogas Holding Tank(1)	CFD	Existing	**1**	**1**	**0**	**25,000**	**25,000**	**22,500**				
	CFD	**New**	0	0	0							New biogas holding tanks are not required
TOTAL	CFD		**1**	**1**	**0**			**22,500**		**25,000**	**25,000**	
Biogas Compressors(1)	SCFM	Existing	**2**	**1**	**0**	**300**	**600**	**270**	**Remove existing compressors and replace with new**			
- With FOG Only		**New**	**3**	**2**	**1**	**680**	**2,040**	**1,360**	**Install 3 larger units**			
- With FOG and Lystek	SCFM	**New**	**3**	**2**	**1**	**850**	**2,550**	**1,700**	**Install 3 larger units**			
TOTAL w/FOG Only	SCFM							**1,360**		1,222	1,352	Two in-service units will be able to satisfy 1352 scfm maximum capacity
TOTAL w/FOG and Lystek	SCFM							**1,700**		1,527	1,690	Two in-service units will be able to satisfy 1690 scfm maximum capacity
Biogas Flares(1)	SCFM	Existing	**2**	**2**	**0**	**550**	1,100	1,100				
- With FOG Only		**New**	**2**	**2**	**0**	**550**	1,100	1,100	**Add 2 flares of size of existing flares**			
- With FOG and Lystek	SCFM	**New**	2	2	0	800	1,600	1,600	**Add 2 larger flares**			
TOTAL w/FOG Only	SCFM		**4**	**4**	**0**	**550**		**2,200**		**1,833**	**2,028**	Four flares will be required to handle full biogas production
TOTAL w/FOG and Lystek	SCFM		**4**	**4**	**0**	**2 AT 550 SCFRM AND 2 AT 800 SCFM**		**2,700**		**2,291**	**2,535**	Four flares will be required to handle full biogas production

(1) Firm capacity for existing equipment is assumed at 90% of nominal capacity

- Increase the size of the digester feed lines and modify digester feed strategies as described in Section 5.2.
- Replace the existing two biogas compressors with two (for Phase I) and three (for Phase II) larger centrifugal biogas compressors.
- Increase the size of the biogas laterals from the biogas compressors, and the biogas header to the cogeneration facility, or provide a new, parallel header to the cogeneration facility. If the City elects to construct a new cogeneration facility, a separate biogas header is recommended to accommodate maximum gas production. In this case, a parallel header to the existing cogeneration facility or upsizing of the existing header will not be required. Predesign and design consultants should further coordinate this with ongoing development of the new cogeneration system, and provide means of biogas conveyance, as necessary.
- For the scenarios with FOG addition only, install one or two additional biogas flares of the size similar to the existing flares for Phase I or Phase II conditions, respectively. For scenarios with FOG plus Lystek, install two additional biogas flares of the size similar to the existing flares for Phase I conditions, or install two larger size flares for Phase II conditions.
- Increase the size of the biogas header supplying the biogas flares.

It appears that no modifications for the biogas headers leading to the biogas holding tank will be required. Under projected loading conditions, biogas holding tank capacity will decrease to 15 minutes (from the current 45 minutes) at Phase II maximum loadings, which appears to be adequate considering that gas production is expected to become more stable because of more consistent digester feed. Potential concerns related to swings of level in the biogas holding tank and the compressor speeds will need to be further evaluated by the predesign and final design consultants.

In addition, consideration should be given to replacing all aged recirculation, mixing, and axial mixing pumps for three existing digesters with new chopper-style pumps or equals at Phase I to enhance biosolids mixing system performance and reliability. However, this modification is not absolutely required at this time, and should be seen as part of required routine maintenance/repair activities, and is listed as “other recommended improvements” in the OPC shown in Section 6 below. These improvements are also identified in Figures 5-4 and 5-6.

As for Section 5.3.2.2, construction of these improvements will require engineering design and preparation of construction documents including design drawings and specifications, with the exception of recommended replacement of existing (digesters 1, 2, and 3) digester recirculation, mixing, and axial mixing pumps with chopper-style pumps, and replacing the existing HEXs for digesters 1 and 2.

5.4 Digested Sludge Dewatering System

5.4.1 Existing Conditions

5.4.1.1 Current Operating Conditions

MBC receives digested sludge from two sources that are blended at the biosolids storage tanks: digested sludge pumped from PLWTP and digested sludge that overflows from the MBC digesters to the online biosolids storage tank (currently the “emergency” biosolids storage tank is kept in service). See Section 5.3 for details on the digestion system and the biosolids storage tanks.

Historical data from June 20, 2013, to June 19, 2014, indicated an average flow of 1,200 gpm of digested sludge pumped from PLWTP to MBC. Within the year, the daily rate of pumping ranged from a minimum of 850 gpm to a maximum of 1,800 gpm. On 3 of those 365 days, there is no recorded flow of digested sludge. These events could be related to pump outages or shutdown/tie-in events by contractors at either PLWTP or MBC. Even within a single day, there can be significant variability in the operation of the PLWTP digested sludge pumps. On February 2, 2016, for example, the average flow of digested sludge pumped from PLWTP was 1.3 mgd, but the rate varied from a low of 0.5 mgd to a high of 2 mgd.

The equalization volume available in the biosolids storage tank dampens any variability in digested sludge flows from PLWTP.

The digested sludge dewatering system begins with the pumping of digested sludge from the tank and consists of four major components, each of which is discussed in turn below:

- Sludge pressurization pumps and feed loop
- Dewatering centrifuge digested sludge feed pumps
- Dewatering centrifuges
- Polymer feed pumps

Process schematics for the sludge dewatering and polymer systems are presented in Figure 5-7, Figure 5-8, and Figure 5-9, respectively. Three chopper pumps[18] (80-P-61–80-P-63) pump digested sludge from the emergency biosolids storage tank 80-T-71 through a recirculation loop that (1) supplies up to eight dewatering centrifuge feed pumps for the dewatering centrifuges; and (2) returns any remaining surplus flow back to the tank. The supply header is a 10-inch-diameter ductile iron line; the return line is 6-inch diameter. A modulating valve (76-MV-1499) on the return line controls the pressure in the header to maintain a pressure of approximately 13 pounds per square inch gauge (psig).

Operations staff maintain the level in the emergency biosolids storage tank between 9 and 11 feet (elevation of instrument [EOI] at elevation [El.] 387.50). Pressure on the discharge side of the pumps is maintained by manually throttling a series of valves through the sludge grinder bypass. The design duty point for each chopper pump is 1,100 gpm at 85 feet TDH.

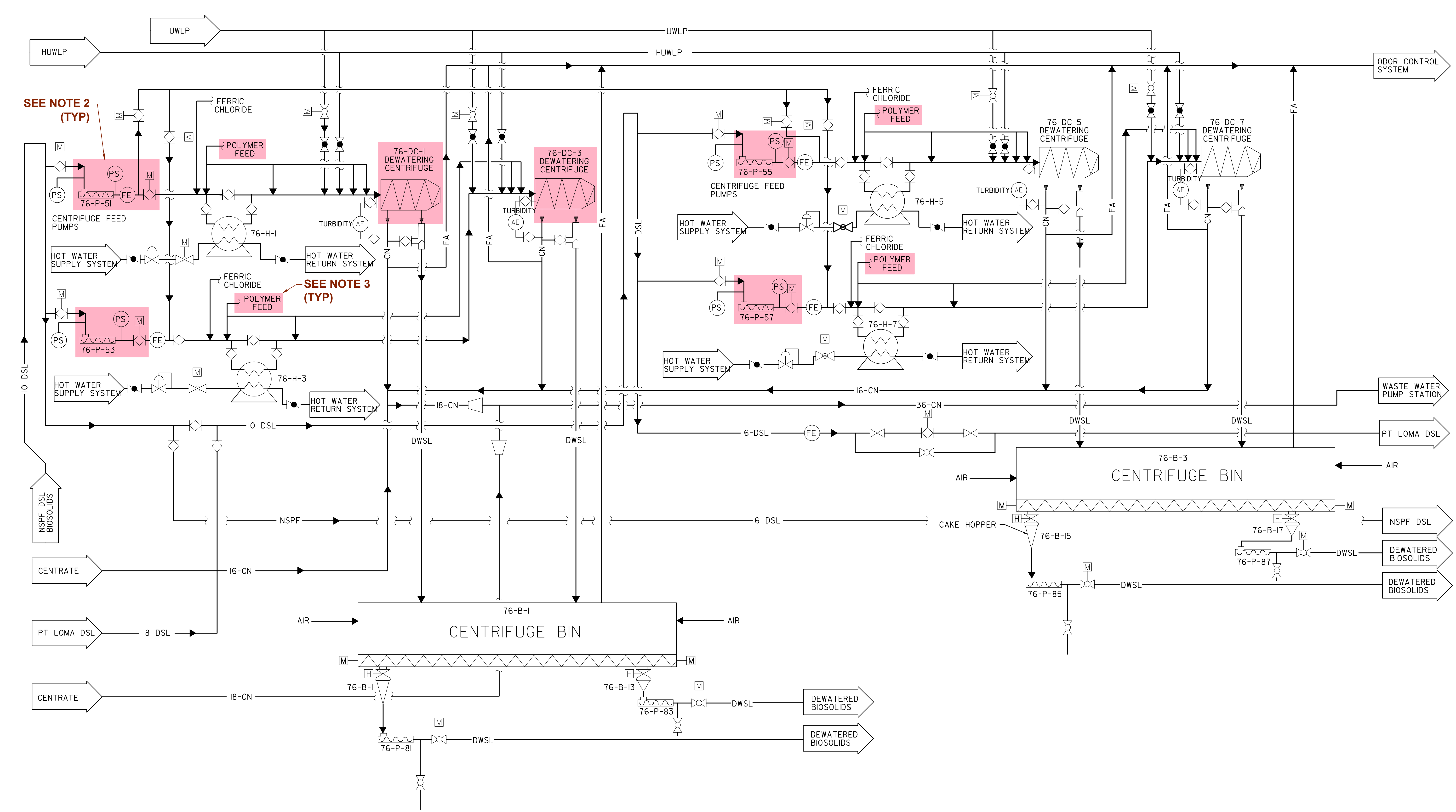
Dewatering centrifuges 1 through 8[19] operate with dedicated sludge feed pumps[20] (76-P-51–76-P-58). Each feed pump delivers digested sludge from the recirculation loop to its respective centrifuge. Dewatered sludge cake is discharged into a cake storage bin with live-bottom augers. Schwing plunger pumps deliver the dewatered cake from the storage bins to silos where it is stored and loaded into trucks for delivery offsite.[21] Centrate from the dewatering centrifuge operations flows by gravity to the centrate pump station. See Section 4.5 for further discussion of the centrate pump station.

[18] Vaughan HE4P6CS, 1,100 gpm at 85 feet TDH, 1,750 rpm, 50 hp.

[19] Sharples DS-706, 250 hp main drive motor, 25 hp backdrive motor.

[20] Seepex Model 110-6L, 25 hp, 1,780 motor rpm, 7.87:1 gearbox ratio.

[21] The dewatered sludge cake systems are not within the scope of this TM.



LEGEND:

- NCWRP EXPANSION (PURE WATER PROGRAM) UPGRADES
- FOG ADDITION UPGRADES
- OTHER RECOMMENDED IMPROVEMENTS

NOTES:

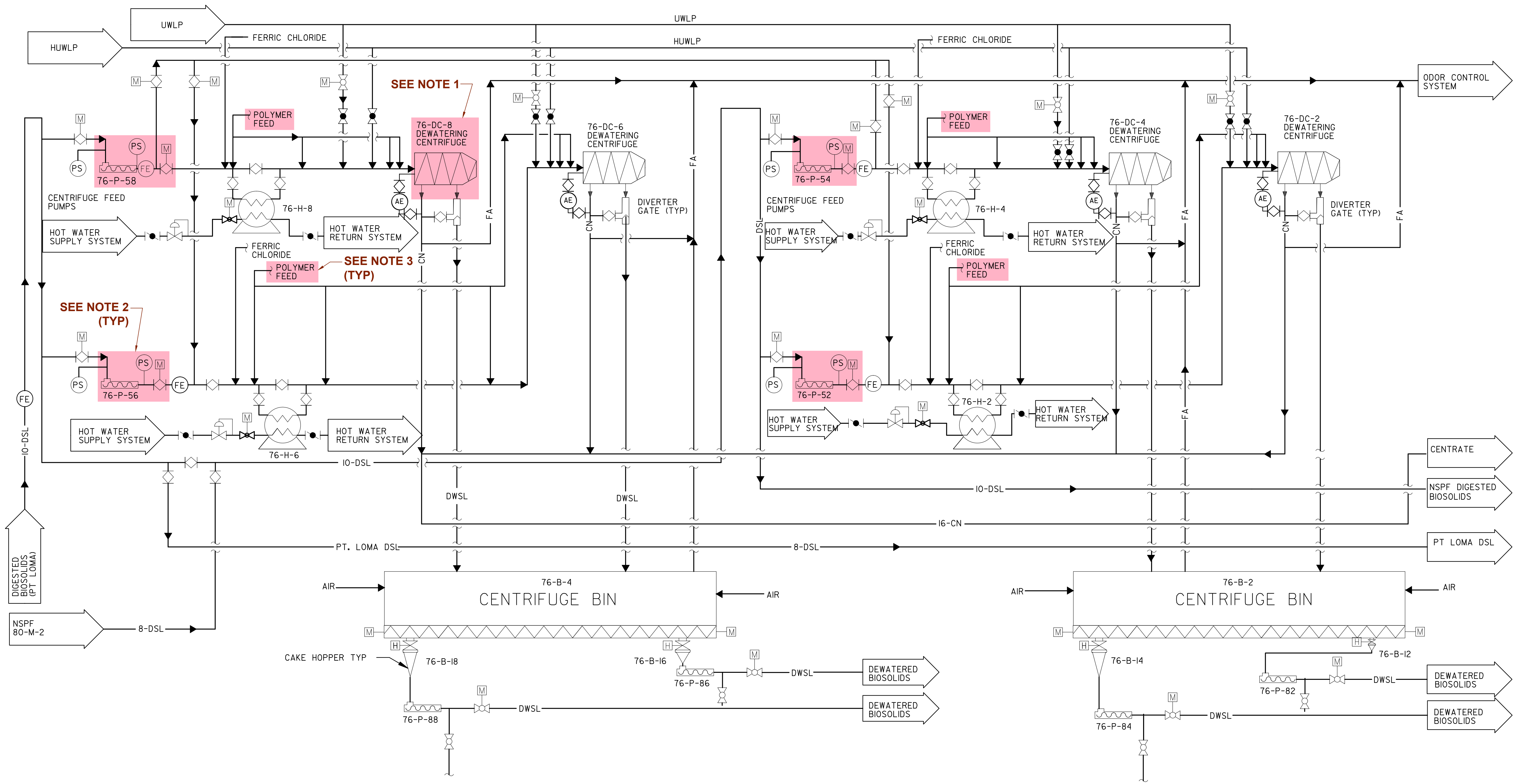
1. INSTALLATION OF 2 NEW CENTRIFUGES TO REPLACE EXISTING CENTRIFUGES NO.1 AND NO.8 IS RECOMMENDED TO ACCOMMODATE PHASE II CONDITIONS.
2. INSTALLATION OF 8 NEW, LARGER CENTRIFUGE FEED PUMPS (ONE FOR EACH CENTRIFUGE) IS RECOMMENDED TO ACCOMMODATE PHASE II CONDITIONS.
3. INSTALLATION OF 8 NEW, LARGER POLYMER FEED PUMPS (ONE FOR EACH CENTRIFUGE) IS RECOMMENDED TO ACCOMMODATE PHASE II CONDITIONS.
4. HYDRAULIC LOADING REPRESENTS AN NCPWF PRODUCTION OF 30 MGD. REFER TO SECTION 9 OF THIS TECHNICAL MEMORANDUM FOR FURTHER DETAILS.

MWH. Brown AND Caldwell
BLP Engineers, Inc.

IMPACTS OF NCWRP EXPANSION ON MBC

FIGURE 5-7

SLUDGE DEWATERING SYSTEM PROCESS SCHEMATIC - 1



LEGEND:

- NCWRP EXPANSION (PURE WATER PROGRAM) UPGRADES
- FOG ADDITION UPGRADES
- OTHER RECOMMENDED IMPROVEMENTS

NOTES:

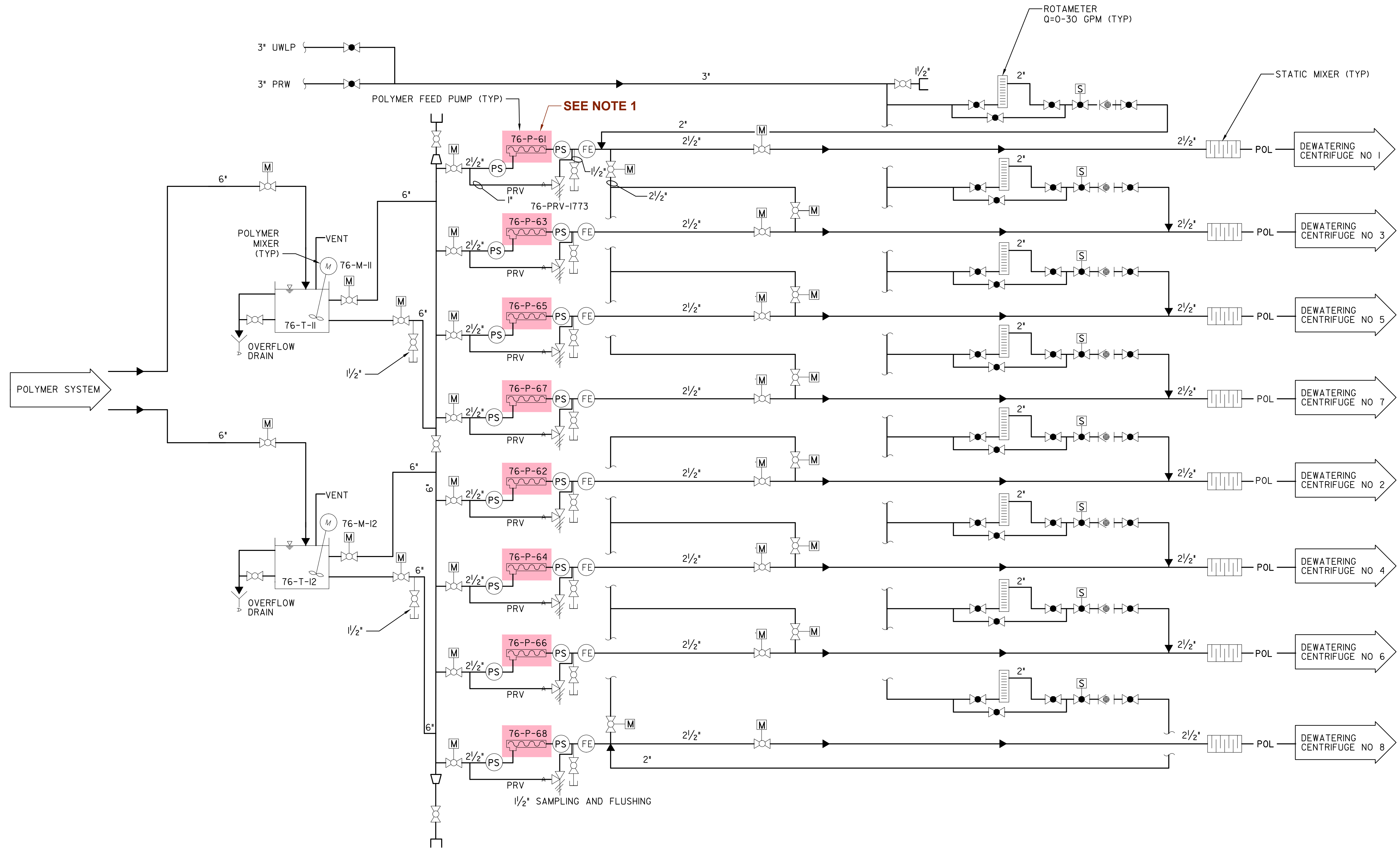
1. INSTALLATION OF 2 NEW CENTRIFUGES TO REPLACE EXISTING CENTRIFUGES NO.I AND NO.8 IS RECOMMENDED TO ACCOMMODATE PHASE II CONDITIONS.
2. INSTALLATION OF 8 NEW, LARGER CENTRIFUGE FEED PUMPS (ONE FOR EACH CENTRIFUGE) IS RECOMMENDED TO ACCOMMODATE PHASE II CONDITIONS.
3. INSTALLATION OF 8 NEW, LARGER POLYMER FEED PUMPS (ONE FOR EACH CENTRIFUGE) IS RECOMMENDED TO ACCOMMODATE PHASE II CONDITIONS.
4. HYDRAULIC LOADING REPRESENTS AN NCPWF PRODUCTION OF 30 MGD. REFER TO SECTION 9 OF THIS TECHNICAL MEMORANDUM FOR FURTHER DETAILS.

MWH. Brown AND Caldwell BLP Engineers, Inc.

IMPACTS OF NCWRP EXPANSION ON MBC

FIGURE 5-8

SLUDGE DEWATERING SYSTEM PROCESS SCHEMATIC - 2



LEGEND:

- NCWRP EXPANSION (PURE WATER PROGRAM) UPGRADES
- FOG ADDITION UPGRADES
- OTHER RECOMMENDED IMPROVEMENTS

NOTES:

1. INSTALLATION OF 8 NEW LARGER POLYMER FEED PUMPS (ONE FOR EACH CENTRIFUGE) IS RECOMMENDED TO ACCOMMODATE PHASE II CONDITIONS.
2. HYDRAULIC LOADING REPRESENTS AN NCPWF PRODUCTION OF 30 MGD. REFER TO SECTION 9 OF THIS TECHNICAL MEMORANDUM FOR FURTHER DETAILS.

MWH. Brown AND Caldwell
BLP Engineers, Inc.

IMPACTS OF NCWRP EXPANSION ON MBC

FIGURE 5-9

SLUDGE DEWATERING POLYMER SYSTEM PROCESS SCHEMATIC

Operations staff manage the supply/demand relationship between the digested sludge supplied by the chopper pumps and the demand of the dewatering centrifuges via the existing Ovation DCS. Two of the three chopper pumps serve as lead and lag pumps while the third is a standby pump. The lead pump is operational while the first four operating centrifuges are online. If circumstances require the operation of a fifth centrifuge, the lag chopper pump is started to maintain adequate pressure in the supply header.

Each of the existing Sharples dewatering centrifuges (76-DC-1–76-DC-8) operates with a dedicated progressive-cavity sludge feed pump. Under conditions at the time of this writing, each sludge feed pump nominally delivers up to 250 gpm of digested sludge to its dewatering centrifuge. At the time of this writing, the City typically operates between four and five centrifuges continuously (24 hours per day, 7 days per week) between 195 gpm and 225 gpm each.

A dedicated polymer feed pump[22] delivers up to 40 gpm of dilute polymer solution to the centrifuge inlet to improve the ability of the centrifuge to dewater the solids.

Because of the suction pressure available at the inlet to each of the sludge feed pumps, the pumps operate in a “metering” capacity. Each progressive-cavity pump is a constant-torque machine and maintains a relatively constant delivery to its receiving centrifuge across a widely varying range of pressures.[23]

5.4.1.2 Near-Term Upgrades and Modifications

The City is in the process of retrofitting six new Alfa Laval G2 centrifuges[24] to replace existing centrifuges 76-DC-2 through 76-DC-7. Two of the original Sharples centrifuges, 76-DC-1 and 76-DC-8, will remain.

Although the new centrifuges are rated for up to 400 gpm capacity, they require higher inlet pressures than the existing Sharples centrifuges. Because the new centrifuges will operate with the original sludge feed pumps and polymer feed pumps, the capacities of the pumps limit the capacity of the new centrifuges. Table 5-17 compares the current maximum operating conditions for sludge and polymer feed with the proposed operating conditions.

Table 5-17: Comparison of Current Maximum Operating Conditions and Proposed Near-term Operating Conditions for Sludge Feed Pumps and Polymer Feed Pumps (25)

Equipment	Current Max Conditions			Proposed Near-term Max Conditions		
	gpm	psi	rpm	gpm	psi	rpm
Sludge feed pump	250	21	220	340	33	250
Polymer feed pump	22	38	178	30	58	320
Total flow	**272**			**370**		

[22] Seepex BN15-6LT, 5 hp, 1,760 rpm motor with 6.7:1 gearbox ratio, 40 gpm at 50 psi discharge pressure.

[23] A review of Seepex pump curves shows that a 50% increase in discharge pressure from 60 to 90 psig results in only a 7% decrease in flow at maximum speed. As a result, the operation of the centrifuges is relatively insensitive to pressure fluctuations.

[24] Alfa Laval Aldec G2 centrifuge: 200 hp main drive motor, 50 hp backdrive motor.

TM 3 (25) proposes operating the existing sludge feed pump and polymer feed pump at higher speeds to maximize the output of the new centrifuges. In the case of the polymer feed pumps, operation requires that the VFDs control the motor at speeds that are higher than its synchronous speed.[25]

The proposed operational modifications do not require replacement of motors, drives, or pump components, but pump operation at higher speeds necessarily leads to an increase in stator wear. Table 5-18 summarizes the system design capacity of the digested sludge dewatering system that will be available once the project to replace six of the existing centrifuges is completed. In addition, it compares the pending available capacity with the current operating conditions. All of the subsystems have sufficient firm capacity to satisfy current conditions. It is anticipated that the centrifuge retrofits currently under way will be completed prior to commissioning of the expansion to NCWRP and NCPWF.

5.4.2 Projected Conditions: 30 mgd Production at NCPWF

5.4.2.1 Summary

Table 5-19 shows the projected flows of digested sludge under Phase I conditions and Phase II conditions, and compared to the system design capacity. No substantial difference between the current sludge flows and loadings and the projected Phase II conditions is shown in Table 5-18. The current maximum flow of digested sludge is 1.94 mgd based on data provided for 2013/2014; the projected Phase II maximum flow of digested sludge is 2.24 mgd under the worst case scenario dewatering centrifuge loadings for Phase II(Scenario B.2 in Appendix C).

Table 5-18: Sludge Dewatering Facilities(1) - System Design Criteria and Current Operating Conditions for the Existing System

Parameter	Unit of Measure	System Design Capacity		Estimated Firm Capacity	Current Operating Conditions		Comments
		Avg,	Max.(2)		Avg.	Max.	
Digested Sludge Pressurization(3)	MGD	N/A	3.2	2.85	1.46	1.94	Ex. System adequate to handle current loads
	gpm		2,200	1,980	1,014	1,347	
Digested Sludge Feed Rate (sludge feed pumps)	MGD	N/A	2.9	**2.32**	1.46	1.94	Ex. System adequate to handle current loads.
	gpm		2,000	**1,600**	1,014	1,347	See Note (4)
	LB TSS/D		757,000	**605,600**	327,000	551,000	
Digested Sludge Centrifuge Dewatering	MGD	N/A	3.31	2.65	1.46	1.94	Ex. System adequate to handle current loads.
	gpm		2,300	1,840	1,014	1,347	
	LB TSS/D		860,000	688,000	327,000	551,000	

[25] The listing of configuration parameters in the manual for the Robicon 454 GT drive indicates that the overspeed trip setting can be set as high as 440 Hz. The speed setting of 99 Hz proposed by Arcadis in TM 3 (25) is within the range allowed by the VFD.

Table 5-18: Sludge Dewatering Facilities[(1)] - System Design Criteria and Current Operating Conditions for the Existing System							
Parameter	Unit of Measure	System Design Capacity		Estimated Firm Capacity	Current Operating Conditions		Comments
		Avg,	Max.[(2)]		Avg.	Max.	
Polymer feed rate	gpm	N/A	240[(5)]	192	51[(6)]	86[(7)]	Ex. System adequate to handle current loads

(1) System design capacities are summarized based on the completion of the current upgrade which replaces 6 of the existing Sharples Centrifuges with six Alfa Laval Aldec G2 centrifuges.

(2) Maximum centrifuge capacity based on running 5 Aldec units at 400 gpm and 1 Sharples unit at 300 gpm and 3.0% solids. maximum sludge feed rate based on running 5 sludge feed pumps at 340 gpm each and one at 300 gpm for a total of 2000 gpm maximum pressurization system output based on running 2 of the 3 pressurization pumps.

(3) Pressurization pump system design capacities are listed based on the design TDH of 85 feet. Actual gpm output will vary depending on system backpressure and storage tank level. Three pumps total with 2 duty and 1 standby.

*(4) Sludge feed pumps are the capacity-limiting component of the system. Capacities are highlighted in **bold**.*

(5) System capacity based on an individual pump capacity of 40 gpm per pump in accordance with the original data sheets for the polymer pumps.

(6) Equates to an average of 4.5 centrifuges in operation at 11.3 gpm each.

(7) Equates to a maximum of 6 centrifuges in operation at 14.33 gpm each.

As a result, the centrifuge upgrades currently in progress provide sufficient firm capacity to handle Phase II maximum flows and loads.

5.4.2.2 Recommended Equipment Improvements

The City should consider increasing the capacity of the digested sludge feed pumps and polymer feed pumps to take full advantage of the additional available capacity in the larger Aldec G2 centrifuges. Replacing the pumps will ensure that the pumps are adequately sized, in terms of motor horsepower, to meet the higher inlet pressure requirements of the Aldec G2 centrifuges without resulting in excessive wear of stators. The recommended improvements to the sludge dewatering and polymer systems are shown in Figures 5-7 through 5-9 and illustrate specific improvements focused on improving process reliability and performance.

If the recommended peaking factor of 2:1 is used instead of 1.6:1 (see Section 3.2), the Phase II maximum flow of digested sludge to the centrifuges increases from 2.24 mgd to 2.79 mgd (see Table 5-19). With a firm capacity of 2.32 mgd established by the limitations of the sludge feed pumping systems, the improvements being installed now are marginal. Even if sludge pumps and polymer feed pumps are upgraded to attain a firm capacity of 2.65 mgd, the result would be slightly below the hypothetical maximum of 2.79 mgd.

Table 5-19: Sludge Dewatering Facilities(1) - Existing System Design Criteria and Projected Operating Conditions for the Dewatering System									
Parameter	Unit of Measure	System Design Capacity		Estimated Firm Capacity	Phase I Operating Conditions		Phase II Operating Conditions		Comments
		Avg.	Max.(2)		Avg.	Max.	Avg.	Max.	
Digested Sludge Pressurization(3)	MGD	N/A	3.2	2.85	1.57	2.17	1.60	2.24	System adequate for Phase I and Phase II loads
	gpm		2,200	1,980	1,090	1,507	1,111	1,556	
Digested Sludge Feed Rate (sludge feed pumps)	MGD	N/A	2.9	**2.32**	1.57	2.17	1.60	2.24	System adequate for Phase I and Phase II loads
	gpm		2,000	**1,600**	1,090	1,507	1,111	1,556	See Note (4)
	LB TSS/D		757,000	**605,600**	373,000	524,000	388,000	552,000	
Digested Sludge Centrifuge Dewatering	MGD	N/A	3.31	2.65	1.57	2.17	1.60	2.24	
	gpm		2,300	1,840	1,090	1,507	1,111	1,556	System adequate for Phase I and Phase II loads
	LB TSS/D		860,000	688,000	373,000	524,000	388,000	552,000	
Polymer feed rate	gpm	N/A	240(5)	192	55	100(7)	58	106(6)	System adequate for Phase I and Phase II loads

(1) System design capacities are summarized based on the completion of the current upgrade which replaces six of the existing Sharples centrifuges with six Alfa Laval Aldec G2 centrifuges.

(2) Maximum centrifuge capacity based on running 5 Aldec units at 400 gpm and 1 Sharples unit at 300 gpm and 3.0% solids. Maximum sludge feed rate based on running 5 sludge feed pumps at 340 gpm each and one at 300 gpm for a total of 2000 gpm maximum pressurization system output based on running 2 of the 3 pressurization pumps.

(3) Pressurization pump system design capacities are listed based on the design TDH of 85 feet. Actual gpm output will vary depending on system backpressure and storage tank level. Three pumps total with 2 duty and 1 standby.

*(4) Sludge feed pumps are the capacity-limiting component of the system. Capacities are highlighted in **bold**.*

(5) System capacity based on an individual pump capacity of 40 gpm per pump in accordance with the original data sheets for the polymer pumps.

(6) Six units running with 17.7 gpm polymer to each centrifuge.

(7) Six units running with 16.7 gpm polymer dose to each centrifuge.

(8) Maximum loadings are related to Scenarios B.2 shown in Appendices B and C.

This TM recommends removing and replacing 76-DC-1 and 76-DC-8 to match those currently being installed. Removing and replacing 76-DC-1 and 76-DC-8, in conjunction with sludge feed pumps and polymer feed pumps, provides a firm capacity of 2.8 mgd (six units at 320 gpm each). There are no clear, compelling reasons to replace the two centrifuges, and all eight sludge feed pumps and polymer feed pumps, based on the expansion of NCWRP to supply NCPWF. However, long-term, operational factors on a system-wide scale may need to be considered (see Section 2.2.2). In addition, the City should consider the age of the existing VFDs, and possible replacement. Obsolescence, and the availability of technical support, factor into the decision because the aging electrical components for feed pumps may control the availability of relatively new dewatering centrifuges. While replacing the centrifuges is a significant upgrade, the older remaining support equipment becomes the weak link in the availability of a given centrifuge, new or old.

Budget pricing for upgrades to the solids-dewatering system have been included as a separate line item for general reference in considering system-wide alternatives to biosolids inventory management.

Construction of these improvements will require engineering design and preparation of construction documents including design drawings and specifications.

5.5 Centrate System

5.5.1 Existing Conditions

5.5.1.1 Existing Facilities

The wastewater and centrate pump station is located in Area 94 in the western portion of the site. The pump station receives centrate from both the thickening and dewatering centrifugation processes. It is also designed to receive and pump sanitary wastewater from plant facilities. However, the centrate is the majority of the fluid pumped at this pump station. The City has evaluated options for separating the centrate from the dewatering centrifuges and treating it onsite before discharging back to the pump station under a separate project. The goal of centrate treatment is the reduction of nitrogen concentration as well as removal of N-Nitrosodimethylamine (NDMA) precursors from this stream. This would allow the centrate to augment influent flow to NCWRP. We understand that the City has decided to proceed with centrate disposal versus onsite treatment with potential discharge of the centrate through the brine line.

5.5.1.1.a Wetwell

The wetwell at the pump station has a total working capacity of 10,600 gallons. Flow into the wetwell is controlled by an automatic sluice gate measuring 36 by 36 inches that shuts off the wetwell in case of pump failure or flooding is detected in the drywell. A hand-operated sluice gate can be opened to allow sanitary wastewater from the plant into the wetwell. The wetwell is equipped with level indicators and transmitters that are linked to the DCS.

5.5.1.1.b Centrifugal Pumps

The pump station is equipped with three centrifugal non-clog pumps (94-P-01–94-P-03) with a nominal capacity of 2,650 gpm each. The pumps are operated in lead-lag configuration and in variable-speed mode. The control strategy allows operation of all three pumps if required, although this is not expected to be typical or frequent for current operating conditions. The operating speeds of each pump vary between approximately 900 and 1,160 rpm.

Flow rates range between approximately 1,000 gpm and 3,000 gpm with one pump operating, and between 2,500 gpm and 5,000 gpm with two pumps operating for the low-friction condition. The maximum combined flow rate drops to approximately 4,000 gpm for the high-friction condition. The maximum head developed, at this condition, is 100 feet, while the shutoff head of the pumps is 130 feet. The pump station layout provides room for a future additional pump (94-P-04) of similar capacity as the existing three pumps.

5.5.1.1.c Force Main

The force main is a 20-inch-diameter, Class 350 steel pipeline that runs from MBC to NCWRP. The pipeline runs approximately 4.2 miles northwest from MBC until it reaches the influent pump station (IPS) at NCWRP. The original pipeline design included a pressure-monitoring station that is located outside the MBC site perimeter. The pressure-monitoring system is used for automatically operating a pressure-sustaining station located on the pipeline just upstream of the IPS at NCWRP. The pressure-sustaining station has been bypassed and the pressure-monitoring station is also no longer in use.

5.5.1.1.d Auxiliary Mechanical Equipment

The pumps require various types of auxiliary equipment for operation. These include check valves, isolation valves, force main drain valve, a new air-release valve at the force main high point, seal water system, and various sensors and transmitters. The 36-inch-diameter centrate collection header that conveys the centrate from the Centrifuge Building in Area 76 can also be considered an auxiliary item to the pump station.

5.5.1.2 Current Operating Parameters and Performance

The pump station is currently operating normally with two pumps typically in service and one pump in standby mode. As per the control strategy, the lead pump starts at low speed and ramps up speed to maintain the wetwell level set points. When the level exceeds the preset threshold, the lag pump also starts and both pumps reduce speed initially. Both pumps then ramp up speed and reach full speed before the next higher set point is reached. Although the control strategy allows for three pumps to operate, this mode of operation is rare. The pumps are adequate for handling current flows.

One issue noted by City staff is the possibility that grit deposition has occurred within the force main. The force main lacks intermediate stations along its alignment and is also not equipped with a means for cleaning or pigging. Although the City has attempted to inspect and clean the force main in the past, this was possible only for a short distance beyond the pump station. The likelihood of grit deposition is evidenced by the fact that the pumps are currently operating at much higher discharge heads than anticipated. The condition of the force main is currently being assessed via the condition assessment program; hydraulic testing of the force main has already been completed.

Pump data obtained were plotted to generate a system curve, which was superimposed on the design system curves. Figure 5-10 presents the comparison, where the red curve represents current operational data. The comparison shows that the system curve is significantly steeper than both the low-loss and high-loss system curves. Table 5-20 also shows the performance characteristics of the pumps.

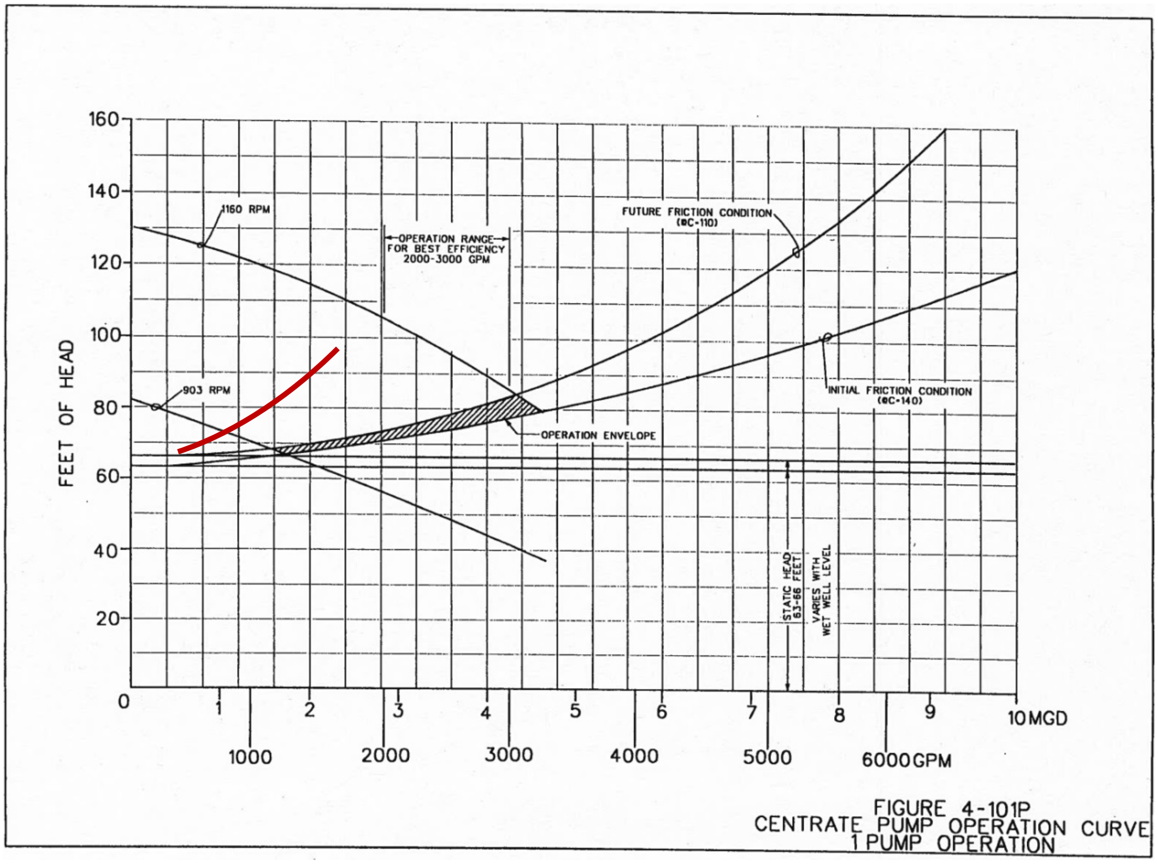


Figure 5-10: Comparison of Design and Current Centrate Pump System Curves

Table 5-20: Centrate Pump Station Facilities - System Design Criteria and Current Operating Conditions for the Existing System

Parameter	Unit of Measure	System Design Capacity		Estimated Firm Capacity	Current Operating Conditions[1]		Comments
		Avg,	Max.		Avg.	Max.	
Centrate Pumps	MGD	N/A	7.6	6.9	1.15	3.20	Ex. System adequate to handle current loads
	gpm		5,300	4,770	799	2,222	
Centrate Force Main	MGD	N/A	11.3	11.3	1.15	3.20	Ex. System adequate to handle current loads[2]
	gpm		7,833	7,833	799	2,222	

(1) Based on data from January 2016 through March 2016.

(2) Based on assumption of maximum velocity of 8 feet per second and that force main will be restored to design conditions.

5.5.2 Projected Conditions: Phase I (15 mgd production at NCPWF) and Phase II (30 mgd Production at NCPWF)

5.5.2.1 Summary

As discussed in Section 3.1, centrate flows are projected to increase significantly with the expansion of NCWRP, with thickener centrifuge centrate contributing a large part of this increase. Table 5-21 shows that the existing pumps operating as currently configured would be adequate for handling increased flows following Phase I expansion. However, the pumps would need to be operated at their maximum capacity and outside the zone of best efficiency during peak conditions.

Table 5-21 also shows the Phase II projected conditions. During peak conditions, the centrate flows generated, when pumped through the existing force main, will generate much higher dynamic losses than anticipated during original design. The total head during peak conditions exceeds the shutoff head of the existing pumps. Therefore, all pumps would need to be replaced with new pumps capable of delivering higher head to handle peak conditions. In addition, a fourth pump would need to be added so that the pump station may be operated with three pumps in service and one on standby.

Table 5-21: Centrate Pump Station Facilities - System Design Criteria and Projected Operating Conditions

Parameter	Unit of Measure	System Design Capacity		Estimated Firm Capacity	Phase I Operating Conditions		Phase II Operating Conditions		Comments
		Avg.	Max.		Avg.	Max.	Avg.	Max.	
Centrate Pumps	MGD	N/A	7.6	6.9	2.90	4.43	4.28	6.55	Ex. System inadequate to handle Phase II loads(1)
	gpm		5,300	4,770	2,014	3,076	2,972	4,548	
Centrate Force Main	MGD	N/A	11.3	11.3	2.90	4.43	4.28	6.55	Ex. System adequate to handle projected loads(2)
	gpm		7,833	7,833	2,014	3,076	2,972	4,548	

(1) Although the capacity of the pumps is greater than the projected flows, the pumps do not have the ability to generate sufficient head.

(2) Based on assumption of maximum velocity of 8 feet per second and that force main will be restored to design conditions.

The existing force main is adequate for handling future flows, both average and peak, at velocities below 8 fps. This velocity is generally the maximum preferred in municipal wastewater systems. Peak flow velocities following Phase II improvements would be below 6 fps and velocity during the average flow condition would be below 4 fps. However, this is predicated on a clean force main that is free of grit and obstructions. A system curve for future conditions developed by extrapolating current data indicates that total head required would be significantly higher than that indicated by the system curve developed during initial design of the plant. The existing 36-inch-diameter centrate collection header was also evaluated and determined to be adequate for all future flow conditions.

5.5.2.2 Required Equipment Improvements

Table 5-22 and Table 5-23, respectively, summarize the required improvements during Phases I and II. The existing pumps are adequate for handling increased flows during Phase I. However, Phase II would require replacement of all existing pumps with new pumps capable of developing higher head, together with installation of a fourth pump. Construction of these improvements will require engineering design and preparation of construction documents including design drawings and specifications.

The centrate pump station represents a critical component of the plant and shutdown of this process will impact operation of the entire plant. Therefore, it is critical that the force main be equipped with a means for inspection and cleaning, or bypassing flow to an alternate location or conveyance system. Evaluating the system for installation of such facilities is outside the scope of this study. However, it is strongly recommended that the City conduct such an evaluation as soon as possible. The required improvements are shown schematically in Figure 5-11.

5.6 Odor Control System

5.6.1 Existing Conditions

5.6.1.1 Existing Facilities

The Area 60 OCS serves a large portion of the MBC process facilities. Foul air from pre-digestion and post-digestion facilities is collected in separate headers and then commingles at the OCS. These facilities include grit removal, centrifugation, and biosolids loading (truck loadout), among others. Foul air treatment is accomplished using chemical scrubbers and carbon adsorbers. The OCS consists of three trains, two of which operate continuously while the third serves as a standby.

5.6.1.1.a Chemical Scrubbers

The OCS consists of acid scrubbers and caustic/hypochlorite scrubbers. The acid scrubbers were designed for treating only the post-digestion foul air stream, while the caustic/hypochlorite scrubbers were designed for treating the entire foul air stream. Each acid scrubber was designed for treating 8,000 cubic feet per minute (cfm) of foul air and each caustic/hypochlorite scrubber was designed for treating 26,000 cfm of foul air.

The acid scrubbers are cylindrical fiberglass-reinforced plastic (FRP) shells with plastic packing media. Each vessel is 60 inches in diameter and approximately 22 feet tall. Sulfuric acid is used for treating ammonia in the foul air. The caustic/hypochlorite scrubbers are also constructed of FRP and are 108 inches in diameter and approximately 22 feet tall. Each scrubber is served by a recirculation pump that recirculates chemical from the scrubber sump to the top of the packing media. Foul air treatment occurs when recirculating chemical liquid comes in contact with the foul air within the packing media.

5.6.1.1.b Heat Exchangers

After treatment in the chemical scrubbers, the foul air stream is directed to the carbon adsorbers. Because excessive moisture in the air stream can significantly reduce the removal efficiency of activated carbon, the OCS was designed to move the air from the scrubbers through HEXs directly upstream of the carbon vessels. The HEXs were designed to heat the air for increasing the dry-bulb temperature. The HEXs were air heating coil type, manufactured by Aerofin Corporation and used hot water for heating foul air. Each had a total surface area of approximately 2,500 square feet (ft^2) and was designed to increase the dry bulb temperature of foul air by 20°F.

5.6.1.1.c Carbon Adsorbers

Carbon adsorption is used as a polishing stage following chemical scrubbing. Heated foul air from the HEXs moves through two carbon adsorbers per train. Each adsorber in turn contains two carbon beds of 3-foot depth arranged vertically. Each adsorber is an FRP vessel 108 inches in diameter and approximately 15 feet tall, and loaded with granular activated carbon. Treated foul air exits the carbon adsorbers at the top of the FRP vessel and is discharged to the atmosphere via a stack.

5.6.1.1.d Foul Air Fans

Each odor control train is served by a single foul air fan with a rated capacity of 26,000 cfm and was designed to develop a static pressure of 17 inches of water column. The fans are all constructed of FRP and include FRP wheels that are 40.25 inches in diameter. The motors are 125 hp each, totally enclosed and fan-cooled, and rated for 95% efficiency at full load. Each fan discharges foul air directly upward into a vertical stack through air that exits the OCS. The inlet opening at each fan is regulated using an inlet vane damper to ensure that each train is operating at the design airflow rate. The fans operate at constant speed and pressure.

5.6.1.2 Current Operating Parameters and Performance

The performance of the OCS was evaluated in September 2012, when field investigations were conducted and airflow measurements were obtained at various points in the foul air collection system and the OCS. The field investigation showed that the airflow rates in the system varied between 85% and 104% of design capacity. However, the airflow in the OCS directly upstream of the foul air fans was higher and varied between 91% and 104%. Prior to the field investigation, it was thought that the system was operating at airflow rates significantly lower than design.

In addition to airflow measurements, grab samples and four-gas meter readings were taken at various locations in the system. Results of the laboratory analysis of the samples and the readings obtained from the four-gas meter indicated that the OCS was operating well. The hydrogen sulfide (H_2S) and ammonia concentrations at the inlet to the OCS were fairly low and the system was thus lightly loaded. Finally, the activated carbon in one of the adsorber vessels was sampled for visual observation. Although biofilm growth was suspected, it was not detected in the samples. A slight amount of stratification had occurred in the beds with smaller carbon granules occurring in greater numbers in the sample from the lower port of the bed compared to the top port. Details of the field investigation are available in the *Basis of Design Report, MBC Odor Control Facilities Upgrade, Brown and Caldwell, September 2013.*

Some of the mechanical equipment originally installed in the OCS are no longer in use. The water-carrying tubes in the HEXs corroded several years ago and the HEXs are therefore no longer in use. The inlet vane dampers upstream of the foul air fans were also removed and replaced with a flexible neoprene fitting. Modifications were also made to the foul air headers inside the carbon adsorber vessels to allow for better drainage of condensate. These modifications resolved operational issues related to condensate aspiration and carry-over that had previously existed.

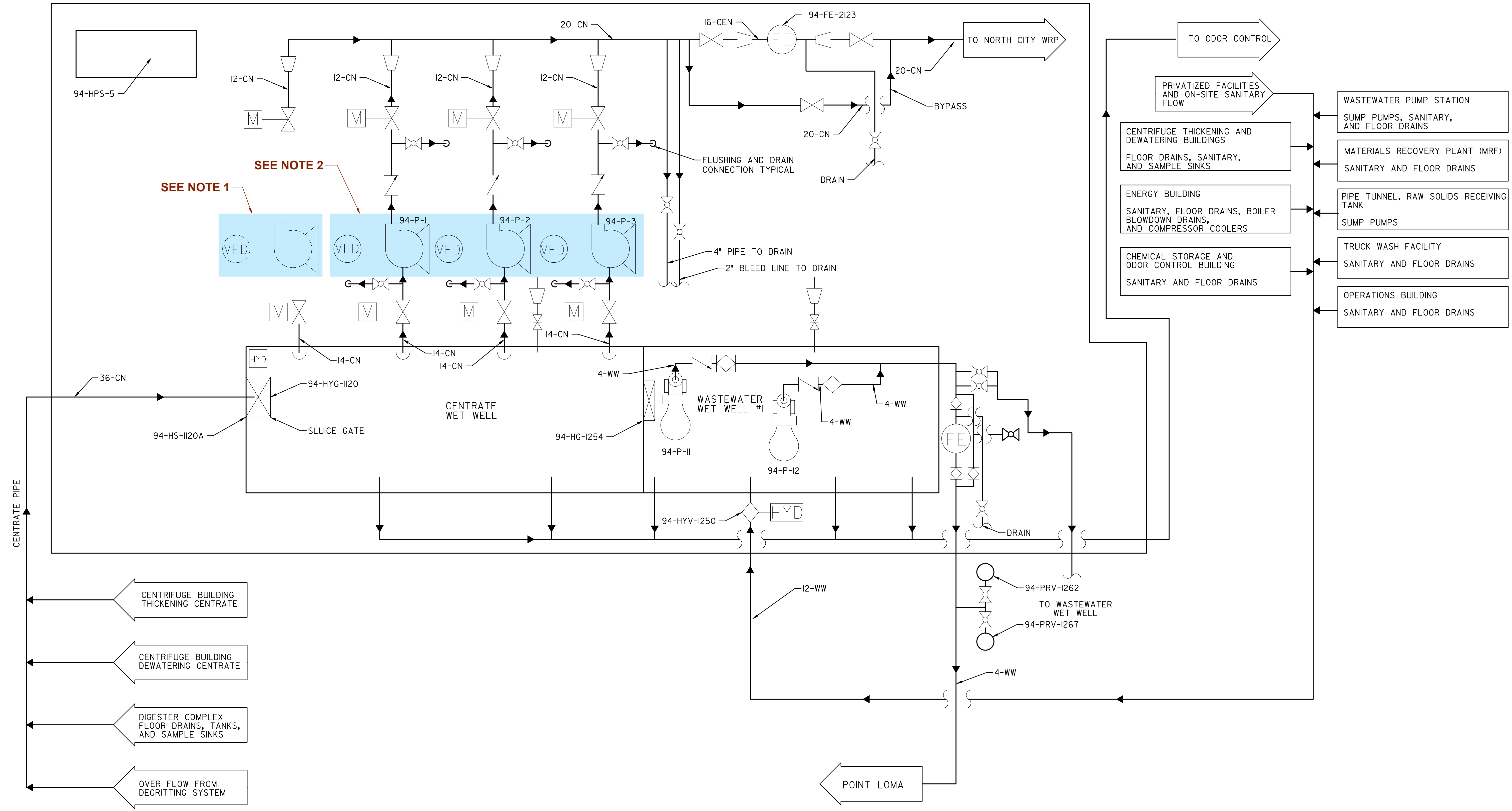
Table 5-22: Centrate Pump Station Facilities - Phase I Projected Equipment Improvements and Phase I Operating Conditions

Equipment Subsystem	Unit of Measure	Phase I Improvements								Phase I Operating Conditions		Capacity Assessment
		No. of Units Under Max. Conditions				Capacity			Summary of Improvements			
		Status	Total	Duty	Standby	Unit Capacity	Rated Capacity	Firm Capacity		Avg.	Max.	
Centrate Pumps	gpm	Existing	3	2	1	2,650	5,300	4,770				
TOTAL	**gpm**		**3**	**2**	**1**	**2,650**	**5,300**	**4,770**	No improvements needed	2,014	3,076	Firm capacity > Phase I max(1)
	MGD									2.90	4.43	

(1) Existing pumps have both the capacity and ability to develop the required head for the projected conditions.

Table 5-23: Centrate Pump Station Facilities - Phase II Projected Equipment Improvements and Phase II Operating Conditions

Equipment Subsystem	Unit of Measure	Phase II Improvements								Phase I Operating Conditions		Capacity Assessment
		No. of Units Under Max. Conditions				Capacity			Summary of Improvements			
		Status	Total	Duty	Standby	Unit Capacity	Rated Capacity	Firm Capacity		Avg.	Max.	
Centrate Pumps	gpm	Existing	3	2	1	2,650	5,300	4,770	Replace existing pumps and add fourth pump			Existing pumps are inadequate due to inability to generate sufficient head at projected flow
	gpm	**New**	**4**	**3**	**1**	**1,700**	**5,100**	**4,590**				
TOTAL	**gpm**		**4**	**3**	**1**	**1,700**	**5,100**	**4,590**		2,972	4,548	
	MGD									4.28	6.55	



LEGEND:

- NCWRP EXPANSION (PURE WATER PROGRAM) UPGRADES
- FOG ADDITION UPGRADES
- OTHER RECOMMENDED IMPROVEMENTS

NOTES:

1. INSTALL FOURTH CENTRATE PUMP.
2. REPLACE EXISTING CENTRATE PUMPS WITH NEW PUMPS CAPABLE OF HANDLING HIGHER HEAD.
3. HYDRAULIC LOADING REPRESENTS AN NCPWF PRODUCTION OF 30 MGD. REFER TO SECTION 9 OF THIS TECHNICAL MEMORANDUM FOR FURTHER DETAILS.

MWH. Brown AND Caldwell
BLP Engineers, Inc.

IMPACTS OF NCWRP EXPANSION ON MBC

FIGURE 5-11

CENTRATE PUMP STATION REQUIRED EQUIPMENT IMPROVEMENTS

5.6.2 Projected Conditions: Phase I (15 mgd production at NCPWF) and Phase II (30 mgd Production at NCPWF)

5.6.2.1 Summary

The required expansion of the Grit Removal Facility will slightly increase the amount of foul air that requires treatment at the OCS. No other process changes or building expansions would increase the airflow requiring treatment. The expansion of the Grit Removal Facility will require treatment of an additional 2,000 cfm of foul air. This represents an increase of 4% in the foul airflow and possible H_2S loading at the OCS. Although the chemical scrubber was designed for an inlet H_2S concentration of 5 parts per million by volume (ppmv), the field investigation described earlier indicated inlet concentrations of under 0.5 ppmv. Therefore, a 4% increase in H_2S loading at the OCS would not pose any operation issues because the system is currently operating far below design loadings and has adequate capacity to handle higher loads.

In addition, the MBC Odor Control Facilities Upgrade work currently under way will implement certain changes to operational strategy as well as changes to equipment. The flexible connection upstream of the fan inlet will be replaced with an open-close type motorized damper to better isolate trains during standby mode. The fan motors will be provided with VFDs and will be operated to achieve constant flow to ensure that the system is operated in compliance with Air Pollution Control District (APCD) permit conditions.

5.6.2.2 Required Equipment Improvements

As discussed earlier, the existing OCS has adequate capacity to handle the minor increase in foul airflow. Therefore, this process does not require any improvements during either Phase I or Phase II.

5.7 Chemical Storage and Handling Systems

5.7.1 Existing Conditions

The discussion of chemical addition systems under this section is confined to only those chemicals that have a direct impact on the solids-processing operations at MBC. Sodium hypochlorite (SHC) and sodium hydroxide are stored and handled on site, and used to support the operation of OCSs, as described in Section 5.6.

The two chemicals of interest for the thickening, dewatering, and anaerobic digestion facilities are ferrous chloride ($FeCl_2$)[26] and anionic polymer (PEA)[27]. $FeCl_2$ is used to control sulfide production in the digesters, and PEA is used in conjunction with thickening and dewatering centrifuges to enhance solids removal.

In general, bulk chemicals are stored and diluted at the central Chemical Handling Facility (Area 60). From the central facility, chemicals are pumped to remote day tanks and day tanks located in the areas where the chemicals are used. In the case of PEA, the dilute polymer solution is transferred to two separate sets of day tanks: one set serves the dewatering centrifuges and the other serves the thickening centrifuges. In the case of $FeCL_2$, commercially available 28% to 32% concentration by weight $FeCL_2$ is transferred to either one of two day tanks located in a chemical room adjacent to the pipe galley in Area 80 at the digesters.

[26] $FeCl_2$ is supplied as a liquid solution that is between 28% and 32% active ingredient by weight. The brown liquid has a specific gravity of 1.4 and is supplied by Kemira Inc. A value of 30% active ingredient by weight was used in calculations. See the safety data sheet for additional information (28).

[27] Polydyne supplies the PEA Clarifloc 331, which is used for both thickening and dewatering centrifuges. Clarifloc 331 is a Mannich polymer. See safety data sheet (27) for additional information.

5.7.1.1 Anionic Polymer Handling Facilities

Dilute PEA is stored in two separate areas within Building 76 in two separate sets of polymer day tanks. The dilute polymer feed pumps that deliver polymer to each centrifuge are mounted adjacent to the polymer day tanks. The room on the southeast corner of Building 76 serves the dewatering centrifuges; the room on the northeast corner of Building 76 serves the thickening centrifuges.

Modeling results indicate that the projected combined production of digested sludge from PLWTP and MBC is largely unchanged over the span of time between current conditions and Phase II conditions. As a result, the diversion of wastewater to meet the needs of the NCWRP Expansion has no significant impact on the existing polymer mixing and storage facilities for solids thickening and dewatering.

Although the throughput of dilute polymer solution for the thickening centrifuges will increase dramatically, the existing system will be able to meet the increased demand because of the batch-processing nature of the operation. Under current conditions, each of the two polymer day tanks for the thickening centrifuges alternates operation. It currently takes 10 hours for the thickening centrifuge to use the volume of dilute polymer solution. Extrapolating from this time span, a five-fold increase in throughput will result in a 2-hour cycle time. Even with a reduced cycle time for polymer transfer from the Chemical Building, the polymer system for thickening centrifuges is adequate to handle Phase II conditions. Further adjustments in high- and low-level set points can be made to lengthen cycle times if necessary.

The polymer feed pumps that feed thickening and dewatering centrifuges are discussed under the sections for thickening and dewatering—Sections 5.2 and 5.4, respectively. Based on this overall assessment of polymer systems, the remainder of this section focuses on the $FeCl_2$ addition system.

5.7.1.2 Ferrous Chloride Handling Facilities

$FeCl_2$ is transferred from Area 60 to one of two day tanks (80-T-01 and 80-T-02) housed in a dedicated chemical-handling area adjacent to the main gallery in Area 80. Currently, one day tank is operational and the other is out of service.

Two peristaltic feed pumps[28] (80-P-80 and 80-P-81), one duty and one standby, feed $FeCl_2$ from the day tank directly into the operating digester (digester 3 at the time of this writing) for control of H_2S. The speed of the duty pump is manually set based on the results of biweekly tests of H_2S levels in the digester gas. Each pump is fitted with a 12-millimeter (mm) Marprene tube element.

Using the available data for 2013/2014, the estimated ratio of dry active chemical per 1 ton of VSS is 99.3 lb/ton. Extrapolations based on this dosage are used to project the chemical addition feed rates under Phase I and Phase II conditions.

[28] Watson Marlow Bredel 620DUN/RE pumps. Although each pump is capable of operating at up to 265 rpm, the rotor warranty is void if the pump discharge pressures exceed 2 bar (29 psig) above the upper limit of 165 rpm. Currently, each pump operates with a two-roller head and a 12 mm Marprene tubing element. Each pump has the ability to operate at a higher capacity by replacing the 12 mm tube with a 17 mm tube.

Pump output under actual field conditions is considerably less than that predicted by the theoretical curves published by the pump manufacturer. Based on pump drawdown tests, the pump output at 92 rpm was 0.31 gpm. Assuming a maximum pump speed of 165 rpm, and prorating the pump output accordingly, the maximum output is 0.56 gpm. Typical operating feed rates are between 0.28 and 0.34 gpm. Occasionally feed rates are as high as 0.44 gpm when high sulfide concentrations are present. Table 5-24 presents this information. This assessment is based on 165 rpm and 0.56 gpm per pump as the maximum firm capacity of each peristaltic pump using 12 mm tubing[29].

Table 5-24: Chemical Handling - Ferrous Chloride Addition Facilities
System Design Criteria and Current Operating Conditions for the Existing System - 1 Digester in Operation

PARAMETER	UNIT OF MEASURE	SYSTEM DESIGN CAPACITY (1)		ESTIMATED FIRM CAPACITY	CURRENT OPERATING CONDITIONS		COMMENTS
		Avg.	Max.		Avg.	Max.	
Ferrous Chloride Feed	gpm	N/A	1.62	0.58 (3)	0.28	0.34	Ex. System adequate to handle current loads.
Day Tank Working Volume	gallons	N/A	576	576	N/A	217 (2)	Ex. System adequate to handle current loads.
Day Tank Cycle Time (2)	hours	N/A	5.9	7	N/A	10.6	Ex. System adequate to handle current loads.

(1) Capacity per pump based on a max rated rpm of 165 rpm. There are no design average values.

(2) Day tank fill starts at level 2.02 and shuts off at level 5.05. Levels are adjustable at the DCS.

(3) The firm capacity is derived by applying a derating factor for the pump to account for tubing attrition. Derating factor of 0.36 based on tests in which an existing pump at 130 rpm delivered 0.44 gpm instead of 1.28 gpm.

5.7.1.3 Ferrous Chloride: Near-Term Upgrades and Modifications

Under a construction contract that is in progress, City staff will add a third $FeCl_2$ metering pump (80-P-82). This pump will be identical to the existing peristaltic pumps. Pump 80-P-81 will serve as a standby pump to either 80-P-80 or 80-P-82.

The proposed chemical discharge piping system allows one pump to supply chemical to any one digester as long as only one digester is in service. The proposed piping does not necessarily anticipate the operating condition when all three digesters are in service. If all digesters are in service, 80-P-80 can feed only digester 1, 80-P-82 can feed only digester 3, and 80-P-81 can feed digester 2. If digester 2 is out of service, 80-P-81 is able to feed either digester 1 or digester 3 as a backup unit. No fourth backup pump is available to deliver $FeCl_2$ if any one of the three pumps is out of service.

[29] Although it is possible to run the pump at a maximum speed of 265 rpm, the warranty for the rotor is no longer in effect for applications above 165 rpm when the pressure exceeds 2 bar.

5.7.2 Projected Conditions: 30 mgd Production at NCPWF

5.7.2.1 Summary

Under Phase II maximum conditions, all three digesters will be operational and each of the three $FeCl_2$ pumps will be in service. No backup pump will be available under these conditions.

The projected rate of $FeCl_2$ delivery based on maximum VSS feed per digester is 0.47 gpm, which is less than the firm capacity per pump of 0.56 gpm. Table 5-25 shows that as a result, the existing pumps will have sufficient firm capacity assuming that 99.3 lb of active chemical per 1 ton of VSS is still an acceptable value at higher loadings.

5.7.2.2 Recommended Equipment Improvements

Under Phase II maximum conditions, there are no clear operating constraints on the $FeCl_2$ feed system. Several recommended modifications may improve the operability and longevity of the system. The projected pump speed at 0.47 gpm is 139 rpm.

Because of accelerated rates of wear on the tubing, this TM recommends the following based on feedback from pump manufacturers:

- Each pump is capable of operating with either 12 mm or 17 mm tubing. The larger-diameter tubing can be installed with the existing pump heads with relatively minor adjustments. With larger tubing installed, operations staff will have greater capacity. Alternately, the pumps with larger-diameter tubes can deliver the same rate of $FeCl_2$ at lower pump head speeds.

- Keep an off-the-shelf spare replacement pump in-stock at MBC as a backup to the three pump installation, which is pending.

If a fourth digester is constructed, the existing system will need to be expanded to include a fourth feed pump complete with valves, flow metering to match the existing, and associated double-containment feed piping between the pump and digester 4.

Construction of these improvements will require engineering design and preparation of construction documents including design drawings and specifications with exception of the spare off-the-shelf $FeCl_2$ feed pump.

5.7.3 Projected Conditions: 15 mgd Production at NCPWF

No special conditions are associated with the Phase I maximum conditions. The same recommendations provided under Section 4.7.2.2 also apply to Phase I.

Table 5-25: Chemical Handling Facilities - Ferrous Chloride Addition Facilities Existing System Design Criteria and Projected Operating Conditions									
Parameter	**Unit of Measure**	**System Firm Capacity [1] No. of Digesters Online**			**Phase I Operating Conditions**		**Phase II Operating Conditions**		**Comments**
					Avg.	**Max.**	**Avg.**	**Max.**	
Number of Digesters Online	#	1	2	3	2	2	3	3	
Volatile Solids Loading	lb VSS/d	70,027 [1]	140,053 [1]	175,067 [1]	85,337	96,431	125,972	142,348	
	tons VSS/d	35.0	70.0	87.5	42.7	48.2	63.0	71.2	
VSS Loading Per Digester	tons VSS/d	35.0	35.0	29.2	21.3	24.1	21.0	23.7	
Ferrous Dosage - lb active per ton VSS	lb active/ ton VSS	99.3 [2]	99.3	99.3	99.3	99.3	99.3	99.3	
Ferrous Chloride lb Active per Day	lb active/day	3,477	3,477	2,897	2,118	2,394	2,085	2,356	
Gallons per Day Ferrous Chloride	GPD	992.6	992.6	827.2	604.8	683.4	595.2	672.6	
Required Pump Output per Digester Loading	gpm	0.69 [3]	0.69	0.57	0.42	0.47	0.41	0.47	System adequate to handle max loads [3]
Available Pump Output Based on Tests (see Table 5-24)	gpm	0.58	0.58	0.58					

(1) See Table 5-9 for digester firm capacities.

(2) 99.3 lb Ferrous Chloride per lb VSS is current digester feed rate based on actual operating conditions.

(3) At their firm VSS loading capacity, and the same dose of Ferrous per ton as existing conditions, the projected chemical pumping rate is 0.69 gpm per digester. at a practical maximum of 0.58 gpm per Table 5-24 based on field tests, the pump is not sized to take full advantage of the digester loading capacity.

5.8 Utilities Extension Needs

The impact of increased raw solids flows and loadings from NCWRP on unit processes at MBC extends to the support utilities and systems. This assessment of support utilities is not exhaustive; it represents a summary of impacts on support utilities that were identified in the course of evaluating principal unit processes. Construction of these improvements will require engineering design and preparation of construction documents including design drawings and specifications.

In some cases, the expansion of existing unit processes was anticipated in the planning and design of the support systems for the original facility—for example, planning for electrical loads associated with a sixth thickening centrifuge.

In other cases, such as the overflows at the raw-solids-receiving tanks, the collateral impacts on support utilities are unintended. In this case, this TM has not made an attempt to include costs for these impacts for the following two main reasons:

- The raw-solids-receiving tanks were not included in the scope of this assessment. This TM identifies the issues for future consideration.
- Even if limited overflow capacity has a chance of occurring, it may be possible to address the issue through corrective action at NCWRP rather than at MBC. While these alternatives may not be hydraulically fail-safe, they may represent a cost-effective approach to an unlikely event.

5.8.1 Overflow/Site Drain

5.8.1.1 Existing Conditions

Two raw-solids-receiving tanks (73-T01 and 73-T-02) provide a storage buffer for flows of raw sludge from NCWRP. The current flow rate of raw sludge to the tanks is roughly 1 mgd, but projections at Phase II maximum conditions indicate that flows will increase from 0.89 mgd to a maximum of 6.55 mgd (see Table 5-6).

Each receiving tank has a capacity of 0.54 MG. One tank is the duty tank while the other is a backup. Raw solids are pumped out of the duty tank, through the closed-loop grit removal system and back to the tank; the thickening centrifuges take suction from the return line on the downstream side of the grit removal process.

In theory, the existing raw solids storage facilities are hydraulically fail-safe. Regardless of what may happen in terms of monitoring and control at the biosolids storage tank, the raw solids have a flow path that allows return of raw solids to the wastewater and centrate pump station. On high-high level conditions, the duty tank overflows to the backup tank assuming that the overflow lines are unobstructed. If the backup tank overflows, the overflow box discharges by gravity to a 10-inch-diameter drain and 8- and 12-inch-diameter plant sewer, which in turn flows by gravity to the wastewater pump station. An 18- by-12-inch gate at the wastewater pump station allows for overflow or displacement of solids into the adjacent wetwell of the centrate pump station. At the centrate pump station, drainage is returned to the NCWRP headworks.

Plant staff maintains a level reading between 20 and 24 feet in the duty receiving tank. The tank overflows at a level reading of 48. The net freeboard represents a volume of approximately 0.3 MG. Based on steady uniform flow, and flowing 90% full, the limiting capacity of the sewer is 2.03 mgd. For the final reach of 12-inch-diameter sewer upstream of the wastewater pump station, the limiting capacity is 5.4 mgd. The minimum capacity of the 10-inch-diameter drain is 1 mgd based on minimum slope.

5.8.1.2 Projected Phase II Conditions and Impacts

If we apply the current level settings at the Phase II maximum condition of 6.55 mgd, the available freeboard in the raw-solids-receiving tank will fill in approximately 1 hour and begin overflowing to the backup tank. It is likely that the 8-inch-diameter gas vent at the top of each tank is too small to handle the proposed rate of gas displacement without pressurizing the tank. Although the overflow weir has sufficient length for the Phase II maximum flow, the energy loss for a 10-inch-diameter outlet at 10.15 cubic feet per second (cfs) is such that the existing weir will become submerged, and the level in the tank will back up to fill the available headspace in the tank.

Assuming that the in-service tank is able to overflow to the backup tank, the backup tank will overflow in approximately 2 hours after the in-service tank fills. Downstream of the backup tank, the 8- and 12-inch-diameter sewers are too small to handle the Phase II maximum flow without surcharging the line.

It is anticipated that the 18-inch-wide by 12-inch-high gate opening between the wastewater pump station wetwell and the centrate pump station wetwell will act as a submerged orifice under Phase II maximum flows. The level will back up in the wetwell, but the structure will be able to contain the overflow water surface elevation.

5.8.1.3 Recommended Improvements

No discussion of improvements is provided at this time pending a review of facilities at NCWRP.

5.8.2 Evaluation of Existing Electrical Facilities and Expansion Needs

A preliminary evaluation of the impacts of the proposed process improvements at MBC required because of the NCWRP Expansion was conducted to determine needs for utilities extensions. In general, no major issues were noted in terms of electrical bus rating or transformer capacity at any of the process power distribution equipment. More details on specific equipment are available in the load list provided in Appendix D. However, below is a summary of findings and recommendations, organized by process.

5.8.2.1 Raw Solids and Grit Removal (Areas 73 and 76)

The analysis of the raw solids and grit removal processes resulted in the following findings:

- The electrical distribution system (EDS) overall capacity is sufficient to accommodate the net increase in process loads
- New raw solids pumps shall be supplied with a new circuit breaker, VFD, disconnect switch, conduit, and feeder as required

5.8.2.2 Thickening (Area 76)

The analysis of the thickening system processes resulted in the following findings:

- The EDS overall capacity is sufficient to accommodate the net increase in process loads
- New thickening centrifuge sludge feed pumps shall be supplied with a new circuit breaker, VFD, disconnect switch, conduit, and feeder as required
- New thickening centrifuge polymer feed pumps shall be supplied with a new circuit breaker, VFD, disconnect switch, conduit, and feeder as required
- New thickening centrifuge units shall be supplied with new a drive, disconnect switch, conduit, and feeders (main drive and backdrive motors) as required

5.8.2.3 Digester Facilities without FOG or Lystek Option (Area 80)

The analysis of the digestion processes (without FOG addition or Lystek) resulted in the following findings:

- The EDS overall capacity is sufficient to accommodate the net increase in process loads
- Motor control centers (MCC) lack sufficient space for the new loads
- New biogas compressors shall be supplied with a starter (at the MCC), disconnect switch, conduit, and feeder as required
- The new biogas flare shall be supplied with circuit breaker, conduit, and feeder as required

5.8.2.4 Digester 4 with FOG and Lystek Option (Area 80)

The analysis of the digestion process (with FOG addition and Lystek implementation) processes resulted in the following findings:

- The EDS overall capacity is sufficient to accommodate the net increase in process loads
- MCCs lack sufficient space for the new loads
- Two new 480-volt (V), 600-ampere (A) MCCs powered from unit substation (USS) 80 shall be provided for the new mixing pumps, axial mix pumps, and recirculation pumps
- New biogas compressors, mixing pumps, axial mix pumps, and recirculation pumps shall be supplied with a starter (at the MCC), disconnect switch, conduit, and feeder as required
- New biogas flares shall be supplied with circuit breaker, conduit, and feeder as required
- Miscellaneous digester and FOG loads shall be supplied with circuit breaker/starter/VFD, disconnect switch, conduit, and feeder as required

5.8.2.5 Dewatering (Area 76)

The analysis of the dewatering processes resulted in the following findings:

- The EDS overall capacity is sufficient to accommodate the net increase in process loads
- New dewatering centrifuge sludge feed pumps shall be supplied with a new circuit breaker, VFD, disconnect switch, conduit, and feeder as required
- New dewatering centrifuge polymer feed pumps shall be supplied with a new circuit breaker, VFD, disconnect switch, conduit, and feeder as required
- New dewatering centrifuge units shall be supplied with new a drive, disconnect switch, conduit, and feeders (main drive and backdrive motors) as required

5.8.2.6 Centrate Pump Station (Area 94)

The analysis of the centrate pumping processes resulted in the following findings:

- USS 94 2,000-kilovolt-ampere (kVA) transformers will need to rely on their forced-air (fan-cooled) rating to accommodate the net increase in process loads or be replaced with 2,250 kVA units as an option
- New centrate pumps shall be supplied with a new circuit breaker, VFD, disconnect switch, conduit, and feeder as required

5.8.2.7 Capacity of the SDG&E and Fortistar Cogeneration System

The analysis of the cogeneration processes resulted in the following findings:

- Per a review of SDG&E electric bills for MBC from December 2012 through May 2014, the existing maximum demand is estimated to be approximately 2.5 MW
- Per the load list provided in Appendix D, the (net) added maximum demand at MBC is estimated to be approximately 3.1 MW (assuming 0.9 power factor, 0.83 efficiency) with FOG and Lystek option considered (worst-case scenario)
- The new maximum demand at MBC is estimated to be approximately 5.6 MW (2.5 MW + 3.1 MW)
- Assuming a generation capacity of 6.4 MW, the Fortistar cogeneration system appears to have sufficient capacity to accommodate the new maximum demand at MBC
- If the Fortistar cogeneration system is not to be relied upon to supply the entire power to the facility, SDG&E shall make provisions if necessary to ensure that it can meet the new maximum demand

5.8.3 Thickened Sludge Feed Lines

See Section 5.2.3.2 for discussion of thickened sludge transfer/digester feed operation.

5.8.4 Biogas Headers

See Section 5.3.3.2 for discussion of biogas headers.

5.8.5 Hot Water Supply/Hot Water Return Lines

See Section 5.10.2.2 for discussion of HWS and HWR.

5.8.6 Ferrous Chloride Feed

See Section 5.7 for a discussion of $FeCl_2$ feed lines to digester 4.

5.8.7 Utility Water High-Pressure

For those scenarios including construction of a fourth digester, utility water high-pressure (UWHP) piping will be extended to digester 4 in conjunction with construction of a gallery extension.

5.8.8 Distributed Control System

5.8.8.1 Existing Conditions

MBC uses Emerson's Ovation DCS platform for process control and data acquisition. The DCS consists of a series of process control modules (PCMs) that are interconnected via drops on a plant information network. Each PCM includes dual redundant processors. The PCMs are housed in dedicated control enclosures located throughout the facility.

PCMs interface with manufacturer-furnished programmable logic controllers (PLCs), field instruments, and primary control elements such as valve actuators, VFDs, and MCCs to create an integrated DCS. In the listing of input/output (I/O) points that interface at each PCM, there are usually spare I/O points for future use.

Thickening centrifuges 1 and 2, and their related sludge and polymer feed pumps, are controlled via 76-PCM-01; thickening centrifuges 3 and 4 are controlled via 76-PCM-02A; and thickening centrifuge 5 is controlled via 76-PCM-03. Each of these PCM cabinets is located on the second floor of Building 76.

The existing biogas compressors and related system components are controlled via 80-PCM-05 located in the Digester Control Building.

5.8.8.2 Projected Phase II Conditions and Impacts

The installation of a sixth thickening centrifuge, with its related support equipment, will have an impact on the I/O associated with centrifuge monitoring and control. The cabinet and racks in 76-PCM-03 have available slots for additional I/O. This is predictable given that both 76-PCM-01 and 76-PCM-02A support two thickening centrifuges. Based on recent experience with the replacement dewatering centrifuges, the three PCM cabinets will need to be retrofitted with Ethernet controllers and routers for managing the interface between the manufacturer-furnished control enclosures for the thickening centrifuges and the existing PCM cabinets.

PCM enclosure 80-PCM-05 will need to be field-verified to confirm that I/O slots are available for the proposed future expansion of the biogas compressors and flares.

5.8.8.3 Recommended Improvements

The only alternative available entails retrofitting the existing PCM enclosures to support the proposed additional process equipment and replacement equipment as outlined in Section 5.2-3.

5.9 Additional Siting Considerations

5.9.1 Existing Conditions

Figure 2-1 shows the existing site configuration. Each process area is coded to a number in the figure, which describes its function.

5.9.2 Projected Conditions: 30 mgd Production at NCPWF

Figure 2-1 shows the proposed upgrades that would impact the site: primarily the FOG facilities, grit facilities, and digester 4. All other upgrades and improvements occur within or adjacent to existing buildings.

5.10 Waste Heat Utilization System

5.10.1 Existing Conditions

5.10.1.1 Existing Facilities

5.10.1.1.a Waste Heat Utilization System

The current waste heat utilization system consists of eight internal-combustion engines owned and operated by Fortistar under contract to provide waste heat from the engine jacket and lube oil cooling, two natural gas 10.2 MMBtu/hr boilers, primary and secondary water recirculation pumps, and a 10-inch-diameter HWS/HWR conveyance system that provides hot water to three anaerobic digesters (with potential addition of two digesters in the future) and building space heating. The hot water loop operates within a supply/return temperature range of 160°F–170°F/145°F, respectively.

The hot water/engine waste heat is provided on an as-needed contractual basis by Fortistar and is invoiced monthly for the amount used. MBC was designed for waste heat absorption chilled water and other building- and process-related opportunities including supplemental heating for enhanced odor control treatment.

5.10.1.1.b Cogeneration Facility

The MBC Cogeneration Facility consists of four 1,600-kilowatt (kW) tandem cogeneration units, each consisting of two 800 kW Caterpillar 3516 engines connected to one 1,600 kW generator, and associated switchgear and heat recovery system. Eight Caterpillar G3516TA 1,053 HP engines operating on a blend of landfill and digester gas with heat recovery of 2.28 MMBtu/hr from the jacket and lube oil heat rejection. The recovered heat from each engine is run through a HEX to extract the heat that is provided to MBC.

Table 5-26 below summarizes that design intent was to operate three 1,600 kW tandem systems with a combined available waste heat. Original design allowed for maximum heat utilization for all digester HEXs, building heating, sludge, and odor process heating and a 675-ton absorption cooler. The absorption cooler concept as well as the odor and sludge heat were abandoned and removed from the waste heat system.

Table 5-26: Available Waste Heat from MBC Engines/Generators 1–4

Power Production Unit	Size (MW)	Available Jacket Waste Heat (MMBtu/hr)	Annual Waste Heat Available @ 90% Online (MMBtu)
Cogeneration engines 1A and 1B	1.60	5.50	43,350
Cogeneration engines 2A and 2B	1.60	5.50	43,350
Cogeneration engines 3A and 3B	1.60	5.50	43,350
Cogeneration engines 4A and 4B	1.60	5.50	43,350
Total	**4.8** [a]	**16.50***	**130,005** [(1)]

(1) Assuming three of four in operation.

5.10.1.1.c Backup Waste Heat Generation: Boilers

If for any reason the hot water source from the MBC Cogeneration Facility is interrupted and/or curtailed, two Superior Boiler Works fire tube boilers (70-B-01 and 70-B-02), are used to reheat the HWR. The purpose of the fire tube boilers is to transfer heat to water by gradually heating HWR as it passes through the boiler, traveling around the heating tubes. The hot water (180°F) then exits the boiler and mixes with the secondary loop as required to maintain the desired HWS temperature of 160°F.

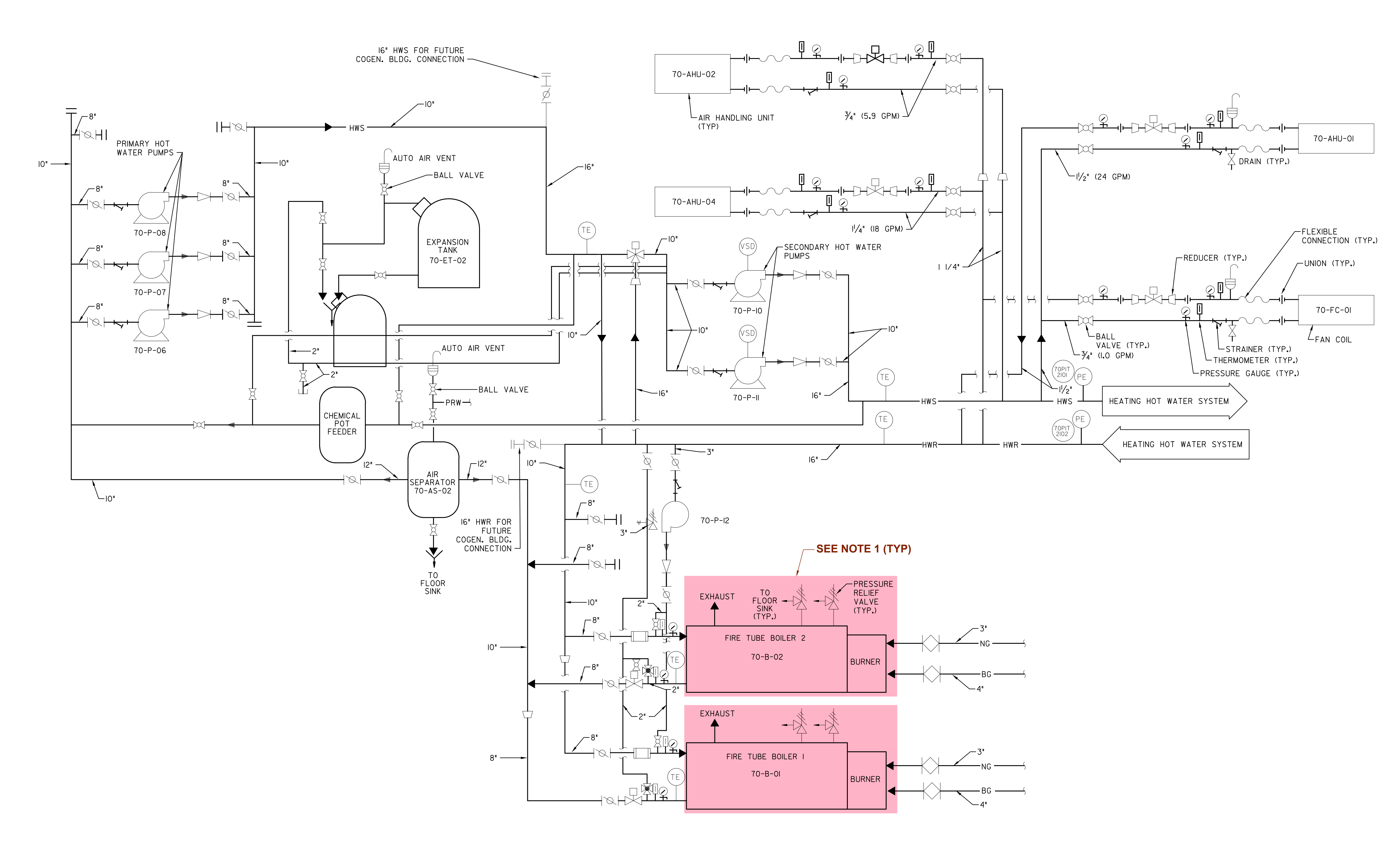
Each boiler is a three-pass fire tube with a water flow rate of 850 gpm outlet temperature 180°F natural, digester, landfill gas rated at 10.2 MMBtu/hr firing rate. Currently, each boiler has an air permit for natural gas firing with an annual fuel limit of 220,000 therms.

5.10.1.1.d Waste Heat Circulation System

Waste heat from the cogeneration engines is utilized in the heating hot water system. Process schematics for the heating hot water system and for the hot water circulation piping are presented in Figure 5-12 and Figure 5-13, respectively.

In accordance with the design, two sets of hot water circulation pumps are provided. The primary hot water pumps consist of three pumps (70-- 06 through 08). The purpose of these pumps is to recirculate HWR through the fire tube boiler for reheating. The primary hot water pumps draw off a common 10-inch HWR header through an 8-inch-diameter suction line, and discharge through an 8-inch-diameter discharge line to a common 10-inch-diameter HWS discharge line. The HWS/HWR temperatures range from 160°F to 170°F /145°F. Each pump is a Bell & Gossett centrifugal pump, 850 gpm equipped with a constant-speed 20 hp motor.

The secondary hot water pumps consist of two pumps (70-P-10 and 7- P-11) that circulate hot water throughout the HWS loop at MBC. Each pump is a Bell & Gossett centrifugal pump, 2,550 gpm equipped with a VFD 150 hp motor. The MBC hot water system is a dynamic system, meaning hot water is always flowing, and is designed to supply hot water on demand. The maximum flow rate of hot water through the HWS loop is 5,100 gpm, as determined by the pumping capacity of the two secondary hot water pumps.



LEGEND:

- NCWRP EXPANSION (PURE WATER PROGRAM) UPGRADES
- FOG ADDITION UPGRADES
- OTHER RECOMMENDED IMPROVEMENTS

NOTES:

1. CONVERSION OF EXISTING BOILERS TO BIOGAS UTILIZATION IS RECOMMENDED.
2. HYDRAULIC LOADING REPRESENTS AN NCPWF PRODUCTION OF 30 MGD. REFER TO SECTION 9 OF THIS TECHNICAL MEMORANDUM FOR FURTHER DETAILS.

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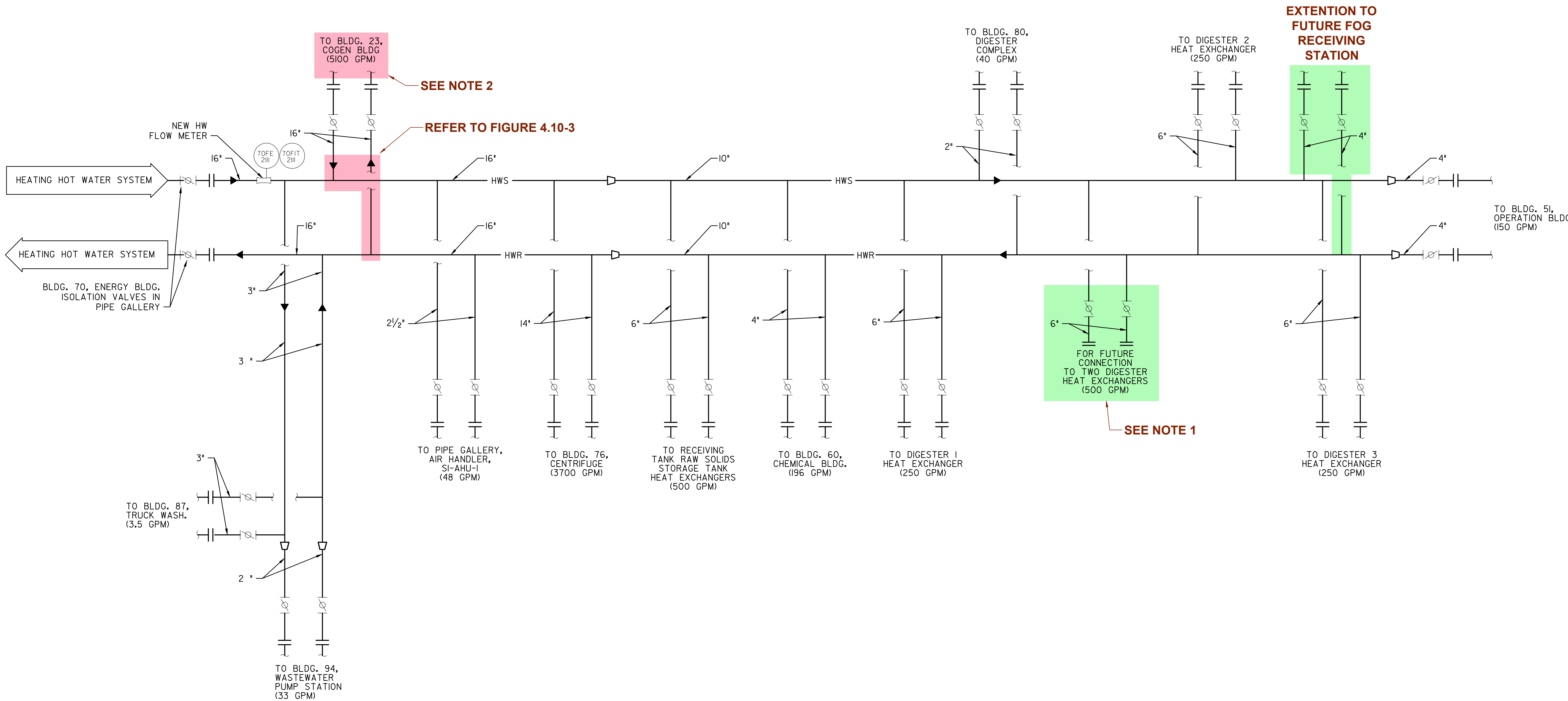
IMPACTS OF NCWRP EXPANSION ON MBC

FIGURE 5-12

HEATING HOT WATER SYSTEM PROCESS SCHEMATIC



LEGEND:

- NCWRP EXPANSION (PURE WATER PROGRAM) UPGRADES
- FOG ADDITION UPGRADES
- OTHER RECOMMENDED IMPROVEMENTS

NOTES:

1. CONSTRUCTION OF DIGESTER NO.4 WILL BE REQUIRED TO ACCOMMODATE PHASE II CONDITIONS WITH ADDITION OF FOG.
2. POTENTIAL ADDITIONAL HARVESTING OF WASTE HEAT FROM COGENERATION ENGINES NO.5 AND NO.6 IS RECOMMENDED.
3. HYDRAULIC LOADING REPRESENTS AN NCPWF PRODUCTION OF 30 MGD. REFER TO SECTION 9 OF THIS TECHNICAL MEMORANDUM FOR FURTHER DETAILS.

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IMPACTS OF NCWRP EXPANSION ON MBC

FIGURE 5-13

HEATING HOT WATER CIRCULATION PIPING PROCESS SCHEMATIC

Path: P:\Projects\San Diego, City of (CA)\Pure Water Program\T018 – Impact of NCWRP Expansion on MBC\CADD\10-FIGURES
Filename: 410-2 Plot date: Aug. 10, 2016 03:03PM CAD User: Eric Stiles

5.10.1.1.e Waste Heat Use Areas

Table 5-27 summarizes the HWS/HWR loop services several areas within MBC and the design intention and allocated hot water flow rates. The information in this table is also depicted in Figure 5-13.

Table 5-27: Design Hot Water Distribution

Process Area	Maximum Flow
Digester complex	40 gpm
Digester HEXs	750 gpm (future expansion will add 500 gpm flow demand)
Operations Building	150 gpm
Chemical Building	196 gpm
Raw-solids-receiving tank HEXs	500 gpm (not currently used)
Centrifuge Building	3,700 gpm
Pipe gallery	48 gpm
Wastewater pump station	33 gpm
Truck wash	3.5 gpm
Total connected hot water system flow requirement	5,420.5 gpm

5.10.1.2 Current Operating Parameters and Performance

As noted above, the current waste heat utilization system consists of eight internal-combustion engines owned and operated by Fortistar under contract to provide waste heat from the engine jacket and lube oil cooling, two natural gas 10.2 MMBtu/hr boilers, primary and secondary water recirculation pumps, and a 10-inch-diameter HWS/HWR hot water conveyance system that provides hot water to three anaerobic digesters (with potential addition of two digesters in the future) and building space heating.

Table 5-28 summarizes available waste heat and additional capability of boilers 70-B-01 and 70-B02.

Table 5-28: Available Waste Heat from Boilers 70-B-01 and 70-B-02			
Boiler Unit	**Input Fuel MMBtu/hr**	**Available Heat (MMBtu/hr) @ 70%**	**Annual Waste Heat Available @ 90% Online (MMBtu)**
70 B 01	10.2	7.1	55,980
70 B 01	10.2	7.1	55,980
Total	**20.4**	**14.2**	**111,960**

Total combined waste heat available is approximately 30 MMBtu/hr and 241,000 MMBtu/yr providing that three of the four engine modules and both boilers are in-service. Table 5-29 summarizes the current HWS/HWR loop service areas within MBC.

Table 5-29: Current Hot Water Distribution	
Process Area	**Maximum Flow**
Digester complex	40 gpm
Digester HEXs	750 gpm
Operations Building	150 gpm
Chemical Building	196 gpm
Raw-solids-receiving tank HEX	500 gpm (not currently used)
Pipe gallery	48 gpm
Wastewater pump station	33 gpm
Total connected hot water system flow required	1,757 gpm
Total hot water system flow available	5,450 gpm
% of excess hot water capacity	32%

Digester gas production and the potential for additional hot water generation is a critical component in the overall future of MBC and the long-term solids management. Table 5-30 summarizes the existing digester gas production considering design and current conditions. The digester gas is provided under contract to the MBC Cogeneration Facility as a fuel source for a beneficial energy rate to power MBC. The City has a contract with Fortistar (MBC Cogeneration) to allocate all MBC site-derived digester gas up to 354,068 scfd.

Table 5-30: Digester Gas Generation (design and current)		
Parameter	**Average Digester Gas (scfd)**	**Maximum Digester Gas (scfd)**
Design	387,370	575,056
Current	245,520	283,637
Fortistar contractual allocation	354,068	354,068
% of design	63	50
% of Fortistar allocation	70	80
% excess available	0	0

Tables 5-30 and 5-31 illustrate that MBC is operating well below the design capabilities of MBC.

5.10.2 Projected Conditions: Phase I (15 mgd production at North City Pure Water Facility [NCPWF]) and Phase II (30 mgd production at NCPWF) without FOG and/or Lystek

5.10.2.1 Summary

Projected NCWRP biosolids flows and loads for different operating scenarios have been analyzed based on the mass balance data presented in Section 4.1 and reflected in Appendix B for Phase I (15 mgd production at NCPWF), and Appendix C for Phase II (30 mgd production at NCPWF). **The hot water requirements for Phase I and Phase II are estimated to remain within the current hot water heat requirements and well below the hot water design capabilities.** Table 5-31 shows that the digester gas generation will substantially increase with the implementation of Phase I and Phase II Pure Water facilities.

Figure 5-14 illustrates that MBC/Pure Water will increase the generation of digester gas by approximately 300% and 400% of existing for Phase I and Phase II, respectively. The generation of digester gas will significantly exceed the contractual allocation of digester gas supply to Fortistar and therefore present possible digester gas utilization opportunities.

5.10.2.2 Recommended Equipment Improvements

Phase I and Phase II projected operating conditions and improvements without FOG addition and Lystek are shown in Tables 5-12 and 5-13, respectively. It is assumed that upgrades and new facilities associated with the HWS/HWR will not be required.

Discussions with MBC plant staff and MBC Cogeneration Facility operators indicated an opportunity to allow improved use of MBC Cogeneration Facility hot water and to minimize the need for standby boiler operation. In order to improve hot water loop management, it is recommended that the interconnection of the MBC Cogeneration Facility and the MBC HWS/HWR loop be reconfigured. This includes extension of the MBC Cogeneration Facility HWS return line to the HWR approximately length of 4 feet of 10-inch-diameter pipe, installation of a three-temperature/flow process control interface to allow a more refined control of the HWS/HWR loop, and minimize the inadvertent use of the standby boilers.

Figure 5-14, Figure 5-13 and Figure 5-14, respectively, present this information. This enhancement would provide an extension of the MBC Cogeneration Facility HWR interconnection to the HWR loop return line, similar to the original design intent and to incorporate and integrate a temperature/flow control strategy to allow more efficient use of MBC Cogeneration Facility hot water.

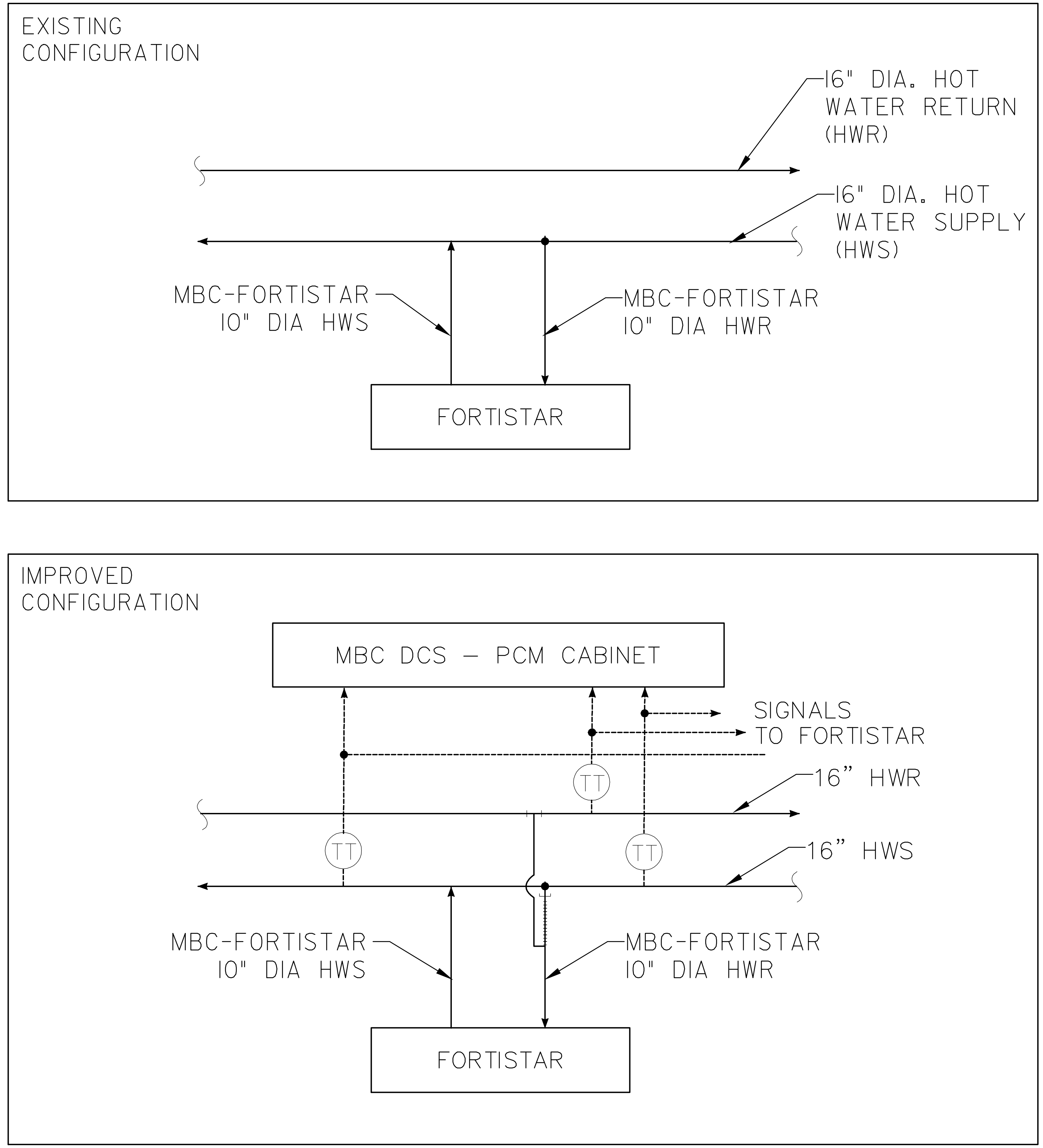
5.10.3 Projected Conditions: Phase I (15 mgd production at NCPWF) and Phase II (30 mgd production at NCPWF) with FOG and Lystek

5.10.3.1 Summary

The hot water requirements for Phase I and Phase II are estimated to increase slightly based on the addition of FOG (Phase I), digester 4 (Phase II), and additional building heating of future structures during Phase I and Phase II. Table 5-31 provides the estimated hot water flow projections with FOG/Lystek.

Table 5-31: Estimated Hot Water Distribution with FOG/Lystek

Process Area	Maximum Flow
Digester complex	40 gpm
Digester HEXs	750 gpm
Operations Building	150 gpm
Chemical Building	196 gpm
Raw-solids-receiving tank HEX	500 gpm (not currently used)
Pipe gallery	48 gpm
Wastewater pump station	33 gpm
FOG heating	250 gpm (Phase I)
Additional digester 4 HEX	250 gpm (Phase II)
Additional space heating future structures	100 gpm (Phases I–II)
Estimated total connected hot water system flow	2,357 gpm
Total available	5,450 gpm
% of hot water capacity	43%



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IMPACTS OF NCWRP EXPANSION ON MBC

FIGURE 5-14

HWR AND HWS IMPROVEMENTS

As noted above, with the entire buildout of Pure Water and FOG/Lystek, the existing hot water system is adequate to meet the heating requirements. The ultimate buildout will use slightly more than 40% of the original design capacity.

Table 5-32 shows that the digester gas generation will substantially increase with the implementation of Phase I and Phase II Pure Water facilities with FOG and Lystek.

Table 5-32: Digester Gas Generation: Comparison of Current, Phase I, and Phase II, FOG and FOG/Lystek

Parameter	Average Digester Gas (scfd)	Maximum Digester Gas (scfd)
Design: 2015	387,370	575,056
Current: 2015	245,520	283,637
Contractual allocation to Fortistar	354,068	354,068
Phase I Pure Water: 15 mgd	764,749	864,166
Phase II Pure Water: 30 mgd	1,080,127	1,220,543
Phase I Pure Water: 15 mgd—FOG	1,353,296	1,485,852

Table 5-32 illustrates how MBC/Pure Water, Pure Water plus FOG, and Pure Water plus FOG/Lystek will substantially increase the generation of digester gas well over the Fortistar digester gas allocation. Although the additional digester gas is not required to generate any additional hot water, the City is pursuing process alternatives to generate more renewable energy to augment the Pure Water NCWRP suite of projects, generate additional waste heat to convert Class B solids into Class A Exceptional Quality solids, and minimize the waste of a renewable fuel by flaring. The opportunities for development and utilization of waste heat are discussed in Section 5.10.4.

5.10.3.2 Required Equipment Improvements

Phase I and Phase II projected operating conditions and improvements with FOG addition and with FOG plus Lystek are shown in Tables 5-14 and 5-15, respectively and also presented in Figures 5-12 through 5-14 which identify specific improvements related to the NCWRP expansion (Pure Water Program), FOG addition, and other recommended improvements focused on improving process reliability and performance. The new FOG facilities will require supplemental hot water heating to maintain the FOG in a temperature range of 70°F to 80°F for ease of storage and distribution.

The following improvements will need to be implemented:

- **Phase I/Phase II:** Extend HWS and HWR lines to the new FOG receiving station. Based on the information presented on record drawings, existing 10-inch-diameter HWS and HWR pipes at the very eastern end of the digester gallery between digester 1 and digester 3 are each provided with a concentric reducer down to 4-inch diameter at El. 396 feet for further supply to the plant hot water needs. It is proposed to modify this arrangement and to replace the subject reducers with 10-by-4-by-4-inch tees to be connected to the existing 4-inch-diameter HWS and HWR lines and to new 4-inch-diameter HWS and HWR Schedule 80 insulated steel lines extending through the east wall of the digester gallery, then north via Plant Road “D” to the potential location of the FOG receiving station at the northeastern corner of the MBC side and immediately northwest from the existing parking lot. The length of each subject line is estimated to be 400 feet. These lines will further split into three 3-inch-diameter lines leading to the HEXs that will be provided to heat contents of the FOG receiving station holding tanks, and will each be equipped with isolation valves and three-way thermal valves. The firm selected for final design of MBC improvements will be required to further evaluate sizing of the HWS and HWR line extension to the FOG receiving station.

- **Phase II:** Extend HWS and HWR to new digester 4 HEX similar to the existing three digesters. Extension of the digester gallery to the south between digester 4 and future digester 5 and extension of the hot water system will be required to accomplish this connection.

5.10.4 Utilization of Excess Digester Gas: General Discussion

5.10.4.1 Summary

Table 5-32 illustrates that the ultimate digester gas production under the Phase II Pure Water and FOG/Lystek will generate approximately 1,530 cfm of digester gas on an average daily basis. The contractual allocation for Fortistar (245 cfm) will reduce the amount of available digester gas for use from 1,530 cfm to approximately 1,285 cfm. In 2009, BC prepared the Biosolids Technology Evaluation for MBC (18) and noted several possible options to improve the quality and reduce the quantity of biosolids using heating technologies. After extensive review of a large number of technologies and alternatives, the following four treatment technologies emerged as viable and warranting further assessment (see References (18) and (44)):

- Enhanced digestion (eliminated because of space and operational restrictions at MBC and PLWTP)
- Direct heat drying (belt dryer 51.6 MMBtu/hr; drum dryer 59 MMBtu/hr)
- Thermal oxidation/incineration (3.9 MMBtu/hr normal operating)
- Heat augmentation for greenhouse biosolids solar dryers (20.5 MMBtu/hr waste heat augmentation)

SlurryCarb technology listed in Reference (18) is out of business and is thus not recommended for further consideration.

Using the entire digester gas generated under Phase II + FOG/Lystek less the Fortistar contractual allocation as the potential hot water (waste heat source) of 1,285 cfm, a boiler operation can generate approximately 30.0 MMBtu/hr assuming 65% boiler efficiency in an external-combustion process or using a cogeneration type configuration similar to MBC Cogeneration Facility jacket waste heat, and 14.8 MMBtu/hr assuming an efficiency of 32%.

5.10.4.2 Additional Heating System Improvements Enhancements

Using the excess digester gas generation for supplemental hot water will reduce the need for natural gas fuel supplies to support the various biosolids alternatives. The following three hot water generation strategies could be provided to supply all or a large portion of the external heating demands as shown in Figures 5-12 through 5-14) harvest hot water from existing assets including MBC: cogeneration engines 5 and 6; 2) convert existing boilers to digester gas status and generate hot water; and 3) use the waste heat from the new cogeneration process being considered as part of Pure Water.

A brief narrative and implementation strategy is provided for each strategy below.

Strategy 1. Convert the existing Marine Air Corps Station (MCAS) Miramar two 1.6 MW engines into “air-cooled” or “water-cooled” configuration, allowing MBC to use the jacket waste heat from the engines if needed. The waste heat utilization concept would include the following components:

- Request and receive permission from MCAS Miramar to upgrade and recover waste heat from the two existing engines.
- Install a waste heat diversion system (HEXs, three-way valves, process controls) for two engines to allow circulation and use of waste heat or diversion to the existing air-cooled systems.
- Re-purpose the insulated 8-inch-diameter cooling water supply/return system to an underground HWS (8-inch diameter) and HWR conveyance pipe loop with two 25 hp circulation pumps (one operating and one standby) operating continuously. The interconnection, three-way valves, controls to the existing 16-inch-diameter HWS and HWR loop within the gallery will be similar to the existing engine-generators 1 through 4.
- Upgrade temperature controllers to monitor HWR temperature and divert sufficient HWS to maintain loop parameters. The ultimate distribution of the harvested hot water is dependent on the location of the specific hot water use and therefore further design and refinement will be required.

Strategy 2. Convert existing boilers to digester gas-fired boiler status to allow excess digester gas use. Integration of existing boilers operating on digester gas to support sludge processing hot water requirements would include evaluating reactivate digester gas supply systems to use digester gas, modify existing APCD permit to allow digester gas, and source test boilers to demonstrate air quality compliance.

Strategy 3. Develop a cogeneration facility (generate power and waste heat source) or expand the boiler plant (generate waste heat) to utilize the entire amount of renewable digester gas. The City is exploring the cogeneration, waste heat, and enhanced solids-processing options and this is beyond the scope of this analysis.

6 Opinion of Probable Cost

This TM includes an OPC for potential upgrades/modifications associated with impacts of the NCWRP Expansion on MBC. In accordance with Association for the Advancement of Cost Engineering International (AACEI) criteria, a Class 5 estimate has been prepared as part of this TM. A Class 5 estimate is typically based on a design where engineering is between 0 and 2% complete. Class 5 estimates are used to prepare planning-level cost scopes or evaluation of alternative schemes, long-range capital outlay planning, and can also form the base work for the Class 4 planning-level or design technical feasibility estimate.

The expected accuracy for a Class 5 estimate is between -50 and +100%, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. In unusual circumstances, ranges could exceed those shown.

The estimate was prepared by using quantity takeoffs and vendor pricing for major equipment. Construction crew labor hours were calculated from production rates published in several databases such as R.S. Means and Mechanical Contractors Association. Costs related to the contractor's general conditions, risk, general liability, and automobile insurance are also included in the estimate. The estimate assumes that construction would be limited to 5 days per week during normal, daytime, 8-hour shifts. A complete list of assumptions is provided in the Basis of Estimate report in Appendix E.

The costs incurred for improvements at MBC are divided into the following three broad categories:

- The first category are costs related to the NCWRP Expansion. These are costs of upgrades required at MBC as a result of the NCWRP Expansion as part of implementation of Pure Water causing increased flows and loads at MBC. These upgrades will be required regardless of any other conditions at MBC.
- The second category are costs related to the implementation of FOG addition at MBC (utilization of other organic waste such as food waste or green waste are not evaluated under this project). These are costs of upgrades required to the anaerobic digestion system and their appurtenant facilities to handle the increased solids loading due to FOG addition, construction of the FOG receiving station, and extension of utilities to the FOG receiving station. These costs are attributed solely to the FOG addition and would not have been required if FOG is not added to the digesters.
- The third category are costs listed as “other.” These are costs associated with upgrades that are recommended but not required. Although MBC would be capable of operating without these upgrades, the plant would operate more reliably and efficiently if these recommended upgrades are implemented. Table 6-1 and Table 6-2, respectively, present costs that have been separated into individual processes or process areas at MBC for Phase I and Phase II conditions, respectively. These costs reflect the current date (June 2016) and no escalation to midpoint of construction schedule is included. Complete details are available in the detailed OPC provided in Appendix E.

Table 6-1: Cost Summary for Upgrades Required for Phase I Conditions (1)

Construction Cost Breakdown	NCWRP Expansion (Pure Water)	FOG Addition	Other Recommended Improvements	See Note (3)
Grit removal	$0	$0	$0	
Thickening centrifuges	$9,119,000	$0	$0	
Digester system (2)	$1,165,000	$4,189,000	$2,206,000	
Dewatering centrifuges	$0	$0	$0	
Centrate system	$0	$0	$0	
Odor control	$0	$0	$0	
Chemical storage	$0	$0	$0	
Evaluation of utilities	$0	$0	$0	
Additional facilities siting	$0	$0	$0	
Waste heat utilization	$0	$73,000	$628,000	
Subtotal construction cost	$10,284,000	$4,262,000	$2,834,000	
Contingency (40%)	$4,114,000	$1,705,000	$1,134,000	
Total construction cost	**$14,398,000**	$5,967,000	$3,968,000	**See Note (4)**
Delivery Costs (5),(6)				
Predesign (2.1%)	$302,000	$125,000	$83,000	
Detailed design (7.1%)	$1,022,000	$424,000	$282,000	
ESDC (1.4%)	$202,000	$84,000	$56,000	

Table 6-1: Cost Summary for Upgrades Required for Phase I Conditions [1]				
Construction Cost Breakdown	**NCWRP Expansion (Pure Water)**	**FOG Addition**	**Other Recommended Improvements**	**See Note [3]**
CM: bid phase (0.4%)	$58,000	$24,000	$16,000	
CM: construction phase (6.8%)	$979,000	$406,000	$270,000	
Environmental: review and permitting (1.4%)	$202,000	$84,000	$56,000	
Environmental: construction compliance (2.1%)	$302,000	$125,000	$83,000	
PM: City project management (3.6%)	$518,000	$215,000	$143,000	
PM: other City departments (1.4%)	$202,000	$84,000	$56,000	
Subtotal delivery costs	**$3,787,000**	**$1,571,000**	**$1,045,000**	
Other Costs [6]				
Land acquisition	$0	$0	$0	
Environmental mitigation (2.1%)	$302,000	$125,000	$83,000	
Subtotal other costs	**$302,000**	**$125,000**	**$83,000**	
Total project cost	**$18,487,000**	**$7,663,000**	**$5,096,000**	**Grand Total**
Without FOG addition, other upgrades included	**$18,487,000**	**$0**	**$5,096,000**	**$23,583,000**
With FOG addition and other upgrades [7]	**$14,896,000**	**$7,663,000**	**$5,096,000**	**$27,655,000**

(1) *All numbers presented in the table are construction OPCs without the 40% contingency.*

(2) *Cost for FOG-receiving station derived from CH2M Hill report, contingency deducted from reported cost.*

(3) *The total depends on whether FOG addition is selected.*

(4) *The project construction subtotal depends on whether FOG addition is selected.*

(5) *Fixed costs are per baseline budget or current Pure Water directive.*

(6) *Delivery and other costs based on the total construction cost.*

(7) *The total project cost excludes digester system costs related to NCWRP Expansion because the upgrades associated with FOG addition cover these operating conditions.*

Table 6-2: Cost Summary for Upgrades Required for Phase II Conditions [1]				
Construction Cost Breakdown	**NCWRP Expansion (Pure Water)**	**FOG Addition**	**Other Recommended Improvements**	**See Note [3]**
Grit removal	$2,721,000	$0	$0	
Thickening centrifuges	$15,199,000	$0	$0	
Digester system [2]	$1,026,000	$14,764,000	$2,206,000	
Dewatering centrifuges	$0	$0	$3,337,000	
Centrate system	$956,000	$0	$0	
Odor control	$0	$0	$0	
Chemical storage	$0	$0	$0	
Evaluation of utilities	$0	$0	$0	
Additional facilities siting	$0	$0	$0	
Waste heat utilization	$0	$73,000	$628,000	
Subtotal construction cost	$19,902,000	$14,837,000	$6,171,000	
Contingency (40%)	$7,961,000	$5,935,000	$2,469,000	
Total construction cost	**$27,863,000**	**$20,772,000**	**$8,640,000**	**See Note [4]**
Delivery Costs [5],[6]				
Predesign (2.1%)	$585,000	$436,000	$181,000	
Detailed design (7.1%)	$1,978,000	$1,475,000	$613,000	
ESDC (1.4%)	$390,000	$291,000	$121,000	
CM: bid phase (0.4%)	$111,000	$83,000	$35,000	
CM: construction phase (6.8%)	$1,895,000	$1,412,000	$588,000	
Environmental: review and permitting (1.4%)	$390,000	$291,000	$121,000	
Environmental: construction compliance (2.1%)	$585,000	$436,000	$181,000	
PM: City project management (3.6%)	$1,003,000	$748,000	$311,000	
PM: other City departments (1.4%)	$390,000	$291,000	$121,000	
Subtotal delivery costs	**$7,327,000**	**$5,463,000**	**$2,272,000**	
Other Costs [6]				
Land acquisition	$0	$0	$0	
Environmental mitigation (2.1%)	$585,000	$436,000	$181,000	
Subtotal other costs	**$585,000**	**$436,000**	**$181,000**	
Total project cost	**$35,775,000**	**$26,671,000**	**$11,093,000**	**Grand Total**
Without FOG addition, other upgrades included	**$35,775,000**	**$0**	**$11,093,000**	**$46,868,000**

Table 6-2: Cost Summary for Upgrades Required for Phase II Conditions [1]				
Construction Cost Breakdown	NCWRP Expansion (Pure Water)	FOG Addition	Other Recommended Improvements	See Note [3]
With FOG addition and other upgrades [7]	$32,184,000	$26,671,000	$11,093,000	$69,948,000

(1) All numbers presented in the table are construction OPCs without the 40% contingency.

(2) Cost for FOG-receiving station derived from CH2M Hill report, contingency deducted from reported cost.

(3) The digester system total depends on whether FOG addition is selected.

(4) The project construction subtotal depends on whether FOG addition is selected.

(5) Fixed costs are per baseline budget or current Pure Water directive.

(6) Delivery and other costs based on the total construction cost.

(7) The total project cost excludes digester system costs related to NCWRP Expansion because the upgrades associated with FOG addition cover these operating conditions.

6.1 Construction Cost Breakdown

The construction cost breakdown represents the estimated cost of construction based on the current design documentation available for development of the OPC. These costs include direct costs as well as contractor overhead, insurance, bond cost, and profit markups. Further explanations of these cost components are included in the OPC reports in Appendix E.

6.2 Contingency

The AACEI recommended practice 10S-90 defines contingency as: An amount added to an estimate to allow for items, conditions, or events for which the state, occurrence, or effect is uncertain and that experience shows will likely result, in aggregate, in additional costs. Contingency is typically estimated using statistical analysis or judgment based on past asset or project experience.

Contingency usually excludes: (1) major scope changes such as changes in end product specification, capacities, building sizes, and location of the asset or project; (2) extraordinary events such as major strikes and natural disasters; (3) management reserves; and (4) escalation and currency effects.

Some of the items, conditions, or events for which the state, occurrence, and/or effect is uncertain include, but are not limited to, planning and estimating errors and omissions, minor price fluctuations (other than general escalation), design developments and changes within the scope, and variations in market and environmental conditions. Contingency is generally included in most estimates, and is expected to be expended.

6.3 Delivery and Other Costs

Delivery and other costs include estimates of costs for non-construction activities required to plan, design, and fully deliver the project to completion. The costs are estimated as an expected percentage of the total construction cost. Where actual costs are known based on awarded service contracts, or more definitive costs are established at the time of TM preparation, those fixed costs are included in the delivery and other cost breakdown.

7 Construction Schedule

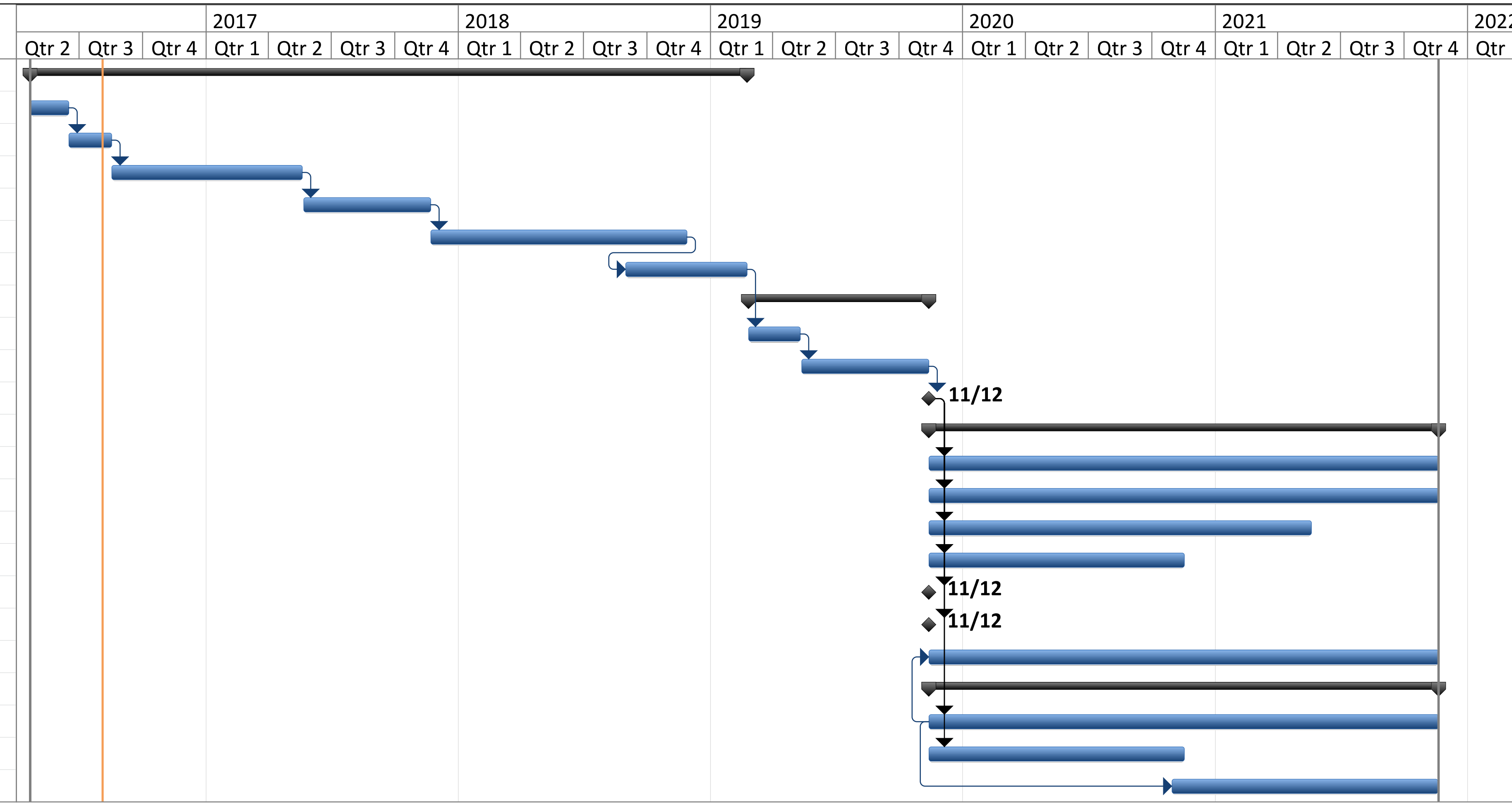
A schedule for implementation of upgrades was developed in Microsoft Project format and is presented in Figure 7-1. Only one schedule was developed; it is not divided into phases and assumes that Phase II conditions, with FOG addition, will require implementation of all the described upgrades. The initial tasks following completion of this study include procurement of a design consultant and development of the 10% design documents. The schedule presented in the draft TM issued on May 6, 2016, used information available from other Pure Water documents on consultant procurement and contract award; this resulted in a duration of approximately 300 working days for procurement of the 10% design consultant and the final design consultant. In addition, upgrades to the thickening and dewatering centrifuges were expected to require the most time because of a long lead time on the machines. As a result, construction of MBC improvements lagged those at NCWRP by approximately 9 months.

To better align construction of MBC improvements with the NCWRP construction schedule, the City agreed to accelerate the procurement of both design consultants as well as pre-purchase procurement of centrifuges. These decisions were made during a Draft TM review workshop, conducted on May 18, 2016, and are documented in the meeting summary log (refer to Appendix F). As a result of these changes, the MBC improvements construction is now on track and runs parallel with the NCWRP Expansion. Overall, the schedule was shortened by approximately 9 months, and currently has a project completion date of November 2021.

Procurement of a final design consultant, preparing the final design documents, and obtaining the necessary permits is the next step and is expected to require approximately 2 calendar years. This is followed by the bid advertisement, contractor selection, and bid award, which are expected to take just under 1 year. The final step is procurement of equipment, construction, commissioning, and placing facilities in operation. Construction of the new anaerobic digester, which requires extensive pre-stressed concrete work, is also expected to require approximately 2 calendar years. Systems such as odor control and chemical dosing do not require any upgrades or improvements and have been therefore listed as requiring zero days.

PROPOSED PROJECT SCHEDULE FOR IMPROVEMENTS AT MBC REQUIRED DUE TO NCWRP EXPANSION
FIGURE 7-1

ID	Task Name	Duration	Start	Finish
1	**Design**	**742 days**	**4/21/2016**	**2/22/2019**
2	Complete PDR(Study)	40 days	4/21/2016	6/15/2016
3	Procure 10% Designer	44 days	6/16/2016	8/16/2016
4	10% Design Development	198 days	8/17/2016	5/19/2017
5	Procure Final Designer	132 days	5/22/2017	11/21/2017
6	Final Design Development	265 days	11/22/2017	11/27/2018
7	Permitting	126 days	8/31/2018	2/22/2019
8	**Construction Bid and Award**	**187 days**	**2/25/2019**	**11/12/2019**
9	Advertise and Bid	55 days	2/25/2019	5/10/2019
10	Award Construction Contract	132 days	5/13/2019	11/12/2019
11	Contractor NTP	0 days	11/12/2019	11/12/2019
12	**Procure/Construct/Commissioning**	**528 days**	**11/12/2019**	**11/19/2021**
13	Grit Removal	528 days	11/13/2019	11/19/2021
14	Thickening Centrifuges	528 days	11/13/2019	11/19/2021
15	Digester Improvements without FOG	396 days	11/13/2019	5/19/2021
16	Centrate System	264 days	11/13/2019	11/16/2020
17	Odor Control (No Improvements)	0 days	11/12/2019	11/12/2019
18	Chemical Systems (No Improvements)	0 days	11/12/2019	11/12/2019
19	Extension of Utilities	528 days	11/13/2019	11/19/2021
20	**FOG Related & Other Improvements**	**528 days**	**11/13/2019**	**11/19/2021**
21	Digester Improvements with FOG	528 days	11/13/2019	11/19/2021
22	Dewatering Centrifuges	264 days	11/13/2019	11/16/2020
23	Waste Heat Utilization	275 days	10/30/2020	11/18/2021



8 Assumptions and Clarifications

8.1 Linear Extrapolations

The findings of this TM are based in large part on linear extrapolations from existing conditions. Without bench-scale or pilot testing in support of the TM, it is not possible to project the impact of second-order effects. For example, solids-dewatering efficiencies and polymer consumption for the existing dewatering centrifuges are based in part on the ability of the existing MBC digester to provide long HRTs and a high degree of solids stabilization. Assuming that higher solids loadings and shorter detention times reduce the efficiency of volatile solids reduction, these changes may adversely impact sludge dewaterability and polymer consumption in ways that are not possible to predict from existing data.

8.2 Required and Recommended Equipment

This TM describes required and recommended equipment for different existing unit processes throughout MBC. These required and recommended upgrades are not based on any evaluation of alternatives and selection of a recommended alternative or best apparent alternative. At all times, the required equipment is listed based on what is already installed, and based on providing a systematic expansion of what is already in place. This TM does not rule out consideration of other alternatives based on a detailed alternatives analysis at a future point in the design process.

8.3 Principal Items of Equipment

This TM is confined to principal items of process equipment within a given unit process. Principal items are defined as those that have a direct impact on the production capability of MBC. This impact is due either to the increase in hydraulic throughput contributed by a principal item of equipment, such as a sludge feed pump to a centrifuge, or to an increase in treatment capacity, for example, a digester HEX. Transfer pumping systems or routine drainage systems are not considered.

8.4 Operations Optimization Project

This TM assumes that none of the recommended operational changes in the subject Draft Operations Optimization Study have been adopted by the City.

8.5 CEPT and Raw Solids

This TM does not address the potential consequences of a change in pH of raw solids as a result of the transition to CEPT at NCWRP. Impacts of sludge pH on digester operations are not factored into this assessment.

8.6 Dewatered Sludge Cake-Handling Facilities

This TM does not assess any impacts on facilities at MBC downstream of the dewatering centrifuges: dewatered sludge cake hoppers, live bottoms, cake pumps, and silos.

8.7 Raw-Solids-Receiving Tanks

This TM does not assess any impacts on the raw-solids-receiving tanks themselves. With a substantial increase in raw sludge flows, the response time before the storage tanks begin to overflow will be reduced by a factor of 5. In addition, it is doubtful that the existing 10-inch-diameter overflow lines have the hydraulic capacity to handle the

Phase II maximum flow of 6.55 mgd. Similarly, rapidly rising level will have an impact on the rate of displacement of foul air to the OCS. These impacts, and related costs, are not included in this assessment.

Impacts on the plant drain and wastewater pump station due to the storage tank overflow system are addressed in the Section 4.8 regarding utilities extensions.

8.8 Thickening Centrifuge Sizing and Selection

The analysis in this TM is based on the assumption that it will be possible to configure the six Alfa Laval Aldec G3-165 centrifuges within the existing space available without having to resort to extensive building modifications or, worse yet, constructing an entirely new building. The cost estimating in this TM is predicated on the assumption that only equipment-specific structural modifications will be needed to anchor and restrain the existing centrifuges.

The main challenge in sizing the future thickening centrifuges is that MBC currently runs only one centrifuge, and there is no documented history of how plant operations would run multiple thickening centrifuges if it were required. In projecting how MBC would run multiple thickening centrifuges, the project team relied on the information available for the existing dewatering centrifuges where MBC typically runs between four and five machines simultaneously.

The firm capacity of each thickening centrifuge is based on applying a 20% de-rating to the capacity of the thickening centrifuges. This assumption results in a firm capacity of 1,168 gpm for each proposed thickening centrifuge. The firm capacity of the proposed thickening centrifuge system is based on the assumption that four centrifuges run continuously (7 days per week, 24 hours per day) and two centrifuges are readily available as backup units.

The 20% de-rating assumption for thickening centrifuge is derived from typical operating practice at MBC for the dewatering centrifuges where multiple units typically run at a margin below their rated capacity. The existing dewatering centrifuges are rated for 300 gpm, but MBC staff typically operate them at 225 gpm.

8.9 Sequencing and Timing of Construction

MBC is currently underutilized relative to its firm operating capacity. This condition allows O&M staff latitude in performing retrofits and upgrades while maintaining plant operations. This assessment assumes that any upgrades and modifications at MBC will occur in advance of any commissioning efforts associated with NCPWF and NCWRP.

8.10 Food Waste

The discussion of FOG in this TM is based on the prior work done by CH2M Hill (39). No effort has been made to update this work to include the effects of Assembly Bill 1826, which would require the separate handling of commercial food waste from facilities generating more than a specified limit.

9 High- and Low-Flow Wasting Scenarios: Maximum Day Conditions

9.1 High- and Low-Flow Wasting Scenarios

This TM assumes a conservative, high-flow biosolids wasting scenario with wasting of mixed liquor and primary sludge at 0.5% TS concentration, which results in a flow of 6.55 mgd from NCWRP to MBC under Phase II peak day, maximum NPR demand conditions. These assumptions result in a more conservative approach to sizing unit processes at MBC for raw solids handling.

Because of the hydraulic limitations of the 16-inch-diameter blended biosolids pipeline and the capacity of pumps at the existing pump station, the NCWRP Expansion 10% EDR (32) proposes to cap the raw solids flow at 3.9 mgd instead of 6.55 mgd with approximately the same mass solids loading. This will be achieved by allowing the solids concentration to increase to 0.92% by surface wasting RAS and primary sludge.

9.2 Sizing and Cost Implications

The OPC presented in Section 6 is based on the conservative approach to solids wasting in the NCWRP primary and secondary treatment processes. Based on this approach, the required improvements will provide sufficient capacity that would be required at MBC to handle the higher average and peak flows.

If the final design consultant for the NCWRP Expansion elects to design the NCWRP Expansion based on the restrictions of the 16-inch-diameter raw solids force main and upgrade MBC according to the lower peak flow of 3.9 mgd (but with the same solids mass loading), the scale of upgrades required at MBC would be reduced. The greatest reduction would be experienced by the three unit processes described below.

9.2.1 Grit Removal Facilities

Because of the slightly reduced flow, it is anticipated that only one additional teacup will be required instead of two. The building expansion required will be smaller because only one additional teacup and auxiliary equipment will need to be housed.

8.2.2 Raw Solids Thickening Facilities

A peak flow of 3.9 mgd of raw solids under Phase II peak-day conditions theoretically allows the existing thickening centrifuges to handle the flow. Each of the existing centrifuges has a capacity of 750 gpm. Four of the existing centrifuges could each handle 1 mgd of biosolids (694 gpm). Addition of a sixth new centrifuge would allow for two backup units with four units in operation.

The weakness in the hydraulic loading approach is that it does not account for potential solids-handling limitations in the existing thickening centrifuges. The existing thickening centrifuges were designed to handle solids concentrations between 0.33% and 0.5%. This concentration equates to a maximum design solids input of 45,000 lb/d. MBC has operated a thickening centrifuge at 37,000 lb/d on average, and during the maximum month, has exceeded the design capacity by 18% with 53,000 lb/d. Under the proposed scenario with 1 mgd per centrifuge, each existing unit would receive 74,000 lb/d, an increase of 64% beyond the design maximum.

For planning purposes, the conservative approach entails budgeting for six new thickening centrifuges specifically designed for higher solids concentrations of 0.92% (3.9 mgd containing 298,000 lb/d of solids based on (32) projections). The work in this TM is based on discussions with Alfa Laval, and the Aldec G3-165 frame size is used for flows as low as 500 gpm. As a result, no savings would be associated with selecting a smaller centrifuge from the standpoint of a centrifuge frame design, but potential savings may come from smaller drive motors, backdrive motors, and VFD components.

9.2.2 Centrate Pump Station

The existing centrate pumps are adequate for handling the projected flows. However, the fourth centrate pump will be required and must be installed prior to Phase II.

9.2.3 Potential Cost Reductions

The outlined potential reduction in the number, or in the individual capacity, of equipment components for the above facilities may result in a reduction in the construction and delivery costs for upgrades to the subject facilities. Table 9-1 summarizes the results of this projection. For thickening centrifuges, the estimated 10% reduction in purchase price is a result of smaller main drive motors, backdrive motors, and VFD components. In addition, there is a savings associated with refurbishing of the existing sludge feed pumps in lieu of providing new, larger pumps. This summary does not include a detailed analysis of potential costs savings associated with the low biosolids-wasting scenario to the level of cost analysis presented in the TM (Class 5 estimate), but a high-level, order-of-magnitude assessment of potential savings (Table 9-1) indicates potential cost reductions in the Phase II OPC.

Table 9-1: Potential Cost Reductions

Facility/System	Potential Construction Cost Savings	Potential Total Project Cost Savings
Grit removal	$1.3M	$2.6M
Raw solids thickening	$1.4M	$2.8M
Centrate pump station	$0.7M	$1.3M
Total	$3.4M	$6.7M

Appendix A: References

Appendix A: References

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(14) Black and Veatch, MBC Chemical Systems Improvements - Phase II 30% Design Technical Memorandum, Project No. 177724, June 24, 2013

(15) Metcalf and Eddy, Biosolids Screen and Blending Tank Improvement Study, March 16, 2016

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(21)Metcalf and Eddy, Operations Manual for the Metropolitan Biosolids Center, April 1997.

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Metro Biosolids Center Site Map	SITEMAPSPDF_2014	PDF
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City of San Diego Wastewater Operations Management Network (COMNET) Metropolitan Biosolids Center, CIP No. 42-911.04 Revision 1.1, Westinghouse Process Control Division Control Control Strategies, July 2012	Control Strategies File Folder with multiple PDF's	PDF
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SDGE Invoices for MBC Facility (5244 Convoy St) and MWWD (5250 Convoy St B), July 2013 to June 2014	Multiple PDF's	PDF
MBC SDGE Electricity and Gas Account Data, January 2013 to June 2014	MBC SDGE Elec and Gas account data	EXCEL
MBC Electricity, Hot Water, Chilled Water, and Processed Gas Purchases, April 2013 to March 2014	Multiple Excel Files	EXCEL
MBC Generation from Cogen, CY 2012 through	MBC Generation CY2012 thru May	EXCEL

MBC Source List		
Document Name	**File Name**	**File Type**
May 2014	2014	
MBC Grit and Sludge Data, January 2012 to April 2014	Optimization Grit and Sludge	EXCEL
San Diego County Pollution Control District Startup Authorization for Digester Flares, Date of Issuance, May 5, 2014	Flares Digester SA_issued May 2014	PDF
County of San Diego Air Pollution Control District Permit to Operate for Area 94: Expires July 31, 2015	MBC_Area_94_exp_July 2015	PDF
County of San Diego Air Pollution Control District Permit to Operate for Areas 60, 76, and 86: Expires July 31, 2015	MBC_Areas_60_76_86_exp_July 2015	PDF

Appendix B: Phase I Scenario Modeling Results

TABLE B1 - SCENARIO A.1

Scenario A.1: Phase I Loads and Flows at 52% VSS Destruction in Digesters with no FOG addition.

	MIR AT AADF			MIR AT PEAK DAY FLOW		
	MIN NPR	BASE NPR	MAX NPR	MIN NPR	BASE NPR	MAX NPR
RECEIVING TANK IN						
RECEIVING TANK OUT						
TEACUPS IN						
TEACUPS OUT						
TC INPUT						
Flow, mgd	1.88	2.45	2.90	2.87	3.75	4.43
TSS, lb/day	78331	102236	124597	125330	163577	199355
VSS, lb/day	59607	77800	94819	95372	124481	151710
TBOD, lb/day	49405	64604	78824	75589	98845	120600
TC CENTRATE						
Flow, mgd	1.71	2.24	2.64	2.62	3.42	4.03
TSS, lb/day	7833	10224	12460	12533	16358	19936
VSS, lb/day	5961	7780	9482	9537	12448	15171
TBOD, lb/day	4940	6460	7882	7559	9884	12060
TC OUTPUT						
SCREENS IN						
SCREENS OUT						
DIGESTER IN						
Flow, mgd	0.16	0.21	0.26	0.25	0.33	0.40
TSS, lb/day	70498	92012	112137	112797	147220	179420
VSS, lb/day	53647	70020	85337	85834	112033	136539
TBOD, lb/day	44464	58144	70941	68030	88960	108540
DIGESTER OUT						
Flow, mgd	0.16	0.21	0.26	0.25	0.33	0.40
TSS, lb/day	42602	55602	67762	68163	88963	108420
VSS, lb/day	25750	33610	40962	41201	53776	65539
TBOD, lb/day	20009	26165	31924	30614	40032	48843

TABLE B1 - SCENARIO A.1

Scenario A.1: Phase I Loads and Flows at 52% VSS Destruction in Digesters with no FOG addition.

	MIR AT AADF			MIR AT PEAK DAY FLOW		
	MIN NPR	BASE NPR	MAX NPR	MIN NPR	BASE NPR	MAX NPR
PLWTP DIGESTED SOLIDS						
Flow, mgd	1.35	1.29	1.24	1.86	1.78	1.71
TSS, lb/day	307359	294284	282021	424155	406112	389189
VSS, lb/day	151210	144959	139110	208670	200043	191972
TBOD, lb/day	60304	57928	55707	83219	79941	76875
DIGESTED SOLIDS STORAGE IN						
DIGESTED SOLIDS STORAGE OUT						
DW CENTRIFUGE IN						
Flow, mgd	1.51	1.50	1.50	2.11	2.10	2.09
TSS, lb/day	349961	349886	349783	489945	489840	489696
VSS, lb/day	176960	178569	180072	247744	249996	252101
TBOD, lb/day	80313	84093	87630	112438	117731	122682
DW CENTRATE						
Flow, mgd	1.38	1.37	1.36	1.93	1.92	1.91
TSS, lb/day	17498	17494	17489	24497	24492	24485
VSS, lb/day	8848	8928	9004	12387	12500	12605
TBOD, lb/day	12891	13097	13290	18048	18336	18606
DW BIOSOLIDS SILOS IN						
DW BIOSOLIDS SILOS OUT						
Flow, mgd	0.133	0.133	0.133	0.186	0.186	0.186

TABLE B2 - SCENARIO A.2

Scenario A.2: Phase I Loads and Flows at 46% VSS Destruction in Digesters with no FOG addition.

	MIR AT AADF			MIR AT PEAK DAY FLOW		
	MIN NPR	BASE NPR	MAX NPR	MIN NPR	BASE NPR	MAX NPR
RECEIVING TANK IN						
RECEIVING TANK OUT						
TEACUPS IN						
TEACUPS OUT						
TC INPUT						
Flow, mgd	1.88	2.45	2.90	2.87	3.75	4.43
TSS, lb/day	78331	102236	124597	125330	163577	199355
VSS, lb/day	59607	77800	94819	95372	124481	151710
TBOD, lb/day	49405	64604	78824	75589	98845	120600
TC CENTRATE						
Flow, mgd	1.71	2.24	2.64	2.62	3.42	4.03
TSS, lb/day	7833	10224	12460	12533	16358	19936
VSS, lb/day	5961	7780	9482	9537	12448	15171
TBOD, lb/day	4940	6460	7882	7559	9884	12060
TC OUTPUT						
SCREENS IN						
SCREENS OUT						
DIGESTER IN						
Flow, mgd	0.16	0.21	0.26	0.25	0.33	0.40
TSS, lb/day	70498	92012	112137	112797	147220	179420
VSS, lb/day	53647	70020	85337	85834	112033	136539
TBOD, lb/day	44464	58144	70941	68030	88960	108540
DIGESTER OUT						
Flow, mgd	0.16	0.21	0.26	0.25	0.33	0.40
TSS, lb/day	45821	59803	72882	73313	95685	116612
VSS, lb/day	28969	37811	46082	46351	60498	73731
TBOD, lb/day	20009	26165	31924	30614	40032	48843

TABLE B2 - SCENARIO A.2

Scenario A.2: Phase I Loads and Flows at 46% VSS Destruction in Digesters with no FOG addition.

	MIR AT AADF			MIR AT PEAK DAY FLOW		
	MIN NPR	BASE NPR	MAX NPR	MIN NPR	BASE NPR	MAX NPR
PLWTP DIGESTED SOLIDS						
Flow, mgd	1.35	1.29	1.24	1.86	1.78	1.71
TSS, lb/day	307449	294403	282165	424280	406276	389388
VSS, lb/day	151264	145030	139197	208745	200141	192092
TBOD, lb/day	60304	57929	55707	83220	79942	76876
DIGESTED SOLIDS STORAGE IN						
DIGESTED SOLIDS STORAGE OUT						
DW CENTRIFUGE IN						
Flow, mgd	1.51	1.50	1.50	2.11	2.10	2.10
TSS, lb/day	353270	354205	355047	494578	495888	497066
VSS, lb/day	180234	182841	185279	252327	255977	259391
TBOD, lb/day	80313	84094	87631	112438	117731	122683
DW CENTRATE						
Flow, mgd	1.38	1.37	1.36	1.93	1.92	1.91
TSS, lb/day	17664	17710	17752	24729	24794	24853
VSS, lb/day	9012	9142	9264	12616	12799	12970
TBOD, lb/day	12894	13101	13294	18051	18341	18612
DW BIOSOLIDS SILOS IN						
DW BIOSOLIDS SILOS OUT						
Flow, mgd	0.134	0.135	0.135	0.188	0.189	0.189

TABLE B3 - SCENARIO B.1

Scenario B.1: Phase I Loads and Flows at 52% VSS Destruction in Digesters with FOG addition without Lystek

	MIR AT AADF			MIR AT PEAK DAY FLOW		
	MIN NPR	BASE NPR	MAX NPR	MIN NPR	BASE NPR	MAX NPR
RECEIVING TANK IN						
RECEIVING TANK OUT						
TEACUPS IN						
TEACUPS OUT						
TC INPUT						
Flow, mgd	1.88	2.45	2.90	2.87	3.75	4.43
TSS, lb/day	78331	102236	124597	125330	163577	199355
VSS, lb/day	59607	77800	94819	95372	124481	151710
TBOD, lb/day	49405	64604	78824	75589	98845	120600
TC CENTRATE						
Flow, mgd	1.71	2.24	2.64	2.62	3.42	4.03
TSS, lb/day	7833	10224	12460	12533	16358	19936
VSS, lb/day	5961	7780	9482	9537	12448	15171
TBOD, lb/day	4940	6460	7882	7559	9884	12060
FOG ADDITION						
Flow, mgd	0.06	0.06	0.06	0.06	0.06	0.06
TSS, lb/day	30024	30024	30024	30024	30024	30024
VSS, lb/day	27922	27922	27922	27922	27922	27922
TBOD, lb/day	50440	50440	50440	50440	50440	50440
TC OUTPUT						
SCREENS IN						
SCREENS OUT						
Flow, mgd	0.16	0.21	0.26	0.25	0.33	0.40
TSS, lb/day	70498	92012	112137	112797	147220	179420
VSS, lb/day	53647	70020	85337	85834	112033	136539
TBOD, lb/day	44464	58144	70941	68030	88960	108540
DIGESTER IN						
Flow, mgd	0.22	0.27	0.32	0.31	0.39	0.46
TSS, lb/day	100522	122036	142161	142821	177244	209444
VSS, lb/day	81569	97943	113259	113757	139955	164461
TBOD, lb/day	94905	108584	121382	118471	139401	158980

TABLE B3 - SCENARIO B.1

Scenario B.1: Phase I Loads and Flows at 52% VSS Destruction in Digesters with FOG addition without Lystek

	MIR AT AADF			MIR AT PEAK DAY FLOW		
	MIN NPR	BASE NPR	MAX NPR	MIN NPR	BASE NPR	MAX NPR
DIGESTER OUT						
Flow, mgd	0.22	0.27	0.32	0.31	0.39	0.46
TSS, lb/day	44704	57703	69864	83667	104467	123924
VSS, lb/day	39153	47013	54364	54603	67178	78941
TBOD, lb/day	42707	48863	54622	53312	62730	71541
PLWTP DIGESTED SOLIDS						
Flow, mgd	1.35	1.29	1.24	1.86	1.78	1.71
TSS, lb/day	307441	294366	282103	424268	406225	389302
VSS, lb/day	151246	144995	139146	208719	200093	192022
TBOD, lb/day	60309	57934	55712	83227	79949	76883
DIGESTED SOLIDS STORAGE IN						
DIGESTED SOLIDS STORAGE OUT						
DW CENTRIFUGE IN						
Flow, mgd	1.57	1.56	1.56	2.17	2.17	2.17
TSS, lb/day	352144	352069	351967	507935	510692	513226
VSS, lb/day	190399	192007	193511	263323	267271	270963
TBOD, lb/day	103016	106797	110334	136539	142679	148424
DW CENTRATE						
Flow, mgd	1.44	1.43	1.42	2.01	2.00	1.99
TSS, lb/day	17607	17603	17598	24650	24645	24638
VSS, lb/day	9520	9600	9676	13328	13441	13546
TBOD, lb/day	12929	13135	13328	18101	18389	18659
DW BIOSOLIDS SILOS IN						
DW BIOSOLIDS SILOS OUT						
Flow, mgd	0.134	0.134	0.134	0.187	0.187	0.187

TABLE B4 - SCENARIO B.1

Scenario B.2: Phase I Loads and Flows at 46% VSS Destruction in Digesters with FOG addition without Lystek

	MIR AT AADF			MIR AT PEAK DAY FLOW		
	MIN NPR	BASE NPR	MAX NPR	MIN NPR	BASE NPR	MAX NPR
RECEIVING TANK IN						
RECEIVING TANK OUT						
TEACUPS IN						
TEACUPS OUT						
TC INPUT						
Flow, mgd	1.88	2.45	2.90	2.87	3.75	4.43
TSS, lb/day	78331	102236	124597	125330	163577	199355
VSS, lb/day	59607	77800	94819	95372	124481	151710
TBOD, lb/day	49405	64604	78824	75589	98845	120600
TC CENTRATE						
Flow, mgd	1.71	2.24	2.64	2.62	3.42	4.03
TSS, lb/day	7833	10224	12460	12533	16358	19936
VSS, lb/day	5961	7780	9482	9537	12448	15171
TBOD, lb/day	4940	6460	7882	7559	9884	12060
FOG ADDITION						
Flow, mgd	0.06	0.06	0.06	0.06	0.06	0.06
TSS, lb/day	30024	30024	30024	30024	30024	30024
VSS, lb/day	27922	27922	27922	27922	27922	27922
TBOD, lb/day	50440	50440	50440	50440	50440	50440
TC OUTPUT						
SCREENS IN						
SCREENS OUT						
Flow, mgd	0.16	0.21	0.26	0.25	0.33	0.40
TSS, lb/day	70498	92012	112137	112797	147220	179420
VSS, lb/day	53647	70020	85337	85834	112033	136539
TBOD, lb/day	44464	58144	70941	68030	88960	108540
DIGESTER IN						
Flow, mgd	0.22	0.27	0.32	0.31	0.39	0.46
TSS, lb/day	100522	122036	142161	142821	177244	209444
VSS, lb/day	81569	97943	113259	113757	139955	164461
TBOD, lb/day	44464	58144	70941	118471	139401	158980

TABLE B4 - SCENARIO B.1

Scenario B.2: Phase I Loads and Flows at 46% VSS Destruction in Digesters with FOG addition without Lystek

	MIR AT AADF			MIR AT PEAK DAY FLOW		
	MIN NPR	BASE NPR	MAX NPR	MIN NPR	BASE NPR	MAX NPR
DIGESTER OUT						
Flow, mgd	0.22	0.27	0.32	0.31	0.39	0.46
TSS, lb/day	47922	61905	74984	90493	112864	133792
VSS, lb/day	44047	52889	61160	61429	75576	88809
TBOD, lb/day	42707	48863	54622	53312	62730	71541
PLWTP DIGESTED SOLIDS						
Flow, mgd	1.35	1.29	1.24	1.86	1.78	1.71
TSS, lb/day	307531	294484	282247	424393	406389	389501
VSS, lb/day	151301	145066	139233	208795	200191	192142
TBOD, lb/day	60310	57935	55713	83227	79950	76884
DIGESTED SOLIDS STORAGE IN						
DIGESTED SOLIDS STORAGE OUT						
DW CENTRIFUGE IN						
Flow, mgd	1.57	1.56	1.56	2.17	2.17	2.17
TSS, lb/day	355454	356389	357231	514886	519253	523292
VSS, lb/day	195348	197955	200393	270223	275767	280951
TBOD, lb/day	103017	106798	110334	136539	142680	148425
DW CENTRATE						
Flow, mgd	1.44	1.43	1.42	2.01	2.00	1.99
TSS, lb/day	17773	17819	17862	24882	24947	25006
VSS, lb/day	9767	9898	10020	13674	13857	14028
TBOD, lb/day	12932	13139	13332	18104	18394	18665
DW BIOSOLIDS SILOS IN						
DW BIOSOLIDS SILOS OUT						
Flow, mgd	0.135	0.136	0.136	0.189	0.190	0.190

TABLE B5 - SCENARIO C.1

Scenario C.1: Phase I Loads and Flows at 65% VSS Destruction in Digesters with FOG addition and Lystek process.

	MIR AT AADF			MIR AT PEAK DAY FLOW		
	MIN NPR	BASE NPR	MAX NPR	MIN NPR	BASE NPR	MAX NPR
RECEIVING TANK IN						
RECEIVING TANK OUT						
TEACUPS IN						
TEACUPS OUT						
TC INPUT						
Flow, mgd	1.88	2.45	2.90	2.87	3.75	4.43
TSS, lb/day	78331	102236	124597	125330	163577	199355
VSS, lb/day	59607	77800	94819	95372	124481	151710
TBOD, lb/day	49405	64604	78824	75589	98845	120600
TC CENTRATE						
Flow, mgd	1.71	2.24	2.64	2.62	3.42	4.03
TSS, lb/day	7833	10224	12460	12533	16358	19936
VSS, lb/day	5961	7780	9482	9537	12448	15171
TBOD, lb/day	4940	6460	7882	7559	9884	12060
FOG ADDITION						
Flow, mgd	0.06	0.06	0.06	0.06	0.06	0.06
TSS, lb/day	30024	30024	30024	30024	30024	30024
VSS, lb/day	27922	27922	27922	27922	27922	27922
TBOD, lb/day	50440	50440	50440	50440	50440	50440
TC OUTPUT						
SCREENS IN						
SCREENS OUT						
Flow, mgd	0.16	0.21	0.26	0.25	0.33	0.40
TSS, lb/day	70498	92012	112137	112797	147220	179420
VSS, lb/day	53647	70020	85337	85834	112033	136539
TBOD, lb/day	44464	58144	70941	68030	88960	108540
DIGESTER IN						
Flow, mgd	0.22	0.27	0.32	0.31	0.39	0.46
TSS, lb/day	100522	122036	142161	142821	177244	209444
VSS, lb/day	81569	97943	113259	113757	139955	164461
TBOD, lb/day	44464	58144	70941	118471	139401	158980

TABLE B5 - SCENARIO C.1

Scenario C.1: Phase I Loads and Flows at 65% VSS Destruction in Digesters with FOG addition and Lystek process.

	MIR AT AADF			MIR AT PEAK DAY FLOW		
	MIN NPR	BASE NPR	MAX NPR	MIN NPR	BASE NPR	MAX NPR
DIGESTER OUT						
Flow, mgd	0.22	0.27	0.32	0.31	0.39	0.46
TSS, lb/day	37729	48601	58770	68879	86273	102544
VSS, lb/day	28549	34280	39641	39815	48984	57561
TBOD, lb/day	42707	48863	54622	53312	62730	71541
PLWTP DIGESTED SOLIDS						
Flow, mgd	1.35	1.29	1.24	1.86	1.78	1.71
TSS, lb/day	307244	294110	281790	423997	405871	388870
VSS, lb/day	151128	144840	138958	208556	199880	191762
TBOD, lb/day	60308	57933	55711	83226	79948	76881
DIGESTED SOLIDS STORAGE IN						
DIGESTED SOLIDS STORAGE OUT						
DW CENTRIFUGE IN						
Flow, mgd	1.57	1.56	1.55	2.17	2.17	2.17
TSS, lb/day	344974	342710	340560	492876	492144	491414
VSS, lb/day	179677	179120	178599	248371	248864	249324
TBOD, lb/day	103015	106796	110332	136537	142678	148422
DW CENTRATE						
Flow, mgd	1.44	1.43	1.43	2.01	2.00	2.00
TSS, lb/day	17249	17136	17028	24148	23990	23839
VSS, lb/day	8984	8956	8930	12577	12538	12502
TBOD, lb/day	12923	13128	13319	18092	18379	18646
DW BIOSOLIDS SILOS IN						
DW BIOSOLIDS SILOS OUT						
Flow, mgd	0.131	0.130	0.129	0.184	0.182	0.181

TABLE B6 - SCENARIO C.2

Scenario C.2: Phase I Loads and Flows at 57.5% VSS Destruction in Digesters with FOG addition and Lystek process.

	MIR AT AADF			MIR AT PEAK DAY FLOW		
	MIN NPR	BASE NPR	MAX NPR	MIN NPR	BASE NPR	MAX NPR
RECEIVING TANK IN						
RECEIVING TANK OUT						
TEACUPS IN						
TEACUPS OUT						
TC INPUT						
Flow, mgd	1.88	2.45	2.90	2.87	3.75	4.43
TSS, lb/day	78331	102236	124597	125330	163577	199355
VSS, lb/day	59607	77800	94819	95372	124481	151710
TBOD, lb/day	49405	64604	78824	75589	98845	120600
TC CENTRATE						
Flow, mgd	1.71	2.24	2.64	2.62	3.42	4.03
TSS, lb/day	7833	10224	12460	12533	16358	19936
VSS, lb/day	5961	7780	9482	9537	12448	15171
TBOD, lb/day	4940	6460	7882	7559	9884	12060
FOG ADDITION						
Flow, mgd	0.06	0.06	0.06	0.06	0.06	0.06
TSS, lb/day	30024	30024	30024	30024	30024	30024
VSS, lb/day	27922	27922	27922	27922	27922	27922
TBOD, lb/day	50440	50440	50440	50440	50440	50440
TC OUTPUT						
SCREENS IN						
SCREENS OUT						
Flow, mgd	0.16	0.21	0.26	0.25	0.33	0.40
TSS, lb/day	70498	92012	112137	112797	147220	179420
VSS, lb/day	53647	70020	85337	85834	112033	136539
TBOD, lb/day	44464	58144	70941	68030	88960	108540
DIGESTER IN						
Flow, mgd	0.22	0.27	0.32	0.31	0.39	0.46
TSS, lb/day	100522	122036	142161	142821	177244	209444
VSS, lb/day	81569	97943	113259	113757	139955	164461
TBOD, lb/day	44464	58144	70941	118471	139401	158980

TABLE B6 - SCENARIO C.2

Scenario C.2: Phase I Loads and Flows at 57.5% VSS Destruction in Digesters with FOG addition and Lystek process.

	MIR AT AADF			MIR AT PEAK DAY FLOW		
	MIN NPR	BASE NPR	MAX NPR	MIN NPR	BASE NPR	MAX NPR
DIGESTER OUT						
Flow, mgd	0.22	0.27	0.32	0.31	0.39	0.46
TSS, lb/day	41753	53852	65170	77411	96770	114879
VSS, lb/day	34667	41626	48135	48347	59481	69896
TBOD, lb/day	42707	48863	54622	53312	62730	71541
PLWTP DIGESTED SOLIDS						
Flow, mgd	1.35	1.29	1.24	1.86	1.78	1.71
TSS, lb/day	307353	294258	281970	424148	406075	389119
VSS, lb/day	151193	144929	139067	208647	200003	191912
TBOD, lb/day	60309	57934	55712	83227	79948	76882
DIGESTED SOLIDS STORAGE IN						
DIGESTED SOLIDS STORAGE OUT						
DW CENTRIFUGE IN						
Flow, mgd	1.57	1.56	1.56	2.17	2.17	2.17
TSS, lb/day	349106	348110	347141	501558	502845	503998
VSS, lb/day	185860	186555	187202	256994	259484	261808
TBOD, lb/day	103016	106797	110333	136538	142679	148423
DW CENTRATE						
Flow, mgd	1.44	1.43	1.42	2.01	2.00	1.99
TSS, lb/day	17455	17405	17357	24437	24368	24300
VSS, lb/day	9293	9328	9360	13010	13059	13104
TBOD, lb/day	12926	13132	13324	18097	18385	18654
DW BIOSOLIDS SILOS IN						
DW BIOSOLIDS SILOS OUT						
Flow, mgd	0.133	0.132	0.132	0.186	0.185	0.185

Appendix C: Phase II Scenario Modeling Results

TABLE C1- SCENARIO A.1

Scenario A.1: Phase II Loads and Flows at 52% VSS Destruction in Digesters with no FOG addition.

	MIR AT AADF			MIR AT PEAK DAY FLOW		
	MIN NPR	BASE NPR	MAX NPR	MIN NPR	BASE NPR	MAX NPR
RECEIVING TANK IN						
RECEIVING TANK OUT						
TEACUPS IN						
TEACUPS OUT						
TC INPUT						
Flow, mgd	3.29	3.87	4.28	5.04	5.92	6.55
TSS, lb/day	137352	161288	183930	219763	258061	294288
VSS, lb/day	104520	122737	139969	167232	196379	223950
TBOD, lb/day	86630	101849	116246	132544	155830	177856
TC CENTRATE						
Flow, mgd	3.01	3.53	3.89	4.60	5.40	5.96
TSS, lb/day	13735	16129	18393	21976	25806	29429
VSS, lb/day	10452	12274	13997	16723	19638	22395
TBOD, lb/day	8663	10185	11625	13254	15583	17786
TC OUTPUT						
SCREENS IN						
SCREENS OUT						
DIGESTER IN						
Flow, mgd	0.29	0.34	0.39	0.44	0.52	0.59
TSS, lb/day	123617	145159	165537	197787	232255	264859
VSS, lb/day	94068	110463	125972	150509	176741	201555
TBOD, lb/day	77967	91664	104621	119290	140247	160070
DIGESTER OUT						
Flow, mgd	0.28	0.33	0.38	0.44	0.52	0.59
TSS, lb/day	74701	87718	100032	119522	140349	160050
VSS, lb/day	45153	53022	60466	72244	84836	96746
TBOD, lb/day	35085	41249	47079	53680	63111	72032

TABLE C1- SCENARIO A.1

Scenario A.1: Phase II Loads and Flows at 52% VSS Destruction in Digesters with no FOG addition.

	MIR AT AADF			MIR AT PEAK DAY FLOW		
	MIN NPR	BASE NPR	MAX NPR	MIN NPR	BASE NPR	MAX NPR
PLWTP DIGESTED SOLIDS						
Flow, mgd	1.26	1.20	1.15	1.74	1.66	1.59
TSS, lb/day	287856	274766	262341	397242	379176	362031
VSS, lb/day	141464	135205	129284	195220	186582	178411
TBOD, lb/day	56856	54478	52228	78461	75179	72075
DIGESTED SOLIDS STORAGE IN						
DIGESTED SOLIDS STORAGE OUT						
DW CENTRIFUGE IN						
Flow, mgd	1.55	1.54	1.53	2.16	2.15	2.15
TSS, lb/day	362558	362484	362373	507581	507477	507322
VSS, lb/day	186617	188227	189750	261263	263518	265650
TBOD, lb/day	91941	95727	99308	128718	134018	139031
DW CENTRATE						
Flow, mgd	1.41	1.40	1.39	1.97	1.96	1.95
TSS, lb/day	18128	18124	18119	25379	25374	25366
VSS, lb/day	9331	9411	9488	13063	13176	13283
TBOD, lb/day	13813	14019	14215	19338	19627	19901
DW BIOSOLIDS SILOS IN						
DW BIOSOLIDS SILOS OUT						
Flow, mgd	0.138	0.138	0.138	0.193	0.193	0.193

TABLE C2 - SCENARIO A.2

Scenario A.2: Phase II Loads and Flows at 46% VSS Destruction in Digesters with no FOG addition.

	MIR AT AADF			MIR AT PEAK DAY FLOW		
	MIN NPR	BASE NPR	MAX NPR	MIN NPR	BASE NPR	MAX NPR
RECEIVING TANK IN						
RECEIVING TANK OUT						
TEACUPS IN						
TEACUPS OUT						
TC INPUT						
Flow, mgd	3.29	3.87	4.28	5.04	5.92	6.55
TSS, lb/day	137352	161288	183930	219763	258061	294288
VSS, lb/day	104520	122737	139969	167232	196379	223950
TBOD, lb/day	86630	101849	116246	132544	155830	177856
TC CENTRATE						
Flow, mgd	3.01	3.53	3.89	4.60	5.40	5.96
TSS, lb/day	13735	16129	18393	21976	25806	29429
VSS, lb/day	10452	12274	13997	16723	19638	22395
TBOD, lb/day	8663	10185	11625	13254	15583	17786
TC OUTPUT						
SCREENS IN						
SCREENS OUT						
DIGESTER IN						
Flow, mgd	0.29	0.34	0.39	0.44	0.52	0.59
TSS, lb/day	123617	145159	165537	197787	232255	264859
VSS, lb/day	94068	110463	125972	150509	176741	201555
TBOD, lb/day	77967	91664	104621	119290	140247	160070
DIGESTER OUT						
Flow, mgd	0.28	0.33	0.38	0.44	0.52	0.59
TSS, lb/day	80346	94346	107590	128553	150954	172144
VSS, lb/day	50797	59650	68025	81275	95440	108840
TBOD, lb/day	35085	41249	47079	53680	63111	72032

TABLE C2 - SCENARIO A.2

Scenario A.2: Phase II Loads and Flows at 46% VSS Destruction in Digesters with no FOG addition.

	MIR AT AADF			MIR AT PEAK DAY FLOW		
	MIN NPR	BASE NPR	MAX NPR	MIN NPR	BASE NPR	MAX NPR
PLWTP DIGESTED SOLIDS						
Flow, mgd	1.26	1.21	1.15	1.74	1.66	1.59
TSS, lb/day	288015	274952	262554	397461	379434	362325
VSS, lb/day	141560	135317	129412	195352	186738	178588
TBOD, lb/day	56857	54479	52229	78462	75181	72076
DIGESTED SOLIDS STORAGE IN						
DIGESTED SOLIDS STORAGE OUT						
DW CENTRIFUGE IN						
Flow, mgd	1.55	1.54	1.53	2.17	2.16	2.15
TSS, lb/day	368361	369298	370144	515705	517018	518202
VSS, lb/day	192356	194967	197437	269299	272954	276411
TBOD, lb/day	91942	95728	99309	128719	134019	139032
DW CENTRATE						
Flow, mgd	1.41	1.40	1.39	1.97	1.96	1.95
TSS, lb/day	18418	18465	18507	25785	25851	25910
VSS, lb/day	9618	9748	9872	13465	13648	13821
TBOD, lb/day	13818	14025	14221	19345	19635	19909
DW BIOSOLIDS SILOS IN						
DW BIOSOLIDS SILOS OUT						
Flow, mgd	0.140	0.140	0.141	0.196	0.197	0.197

TABLE C3 - SCENARIO B.1

Scenario B.1: Phase II Loads and Flows at 52% VSS Destruction in Digesters with FOG addition without Lystek

	MIR AT AADF			MIR AT PEAK DAY FLOW		
	MIN NPR	BASE NPR	MAX NPR	MIN NPR	BASE NPR	MAX NPR
RECEIVING TANK IN						
RECEIVING TANK OUT						
TEACUPS IN						
TEACUPS OUT						
TC INPUT						
Flow, mgd	3.29	3.87	4.28	5.04	5.92	6.55
TSS, lb/day	137352	161288	183930	219763	258061	294288
VSS, lb/day	104520	122737	139969	167232	196379	223950
TBOD, lb/day	86630	101849	116246	132544	155830	177856
TC CENTRATE						
Flow, mgd	3.01	3.53	3.89	4.60	5.40	5.96
TSS, lb/day	13735	16129	18393	21976	25806	29429
VSS, lb/day	10452	12274	13997	16723	19638	22395
TBOD, lb/day	8663	10185	11625	13254	15583	17786
FOG ADDITION						
Flow, mgd	0.06	0.06	0.06	0.06	0.06	0.06
TSS, lb/day	30024	30024	30024	30024	30024	30024
VSS, lb/day	27922	27922	27922	27922	27922	27922
TBOD, lb/day	50440	50440	50440	50440	50440	50440
TC OUTPUT						
SCREENS IN						
SCREENS OUT						
Flow, mgd	0.29	0.34	0.39	0.44	0.52	0.59
TSS, lb/day	123617	145159	165537	197787	232255	264859
VSS, lb/day	94068	110463	125972	150509	176741	201555
TBOD, lb/day	77967	91664	104621	119290	140247	160070
DIGESTER IN						
Flow, mgd	0.35	0.40	0.45	0.50	0.58	0.65
TSS, lb/day	153641	175183	195561	227811	262279	294883
VSS, lb/day	121990	138386	153894	178431	204664	229477
TBOD, lb/day	128407	142105	155061	169730	190687	210510

TABLE C3 - SCENARIO B.1

Scenario B.1: Phase II Loads and Flows at 52% VSS Destruction in Digesters with FOG addition without Lystek

	MIR AT AADF			MIR AT PEAK DAY FLOW		
	MIN NPR	BASE NPR	MAX NPR	MIN NPR	BASE NPR	MAX NPR
DIGESTER OUT						
Flow, mgd	0.34	0.39	0.44	0.50	0.58	0.65
TSS, lb/day	76803	89820	102133	135027	155854	175555
VSS, lb/day	58555	66425	73869	85647	98239	110149
TBOD, lb/day	57783	63947	69778	76378	85809	94730
PLWTP DIGESTED SOLIDS						
Flow, mgd	1.26	1.20	1.15	1.74	1.66	1.59
TSS, lb/day	287938	274847	262423	397355	379289	362144
VSS, lb/day	141500	135241	129320	195270	186632	178461
TBOD, lb/day	56862	54483	52234	78469	75187	72083
DIGESTED SOLIDS STORAGE IN						
DIGESTED SOLIDS STORAGE OUT						
DW CENTRIFUGE IN						
Flow, mgd	1.61	1.60	1.59	2.24	2.24	2.24
TSS, lb/day	364741	364667	364557	532381	535143	537699
VSS, lb/day	200055	201666	203189	280917	284871	288610
TBOD, lb/day	114645	118431	122012	154848	160996	166813
DW CENTRATE						
Flow, mgd	1.47	1.46	1.45	2.06	2.05	2.04
TSS, lb/day	18237	18233	18228	25532	25527	25519
VSS, lb/day	10003	10083	10159	14004	14117	14223
TBOD, lb/day	13851	14057	14253	19391	19680	19954
DW BIOSOLIDS SILOS IN						
DW BIOSOLIDS SILOS OUT						
Flow, mgd	0.139	0.139	0.139	0.194	0.194	0.194

TABLE C4 - SCENARIO B.2

Scenario B.2: Phase II Loads and Flows at 46% VSS Destruction in Digesters with FOG addition without Lystek

	MIR AT AADF			MIR AT PEAK DAY FLOW		
	MIN NPR	BASE NPR	MAX NPR	MIN NPR	BASE NPR	MAX NPR
RECEIVING TANK IN						
RECEIVING TANK OUT						
TEACUPS IN						
TEACUPS OUT						
TC INPUT						
Flow, mgd	3.29	3.87	4.28	5.04	5.92	6.55
TSS, lb/day	137352	161288	183930	219763	258061	294288
VSS, lb/day	104520	122737	139969	167232	196379	223950
TBOD, lb/day	86630	101849	116246	132544	155830	177856
TC CENTRATE						
Flow, mgd	3.01	3.53	3.89	4.60	5.40	5.96
TSS, lb/day	13735	16129	18393	21976	25806	29429
VSS, lb/day	10452	12274	13997	16723	19638	22395
TBOD, lb/day	8663	10185	11625	13254	15583	17786
FOG ADDITION						
Flow, mgd	0.06	0.06	0.06	0.06	0.06	0.06
TSS, lb/day	30024	30024	30024	30024	30024	30024
VSS, lb/day	27922	27922	27922	27922	27922	27922
TBOD, lb/day	50440	50440	50440	50440	50440	50440
TC OUTPUT						
SCREENS IN						
SCREENS OUT						
Flow, mgd	0.29	0.34	0.39	0.44	0.52	0.59
TSS, lb/day	123617	145159	165537	197787	232255	264859
VSS, lb/day	94068	110463	125972	150509	176741	201555
TBOD, lb/day	77967	91664	104621	119290	140247	160070
DIGESTER IN						
Flow, mgd	0.35	0.40	0.45	0.50	0.58	0.65
TSS, lb/day	153641	175183	195561	227811	262279	294883
VSS, lb/day	121990	138386	153894	178431	204664	229477
TBOD, lb/day	77967	91664	104621	169730	190687	210510

TABLE C4 - SCENARIO B.2

Scenario B.2: Phase II Loads and Flows at 46% VSS Destruction in Digesters with FOG addition without Lystek

	MIR AT AADF			MIR AT PEAK DAY FLOW		
	MIN NPR	BASE NPR	MAX NPR	MIN NPR	BASE NPR	MAX NPR
DIGESTER OUT						
Flow, mgd	0.34	0.39	0.44	0.50	0.58	0.65
TSS, lb/day	82447	96448	109692	145733	168133	189324
VSS, lb/day	65875	74728	83103	96353	110518	123918
TBOD, lb/day	57783	63947	69778	76378	85809	94730
PLWTP DIGESTED SOLIDS						
Flow, mgd	1.26	1.21	1.15	1.74	1.66	1.59
TSS, lb/day	288097	275034	262636	397574	379547	362438
VSS, lb/day	141596	135353	129448	195402	186787	178638
TBOD, lb/day	56862	54484	52235	78470	75188	72084
DIGESTED SOLIDS STORAGE IN						
DIGESTED SOLIDS STORAGE OUT						
DW CENTRIFUGE IN						
Flow, mgd	1.61	1.60	1.59	2.24	2.24	2.24
TSS, lb/day	370544	371482	372328	543307	547681	551762
VSS, lb/day	207470	210081	212551	291755	297306	302556
TBOD, lb/day	114646	118431	122012	154849	160997	166814
DW CENTRATE						
Flow, mgd	1.47	1.46	1.45	2.05	2.04	2.03
TSS, lb/day	18527	18574	18616	25938	26004	26063
VSS, lb/day	10374	10504	10628	14523	14706	14879
TBOD, lb/day	13855	14063	14259	19398	19688	19962
DW BIOSOLIDS SILOS IN						
DW BIOSOLIDS SILOS OUT						
Flow, mgd	0.141	0.141	0.142	0.197	0.198	0.198

TABLE C5 - SCENARIO C.1

Scenario C.1: Phase II Loads and Flows at 65% VSS Destruction in Digesters with FOG addition and Lystek process.

	MIR AT AADF			MIR AT PEAK DAY FLOW		
	MIN NPR	BASE NPR	MAX NPR	MIN NPR	BASE NPR	MAX NPR
RECEIVING TANK IN						
RECEIVING TANK OUT						
TEACUPS IN						
TEACUPS OUT						
TC INPUT						
Flow, mgd	3.29	3.87	4.28	5.04	5.92	6.55
TSS, lb/day	137352	161288	183930	219763	258061	294288
VSS, lb/day	104520	122737	139969	167232	196379	223950
TBOD, lb/day	86630	101849	116246	132544	155830	177856
TC CENTRATE						
Flow, mgd	3.01	3.53	3.89	4.60	5.40	5.96
TSS, lb/day	13735	16129	18393	21976	25806	29429
VSS, lb/day	10452	12274	13997	16723	19638	22395
TBOD, lb/day	8663	10185	11625	13254	15583	17786
FOG ADDITION						
Flow, mgd	0.06	0.06	0.06	0.06	0.06	0.06
TSS, lb/day	30024	30024	30024	30024	30024	30024
VSS, lb/day	27922	27922	27922	27922	27922	27922
TBOD, lb/day	50440	50440	50440	50440	50440	50440
TC OUTPUT						
SCREENS IN						
SCREENS OUT						
Flow, mgd	0.29	0.34	0.39	0.44	0.52	0.59
TSS, lb/day	123617	145159	165537	197787	232255	264859
VSS, lb/day	94068	110463	125972	150509	176741	201555
TBOD, lb/day	77967	91664	104621	119290	140247	160070
DIGESTER IN						
Flow, mgd	0.35	0.40	0.45	0.50	0.58	0.65
TSS, lb/day	153641	175183	195561	227811	262279	294883
VSS, lb/day	121990	138386	153894	178431	204664	229477
TBOD, lb/day	77967	91664	104621	169730	190687	210510

TABLE C5 - SCENARIO C.1

Scenario C.1: Phase II Loads and Flows at 65% VSS Destruction in Digesters with FOG addition and Lystek process.

	MIR AT AADF			MIR AT PEAK DAY FLOW		
	MIN NPR	BASE NPR	MAX NPR	MIN NPR	BASE NPR	MAX NPR
DIGESTER OUT						
Flow, mgd	0.34	0.39	0.44	0.50	0.58	0.65
TSS, lb/day	64574	75460	85757	111831	129247	145723
VSS, lb/day	42697	48435	53863	62451	71632	80317
TBOD, lb/day	57783	63947	69778	76378	85809	94730
PLWTP DIGESTED SOLIDS						
Flow, mgd	1.26	1.20	1.15	1.74	1.66	1.59
TSS, lb/day	287594	274443	261962	396879	378731	361507
VSS, lb/day	141292	134997	129042	194984	186296	178078
TBOD, lb/day	56860	54482	52232	78467	75185	72080
DIGESTED SOLIDS STORAGE IN						
DIGESTED SOLIDS STORAGE OUT						
DW CENTRIFUGE IN						
Flow, mgd	1.61	1.60	1.59	2.24	2.24	2.24
TSS, lb/day	352168	349902	347719	508710	507978	507230
VSS, lb/day	183989	183432	182905	257434	257928	258395
TBOD, lb/day	114644	118429	122010	154846	160994	166810
DW CENTRATE						
Flow, mgd	1.47	1.46	1.46	2.06	2.05	2.04
TSS, lb/day	17608	17495	17386	24652	24493	24340
VSS, lb/day	9199	9172	9145	12879	12840	12803
TBOD, lb/day	13841	14045	14239	19377	19663	19934
DW BIOSOLIDS SILOS IN						
DW BIOSOLIDS SILOS OUT						
Flow, mgd	0.134	0.133	0.132	0.187	0.186	0.185

TABLE C6 - SCENARIO C.2

Scenario C.2: Phase II Loads and Flows at 57.5% VSS Destruction in Digesters with FOG addition and Lystek process.

	MIR AT AADF			MIR AT PEAK DAY FLOW		
	MIN NPR	BASE NPR	MAX NPR	MIN NPR	BASE NPR	MAX NPR
RECEIVING TANK IN						
RECEIVING TANK OUT						
TEACUPS IN						
TEACUPS OUT						
TC INPUT						
Flow, mgd	3.29	3.87	4.28	5.04	5.92	6.55
TSS, lb/day	137352	161288	183930	219763	258061	294288
VSS, lb/day	104520	122737	139969	167232	196379	223950
TBOD, lb/day	86630	101849	116246	132544	155830	177856
TC CENTRATE						
Flow, mgd	3.01	3.53	3.89	4.60	5.40	5.96
TSS, lb/day	13735	16129	18393	21976	25806	29429
VSS, lb/day	10452	12274	13997	16723	19638	22395
TBOD, lb/day	8663	10185	11625	13254	15583	17786
FOG ADDITION						
Flow, mgd	0.06	0.06	0.06	0.06	0.06	0.06
TSS, lb/day	30024	30024	30024	30024	30024	30024
VSS, lb/day	27922	27922	27922	27922	27922	27922
TBOD, lb/day	50440	50440	50440	50440	50440	50440
TC OUTPUT						
SCREENS IN						
SCREENS OUT						
Flow, mgd	0.29	0.34	0.39	0.44	0.52	0.59
TSS, lb/day	123617	145159	165537	197787	232255	264859
VSS, lb/day	94068	110463	125972	150509	176741	201555
TBOD, lb/day	77967	91664	104621	119290	140247	160070
DIGESTER IN						
Flow, mgd	0.35	0.40	0.45	0.50	0.58	0.65
TSS, lb/day	153641	175183	195561	227811	262279	294883
VSS, lb/day	121990	138386	153894	178431	204664	229477
TBOD, lb/day	77967	91664	104621	169730	190687	210510

TABLE C6 - SCENARIO C.2

Scenario C.2: Phase II Loads and Flows at 57.5% VSS Destruction in Digesters with FOG addition and Lystek process.

	MIR AT AADF			MIR AT PEAK DAY FLOW		
	MIN NPR	BASE NPR	MAX NPR	MIN NPR	BASE NPR	MAX NPR
DIGESTER OUT						
Flow, mgd	0.34	0.39	0.44	0.50	0.58	0.65
TSS, lb/day	71629	83744	95205	125213	144597	162934
VSS, lb/day	51846	58814	65405	75833	86982	97528
TBOD, lb/day	57783	63947	69778	76378	85809	94730
PLWTP DIGESTED SOLIDS						
Flow, mgd	1.26	1.20	1.15	1.74	1.66	1.59
TSS, lb/day	287792	274676	262228	397154	379053	361875
VSS, lb/day	141412	135138	129202	195149	186490	178299
TBOD, lb/day	56861	54483	52233	78468	75186	72082
DIGESTED SOLIDS STORAGE IN						
DIGESTED SOLIDS STORAGE OUT						
DW CENTRIFUGE IN						
Flow, mgd	1.61	1.60	1.59	2.24	2.24	2.24
TSS, lb/day	359422	358421	357433	522367	523650	524808
VSS, lb/day	193258	193952	194607	270982	273472	275827
TBOD, lb/day	114644	118430	122011	154847	160995	166811
DW CENTRATE						
Flow, mgd	1.47	1.46	1.46	2.06	2.05	2.04
TSS, lb/day	17971	17921	17872	25160	25089	25020
VSS, lb/day	9663	9698	9730	13528	13577	13623
TBOD, lb/day	13846	14052	14247	19385	19673	19945
DW BIOSOLIDS SILOS IN						
DW BIOSOLIDS SILOS OUT						
Flow, mgd	0.137	0.136	0.136	0.191	0.191	0.190

Appendix D: Load Lists

APPENDIX D - TABLE 1: RAW SOLIDS PUMPING AND GRIT

MBC CAPACITY ASSESSMENT - PROJECTED LOAD MODIFICATIONS

REVISION 1

DRIVEN EQUIPMENT								NOTES	480 V LOAD - AC MOTORS						MOTOR CONTROL			
TAG		DWG	DRIVEN EQUIPMENT NAME	EQUIPMENT STATUS					CONNECTED		MAX RUNNING		DUTY CYCLE		SPEED			ELECTRICAL WORK REQUIRED
NUMBER(S)		NUMBER		EXISTING MCC NAME	EXISTING TO DEMO	EXISTING TO REMAIN	**PROPOSED LOAD**		HP	KW/ KVA	HP	KW/ KVA	CONT	INT/ VAR	CONSTANT SPEED	VARIABLE VFD	BYPASS CONTACTOR	
73-	P-21	60-E-11	RAW SOLIDS PUMP 1	60MCC001	X				-60				CONT			X		DEMO EXIST CB, ISO XFR, HARMONIC FILTER, VFD, DS, FDR
73-	P-22	60-E-12	RAW SOLIDS PUMP 2	60MCC002	X				-60				CONT			X		DEMO EXIST CB, ISO XFR, HARMONIC FILTER, VFD, DS, FDR
73-	P-23	60-E-13	RAW SOLIDS PUMP 3	60MCC003	X				-60									DEMO EXIST CB, ISO XFR, HARMONIC FILTER, VFD, DS, FDR
73-	**P-21**	**60-E-11**	**RAW SOLIDS PUMP 1 (LEAD)**	**60MCC001**			**X**		**200**				**CONT**			**X**		**INSTALL NEW CB, ISO XFR, VFD, HARMONIC FILTER, DS, FDR (NOTE 3)**
73-	**P-22**	**60-E-12**	**RAW SOLIDS PUMP 2 (LAG)**	**60MCC002**			**X**		**200**				**CONT**			**X**		**INSTALL NEW CB, ISO XFR, VFD, HARMONIC FILTER, DS, FDR (NOTE 3)**
73-	**P-23**	**60-E-13**	**RAW SOLIDS PUMP 3 (STANDBY)**	**60MCC003**			**X**		**200**				**CONT**			**X**		**INSTALL NEW CB, ISO XFR, VFD, HARMONIC FILTER, DS, FDR (NOTE 3)**

NOTES

1. EX. HP'S TAKEN FROM SINGLE LINE - NOT FIELD VERIFIED
2. HP'S FOR A VFD-DRIVEN MOTOR ARE LISTED WITH THE EQUIPMENT
3. FIELD-VERIFY SPACE FOR NEW EQUIPMENT.

APPENDIX D - TABLE 2: SLUDGE THICKENING SYSTEM

MBC CAPACITY ASSESSMENT - PROJECTED LOAD MODIFICATIONS

REVISION		1														
DRIVEN EQUIPMENT						NOTES	480 V LOAD - AC MOTORS						MOTOR CONTROL			
TAG	DWG	DRIVEN EQUIPMENT NAME	EQUIPMENT STATUS				CONNECTED		MAX RUNNING		DUTY CYCLE		SPEED			ELECTRICAL WORK REQUIRED
NUMBER(S)	NUMBER		EXISTING MCC NAME	EXISTING TO DEMO	PROPOSED LOAD		HP	KW/ KVA	HP	KW/ KVA	CONT	INT/ VAR	CONSTANT SPEED	VARIABLE VFD	BYPASS CONTACTOR	
76- P-11	76-E-11	THICKENING CENTRIFUGE SLUDGE FEED PUMP 1	76MCC76A01	X			-50				CONT			X	NO	
76- P-12	76-E-11	THICKENING CENTRIFUGE SLUDGE FEED PUMP 2	76MCC76A01	X			-50				CONT			X	NO	
76- P-13	76-E-18	THICKENING CENTRIFUGE SLUDGE FEED PUMP 3	76MCC76D02	X			-50				CONT			X	NO	
76- P-14	76-E-12	THICKENING CENTRIFUGE SLUDGE FEED PUMP 4	76MCC76A02	X			-50				CONT			X	NO	
76- P-15	76-E-17	THICKENING CENTRIFUGE SLUDGE FEED PUMP 5	76MCC76D01	X			-50				CONT			X	NO	
76- VFD-11	76-E-11	THICKENING CENTRIFUGE SLUDGE FEED PUMP 1 VFD	76MCC76A01	X												DEMO EXIST ISO XFR, HARMONIC FILTER, VFD
76- VFD-12	76-E-11	THICKENING CENTRIFUGE SLUDGE FEED PUMP 2 VFD	76MCC76A01	X												DEMO EXIST ISO XFR, HARMONIC FILTER, VFD
76- VFD-13	76-E-18	THICKENING CENTRIFUGE SLUDGE FEED PUMP 3 VFD	76MCC76D02	X												DEMO EXIST ISO XFR, HARMONIC FILTER, VFD
76- VFD-14	76-E-12	THICKENING CENTRIFUGE SLUDGE FEED PUMP 4 VFD	76MCC76A02	X												DEMO EXIST ISO XFR, HARMONIC FILTER, VFD
76- VFD-15	76-E-17	THICKENING CENTRIFUGE SLUDGE FEED PUMP 5 VFD	76MCC76D01	X												DEMO EXIST ISO XFR, HARMONIC FILTER, VFD
76- P-11A	76-E-11	**THICKENING CENTRIFUGE SLUDGE FEED PUMP 1A**	**76MCC76A01**		**X**		**60**		**60**		CONT			X	NO	
76- P-12A	76-E-11	**THICKENING CENTRIFUGE SLUDGE FEED PUMP 2A**	**76MCC76A01**		**X**		**60**		**60**		CONT			X	NO	
76- P-13A	76-E-18	**THICKENING CENTRIFUGE SLUDGE FEED PUMP 3A**	**76MCC76D02**		**X**		**60**		**60**		CONT			X	NO	
76- P-14A	76-E-12	**THICKENING CENTIFUGE SLUDGE FEED PUMP 4A**	**76MCC76A02**		**X**		**60**		**60**		CONT			X	NO	
76- P-15A	76-E-17	**THICKENING CENTRIFUGE SLUDGE FEED PUMP 5A**	**76MCC76D01**		**X**		**60**		**60**		CONT			X	NO	
76- P-16	**76-E-17**	**THICKENING CENTRIFUGE D SLUDGE FEED PUMP 6**	**76MCC76D01**		**X**	NOTE 3	**60**		**60**		CONT			X	NO	
76- VFD-11A	76-E-11	**THICKENING CENTRIFUGE SLUDGE FEED PUMP 1A VFD**	**76MCC76A01**		**X**											**INSTALL NEW ISO XFR, HARMONIC FILTER, VFD (NOTE 7)**
76- VFD-12A	76-E-11	**THICKENING CENTRIFUGE SLUDGE FEED PUMP 2A VFD**	**76MCC76A01**		**X**											**INSTALL NEW ISO XFR, HARMONIC FILTER, VFD (NOTE 7)**
76- VFD-13A	76-E-18	**THICKENING CENTRIFUGE SLUDGE FEED PUMP 3A VFD**	**76MCC76D02**		**X**											**INSTALL NEW ISO XFR, HARMONIC FILTER, VFD (NOTE 7)**
76- VFD-14A	76-E-12	**THICKENING CENTIFUGE SLUDGE FEED PUMP 4A VFD**	**76MCC76A02**		**X**											**INSTALL NEW ISO XFR, HARMONIC FILTER, VFD (NOTE 7)**
76- VFD-15A	76-E-17	**THICKENING CENTRIFUGE SLUDGE FEED PUMP 5A VFD**	**76MCC76D01**		**X**											**INSTALL NEW ISO XFR, HARMONIC FILTER, VFD (NOTE 7)**
76- VFD-16	**76-E-17**	**THICKENING CENTRIFUGE D SLUDGE FEED PUMP 6 VFD**	**76MCC76D01**		**X**	NOTE 3										**INSTALL NEW CB, ISO XFR, HARMONIC FILTER, VFD, DISCONNECT, CONDUIT, FEEDER (NOTE 7)**
76- P-21	76-E-11	TC POLYMER FEED PUMP 1	76MCC76A01	X			-5				CONT			X	NO	
76- P-22	76-E-17	TC POLYMER FEED PUMP 2	76MCC76D01	X			-5				CONT			X	NO	
76- P-23	76-E-12	TC POLYMER FEED PUMP 3	76MCC76A02	X			-5				CONT			X	NO	
76- P-24	76-E-18	TC POLYMER FEED PUMP 4	76MCC76D02	X			-5				CONT			X	NO	
76- P-25	76-E-17	TC POLYMER FEED PUMP 5	76MCC76D01	X			-5				CONT			X	NO	
76- VFD-21	76-E-11	TC POLYMER FEED PUMP 1 VFD	76MCC76A01	X							CONT					
76- VFD-22	76-E-17	TC POLYMER FEED PUMP 2 VFD	76MCC76D01	X							CONT					
76- VFD-23	76-E-12	TC POLYMER FEED PUMP 3 VFD	76MCC76A02	X							CONT					
76- VFD-24	76-E-18	TC POLYMER FEED PUMP 4 VFD	76MCC76D02	X							CONT					
76- VFD-25	76-E-17	TC POLYMER FEED PUMP 5 VFD	76MCC76D01	X							CONT					
76- P-21A	**76-E-11**	**TC POLYMER FEED PUMP 1A**	**76MCC76A01**		**X**		**5**		***5***		**CONT**			**X**	**NO**	
76- P-22A	**76-E-17**	**TC POLYMER FEED PUMP 2A**	**76MCC76D01**		**X**		**5**		***5***		**CONT**			**X**	**NO**	
76- P-23A	**76-E-12**	**TC POLYMER FEED PUMP 3A**	**76MCC76A02**		**X**		**5**		***5***		**CONT**			**X**	**NO**	
76- P-24A	**76-E-18**	**TC POLYMER FEED PUMP 4A**	**76MCC76D02**		**X**		**5**		***5***		**CONT**			**X**	**NO**	
76- P-25A	**76-E-17**	**TC POLYMER FEED PUMP 5A**	**76MCC76D01**		**X**		**5**		***5***		**CONT**			**X**	**NO**	
76- P-26	**76-E-17**	**TC POLYMER FEED PUMP 6**	**76MCC76D01**		**X**		**5**		***5***		**CONT**			**X**	**NO**	
76- VFD-21A	**76-E-11**	**TC POLYMER FEED PUMP 1A VFD**	**76MCC76A01**		**X**						**CONT**			**X**	**NO**	**RECOMMEND NEW ISO XFR, HARMONIC FILTER, VFD, DISCONNECT, FEEDER (NOTE 7)**
76- VFD-22A	**76-E-17**	**TC POLYMER FEED PUMP 2A VFD**	**76MCC76D01**		**X**						**CONT**			**X**	**NO**	**RECOMMEND NEW ISO XFR, HARMONIC FILTER, VFD, DISCONNECT, FEEDER (NOTE 7)**
76- VFD-23A	**76-E-12**	**TC POLYMER FEED PUMP 3A VFD**	**76MCC76A02**		**X**						**CONT**			**X**	**NO**	**RECOMMEND NEW ISO XFR, HARMONIC FILTER, VFD, DISCONNECT, FEEDER (NOTE 7)**
76- VFD-24A	**76-E-18**	**TC POLYMER FEED PUMP 4A VFD**	**76MCC76D02**		**X**						**CONT**			**X**	**NO**	**RECOMMEND NEW ISO XFR, HARMONIC FILTER, VFD, DISCONNECT, FEEDER (NOTE 7)**
76- VFD-25A	**76-E-17**	**TC POLYMER FEED PUMP 5A VFD**	**76MCC76D01**		**X**						**CONT**			**X**	**NO**	**RECOMMEND NEW ISO XFR, HARMONIC FILTER, VFD, DISCONNECT, FEEDER (NOTE 7)**
76- P-26	**76-E-17**	**TC POLYMER FEED PUMP 6 VFD**	**76MCC76D01**		**X**						**CONT**			**X**	**NO**	**INSTALL NEW CB, ISO XFR, HARMONIC FILTER, VFD, DISCONNECT, CONDUIT, FEEDER (NOTE 7)**
76- TC-1	SI-E-25	THICKENING CENTRIFUGE 1 MAIN DRIVE	76USSA			NOTE 4	-300									DEMO EXIST REACTOR, VFD
		TC1 BACKDRIVE	76USSA			NOTE 4	-60									DEMO EXIST REACTOR, VFD
76- TC-2	SI-E-25	THICKENING CENTRIFUGE 2	76USSA			NOTE 4	-300									DEMO EXIST REACTOR, VFD
		TC2 BACKDRIVE	76USSA			NOTE 4	-60									DEMO EXIST REACTOR, VFD
76- TC-3	SI-E-32	THICKENING CENTRIFUGE 3	76USSD			NOTE 4	-300									DEMO EXIST REACTOR, VFD
		TC3 BACKDRIVE	76USSD			NOTE 4	-60									DEMO EXIST REACTOR, VFD
76- TC-4	SI-E-26	THICKENING CENTRIFUGE 4	76USSA			NOTE 4	-300									DEMO EXIST REACTOR, VFD
		TC4 BACKDRIVE	76USSA			NOTE 4	-60									DEMO EXIST REACTOR, VFD
76- TC-5	SI-E-31	THICKENING CENTRIFUGE 5	76USSD			NOTE 4	-300									DEMO EXIST REACTOR, VFD
		TC5 BACKDRIVE	76USSD			NOTE 4	-60									
76- TC-1A	**SI-E-25**	**THICKENING CENTRIFUGE 1A MAIN DRIVE**	**76USSA**			**NOTE 5**	**350**									**INSTALL NEW CENTRIFUGE DRIVE (NOTE 7)**
		TC1A BACKDRIVE	**76USSA**			**NOTE 5**	**40**									**INSTALL NEW CENTRIFUGE DRIVE (NOTE 7)**
76- TC-2A	**SI-E-25**	**THICKENING CENTRIFUGE 2A**	**76USSA**			**NOTE 5**	**350**									**INSTALL NEW CENTRIFUGE DRIVE (NOTE 7)**
		TC2A BACKDRIVE	**76USSA**			**NOTE 5**	**40**									**INSTALL NEW CENTRIFUGE DRIVE (NOTE 7)**
76- TC-3A	**SI-E-32**	**THICKENING CENTRIFUGE 3A**	**76USSD**			**NOTE 5**	**350**									**INSTALL NEW CENTRIFUGE DRIVE (NOTE 7)**
		TC3A BACKDRIVE	**76USSD**			**NOTE 5**	**40**									**INSTALL NEW CENTRIFUGE DRIVE (NOTE 7)**
76- TC-4A	**SI-E-26**	**THICKENING CENTRIFUGE 4A**	**76USSA**			**NOTE 5**	**350**									**INSTALL NEW CENTRIFUGE DRIVE (NOTE 7)**
		TC4A BACKDRIVE	**76USSA**			**NOTE 5**	**40**									**INSTALL NEW CENTRIFUGE DRIVE (NOTE 7)**
76- TC-5A	**SI-E-31**	**THICKENING CENTRIFUGE 5A**	**76USSD**			**NOTE 5**	**350**									**INSTALL NEW CENTRIFUGE DRIVE (NOTE 7)**
		TC5A BACKDRIVE	**76USSD**			**NOTE 5**	**40**									**INSTALL NEW CENTRIFUGE DRIVE (NOTE 7)**
76- TC-6	**SI-E-31**	**THICKENING CENTRIFUGE 6**	**76USSD**			**NOTE 5**	**350**									**INSTALL NEW CENTRIFUGE DRIVE (NOTE 7)**
		TC6BACKDRIVE	**76USSD**			**NOTE 5**	**40**									**INSTALL NEW CENTRIFUGE DRIVE (NOTE 7)**
76- P-31A	76-E-11	THICKENED SLUDGE DIGESTER FEED PUMP 1A	76MCC76A01	X		NOTE 6	-20					INT	X			DEMO EXIST STARTER, FEEDER
76- P-32A	76-E-18	THICKENED SLUDGE DIGESTER FEED PUMP 2A	76MCC76D02	X		NOTE 6	-20					INT	X			DEMO EXIST STARTER, FEEDER
76- P-33A	76-E-12	THICKENED SLUDGE DIGESTER FEED PUMP 3A	76MCC76A02	X		NOTE 6	-20					INT	X			DEMO EXIST STARTER, FEEDER
76- P-31B	76-E-11	**THICKENED SLUDGE DIGESTER FEED PUMP 1B**	**76MCC76A01**		**X**		**25**					**INT**	**X**			**INSTALL NEW STARTER, FEEDER (NOTE 7)**
76- P-32B	76-E-18	**THICKENED SLUDGE DIGESTER FEED PUMP 2B**	**76MCC76D02**		**X**		**25**					**INT**	**X**			**INSTALL NEW STARTER, FEEDER (NOTE 7)**

APPENDIX D - TABLE 2: SLUDGE THICKENING SYSTEM

MBC CAPACITY ASSESSMENT - PROJECTED LOAD MODIFICATIONS

REVISION 1

DRIVEN EQUIPMENT							NOTES	480 V LOAD - AC MOTORS						MOTOR CONTROL			
TAG		DWG	DRIVEN EQUIPMENT NAME	EQUIPMENT STATUS				CONNECTED		MAX RUNNING		DUTY CYCLE		SPEED			ELECTRICAL WORK REQUIRED
NUMBER(S)		NUMBER		EXISTING MCC NAME	EXISTING TO DEMO	**PROPOSED LOAD**		HP	KW/ KVA	HP	KW/ KVA	CONT	INT/ VAR	CONSTANT SPEED	VARIABLE VFD	BYPASS CONTACTOR	
76-	**P-33B**	76-E-12	**THICKENED SLUDGE DIGESTER FEED PUMP 3B**	**76MCC76A02**		**X**		**25**					**INT**	**X**			**INSTALL NEW STARTER, FEEDER (NOTE 7)**
76-	**P-34**	**76-E-18**	**THICKENED SLUDGE DIGESTER FEED PUMP 4**	**76MCC76D01**		**X**		**25**					**INT**	**X**			**INSTALL NEW STARTER, FEEDER (NOTE 7)**

NOTES

1 EX. HP'S TAKEN FROM SINGLE LINE - NOT FIELD VERIFIED

2 HP'S FOR A VFD-DRIVEN MOTOR ARE LISTED WITH THE EQUIPMENT

3 SPACE AVAILABLE IN ORIGINAL MCC FOR UNIT NO. 6

4 300 HP MAIN DRIVE AND 60 HP BACKDRIVE FIELD VERIFIED

5 BASED ON ALDEC G3-165 DATA SHEET PROVIDED BY COOMBS HOPKINS

6 ORIGINAL PUMPS HAVE ALREADY BEEN REPLACED ONCE. ORIGINAL 10 HP'S ARE NOW 20 HP'S

7 FIELD-VERIFY SPACE FOR NEW EQUIPMENT.

APPENDIX D - TABLE 3: DIGESTER FOG OR LYSTEK OPTION

MBC CAPACITY ASSESSMENT - PROJECTED LOAD MODIFICATIONS

REVISION 1

DRIVEN EQUIPMENT								NOTES	480 V LOAD - AC MOTORS						MOTOR CONTROL			
TAG NUMBER(S)		DWG NUMBER	DRIVEN EQUIPMENT NAME	EQUIPMENT STATUS					CONNECTED		MAX RUNNING		DUTY CYCLE		SPEED			ELECTRICAL WORK REQUIRED
				EXISTING MCC NAME	EXISTING TO DEMO	EXISTING TO REMAIN	**PROPOSED LOAD**		HP	KW/ KVA	HP	KW/ KVA	CONT	INT/ VAR	CONSTANT SPEED	VARIABLE VFD	BYPASS CONTACTOR	
80-	C-01	80-E-11	BIOGAS COMPRESSOR 1	80MCC8001	X				-20				CONT		X			DEMO EXIST STARTER, FDR. RECOMMEND DEMO DS
80-	C-02	80-E-14	BIOGAS COMPRESSOR 2	80MCC8004	X				-20				CONT		X			DEMO EXIST STARTER, FDR. RECOMMEND DEMO DS
80-	**C-03**	**80-E-11**	**BIOGAS COMPRESSOR 1**	**80MCC8001**			**X**		**60**		**60**		**CONT**		**X**			**INSTALL NEW STARTER, FDR. RECOMMEND REPLACE DS**
80-	**C-04**	**80-E-14**	**BIOGAS COMPRESSOR 2**	**80MCC8004**			**X**		**60**		**60**		**CONT**		**X**			**INSTALL NEW STARTER, FDR. RECOMMEND REPLACE DS**
80-	**C-05**	**80-E-14**	**BIOGAS COMPRESSOR 3**	**80MCC8004**			**X**		**60**				**CONT**		**X**			**INSTALL NEW STARTER (IN MCC8001 SECTION 8), FDR. RECOMMEND REPLACE DS**
80-	**P-81**	**TBD**	**DIGESTER 4 MIXING PUMP 1**	**80MCC8004A**			**X**		**40**		**40**		**CONT**		**X**			**INSTALL NEW MCC, DS, CONDUIT FDR, SEE NOTE 3**
80-	**P-82**	**TBD**	**DIGESTER 4 MIXING PUMP 2**	**80MCC8004B**			**X**		**40**		**40**		**CONT**		**X**			**INSTALL NEW MCC, DS, CONDUIT FDR, SEE NOTE 3**
80-	**P-83**	**TBD**	**DIGESTER 4 MIXING PUMP 3**	**80MCC8004A**			**X**		**40**		**40**		**CONT**		**X**			**INSTALL NEW MCC, DS, CONDUIT FDR, SEE NOTE 3**
80-	**P-84**	**TBD**	**DIGESTER 4 AXIAL MIX PUMP 1**	**80MCC8004A**			**X**		**40**		**40**		**CONT**		**X**			**INSTALL NEW MCC, DS, CONDUIT FDR, SEE NOTE 3**
80-	**P-85**	**TBD**	**DIGESTER 4 AXIAL MIX PUMP 2**	**80MCC8004B**			**X**		**40**		**40**		**CONT**		**X**			**INSTALL NEW MCC, DS, CONDUIT FDR, SEE NOTE 3**
80-	**P-86**	**TBD**	**DIGESTER 4 AXIAL MIX PUMP 3**	**80MCC8004A**			**X**		**40**		**40**		**CONT**		**X**			**INSTALL NEW MCC, DS, CONDUIT FDR, SEE NOTE 3**
80-	**P-87**	**TBD**	**DIGESTER 4 RECIRC PUMP 1**	**80MCC8004A**			**X**		**20**		**20**		**CONT**		**X**			**INSTALL NEW MCC, DS, CONDUIT FDR, SEE NOTE 3**
80-	**P-88**	**TBD**	**DIGESTER 4 RECIRC PUMP 2**	**80MCC8004B**			**X**		**20**		**20**		**CONT**		**X**			**INSTALL NEW MCC, DS, CONDUIT FDR, SEE NOTE 3**
80-	F-01	N/A	BIOGAS FLARE 1	TBD		X			5		*2.5*		*50%*		*X*			
80-	F-02	N/A	BIOGAS FLARE 2	TBD		X			5		*2.5*		*50%*		*X*			
80-	**F-03**	**N/A**	**BIOGAS FLARE 3**	**TBD**			**X**		**7.5**		**3.75**		**50%**		**X**			**INSTALL NEW CB, CONDUIT, FDR**
80-	**F-03**	**N/A**	**BIOGAS FLARE 4**				**X**		**7.5**		**3.75**		**50%**		**X**			**INSTALL NEW CB, CONDUIT, FDR**
80-		**N/A**	**MISCELLANEOUS ADDITIONAL DIGESTER LOADS**	**TBD**			**X**		**100**		**50**							**INSTALL NEW MCC, DS, CONDUIT FDR, SEE NOTE 3**
N/A		**N/A**	**FOG LOADS**				**X**		**120**		**100**		**CONT**					**INSTALL NEW MCC, DS, CONDUIT FDR, SEE NOTE 3**

NOTES

1. EX. HP'S TAKEN FROM SINGLE LINE - NOT FIELD VERIFIED
2. HP'S FOR A VFD-DRIVEN MOTOR ARE LISTED WITH THE EQUIPMENT
3. INSTALL NEW MCCs 80MCC8007 AND 80MCC8008 FED FROM 80USS TO ACCOMMODATE THE NEW LOADS. FIELD-VERIFY SPACE FOR NEW EQUIPMENT.

APPENDIX D - TABLE 4: SLUDGE DEWATERING SYSTEM

MBC CAPACITY ASSESSMENT - PROJECTED LOAD MODIFICATIONS

REVISION 1

TAG		DWG	DRIVEN EQUIPMENT	EQUIPMENT STATUS			NOTES	480 V LOAD - AC MOTORS						MOTOR CONTROL			
NUMBER(S)		NUMBER	DRIVEN EQUIPMENT NAME	EXISTING MCC NAME	EXISTING TO DEMO	PROPOSED LOAD		CONNECTED HP	CONNECTED KW/ KVA	MAX RUNNING HP	MAX RUNNING KW/ KVA	DUTY CYCLE CONT	DUTY CYCLE INT/ VAR	SPEED CONSTANT SPEED	SPEED VARIABLE VFD	BYPASS CONTACTOR	ELECTRICAL WORK REQUIRED
76-	P-51	76-E-15	DEWATERING CENTRIFUGE SLUDGE FEED PUMP 1	76MCC76C01	X			-25				CONT			X	NO	
76-	P-52	76-E-16	DEWATERING CENTRIFUGE SLUDGE FEED PUMP 2	76MCC76C02	X			-25				CONT			X	NO	
76-	P-53	76-E-15	DEWATERING CENTRIFUGE SLUDGE FEED PUMP 3	76MCC76C01	X			-25				CONT			X	NO	
76-	P-54	76-E-16	DEWATERING CENTRIFUGE SLUDGE FEED PUMP 4	76MCC76C02	X			-25				CONT			X	NO	
76-	P-55	76-E-13	DEWATERING CENTRIFUGE SLUDGE FEED PUMP 5	76MCC76B01	X			-25				CONT			X	NO	
76-	P-56	76-E-14	DEWATERING CENTRIFUGE SLUDGE FEED PUMP 6	76MCC76B02	X			-25				CONT			X	NO	
76-	P-57	76-E-13	DEWATERING CENTRIFUGE SLUDGE FEED PUMP 7	76MCC76B01	X			-25				CONT			X	NO	
76-	P-58	76-E-14	DEWATERING CENTRIFUGE SLUDGE FEED PUMP 8	76MCC76B02	X			-25				CONT			X	NO	
76-	VFD-51	76-E-15	DEWATERING CENTRIFUGE SLUDGE FEED PUMP 1 VFD	76MCC76C01	X												DEMO EXIST CB, ISO XFR, VFD, DS, FDR
76-	VFD-52	76-E-16	DEWATERING CENTRIFUGE SLUDGE FEED PUMP 2 VFD	76MCC76C02	X												DEMO EXIST CB, ISO XFR, VFD, DS, FDR
76-	VFD-53	76-E-15	DEWATERING CENTRIFUGE SLUDGE FEED PUMP 3 VFD	76MCC76C01	X												DEMO EXIST CB, ISO XFR, VFD, DS, FDR
76-	VFD-54	76-E-16	DEWATERING CENTRIFUGE SLUDGE FEED PUMP 4 VFD	76MCC76C02	X												DEMO EXIST CB, ISO XFR, VFD, DS, FDR
76-	VFD-55	76-E-13	DEWATERING CENTRIFUGE SLUDGE FEED PUMP 5 VFD	76MCC76B01	X												DEMO EXIST CB, ISO XFR, VFD, DS, FDR
76-	VFD-56	76-E-14	DEWATERING CENTRIFUGE SLUDGE FEED PUMP 6 VFD	76MCC76B02	X												DEMO EXIST CB, ISO XFR, VFD, DS, FDR
76-	VFD-57	76-E-13	DEWATERING CENTRIFUGE SLUDGE FEED PUMP 7 VFD	76MCC76B01	X												DEMO EXIST CB, ISO XFR, VFD, DS, FDR
76-	VFD-58	76-E-14	DEWATERING CENTRIFUGE SLUDGE FEED PUMP 8 VFD	76MCC76B02	X												DEMO EXIST CB, ISO XFR, VFD, DS, FDR
76-	**P-51A**	76-E-15	**DEWATERING CENTRIFUGE SLUDGE FEED PUMP 1A**	76MCC76C01		**X**		**50**				**CONT**			**X**	**NO**	
76-	**P-52A**	76-E-16	**DEWATERING CENTRIFUGE SLUDGE FEED PUMP 2A**	76MCC76C02		**X**		**50**				**CONT**			**X**	**NO**	
76-	**P-53A**	76-E-15	**DEWATERING CENTRIFUGE SLUDGE FEED PUMP 3A**	76MCC76C01		**X**		**50**				**CONT**			**X**	**NO**	
76-	**P-54A**	76-E-16	**DEWATERING CENTRIFUGE SLUDGE FEED PUMP 4A**	76MCC76C02		**X**		**50**				**CONT**			**X**	**NO**	
76-	**P-55A**	76-E-13	**DEWATERING CENTRIFUGE SLUDGE FEED PUMP 5A**	76MCC76B01		**X**		**50**				**CONT**			**X**	**NO**	
76-	**P-56A**	76-E-14	**DEWATERING CENTRIFUGE SLUDGE FEED PUMP 6A**	76MCC76B02		**X**		**50**				**CONT**			**X**	**NO**	
76-	**P-57A**	76-E-13	**DEWATERING CENTRIFUGE SLUDGE FEED PUMP 7A**	76MCC76B01		**X**		**50**				**CONT**			**X**	**NO**	
76-	**P-58A**	76-E-14	**DEWATERING CENTRIFUGE SLUDGE FEED PUMP 8A**	76MCC76B02		**X**		**50**				**CONT**			**X**	**NO**	
76-	**VFD-51A**	**76-E-15**	**DEWATERING CENTRIFUGE SLUDGE FEED PUMP 1A VFD**	**76MCC76C01**		**X**											**INSTALL NEW CB, ISO XFR, VFD, DS, FDR**
76-	**VFD-52A**	**76-E-16**	**DEWATERING CENTRIFUGE SLUDGE FEED PUMP 2A VFD**	**76MCC76C02**		**X**											**INSTALL NEW CB, ISO XFR, VFD, DS, FDR**
76-	**VFD-53A**	**76-E-15**	**DEWATERING CENTRIFUGE SLUDGE FEED PUMP 3A VFD**	**76MCC76C01**		**X**											**INSTALL NEW CB, ISO XFR, VFD, DS, FDR**
76-	**VFD-54A**	**76-E-16**	**DEWATERING CENTRIFUGE SLUDGE FEED PUMP 4A VFD**	**76MCC76C02**		**X**											**INSTALL NEW CB, ISO XFR, VFD, DS, FDR**
76-	**VFD-55A**	**76-E-13**	**DEWATERING CENTRIFUGE SLUDGE FEED PUMP 5A VFD**	**76MCC76B01**		**X**											**INSTALL NEW CB, ISO XFR, VFD, DS, FDR**
76-	**P-56A**	**76-E-14**	**DEWATERING CENTRIFUGE SLUDGE FEED PUMP 6A VFD**	**76MCC76B02**		**X**											**INSTALL NEW CB, ISO XFR, VFD, DS, FDR**
76-	**P-57A**	**76-E-13**	**DEWATERING CENTRIFUGE SLUDGE FEED PUMP 7A VFD**	**76MCC76B01**		**X**											**INSTALL NEW CB, ISO XFR, VFD, DS, FDR**
76-	**P-58A**	**76-E-14**	**DEWATERING CENTRIFUGE SLUDGE FEED PUMP 8A VFD**	**76MCC76B02**		**X**											**INSTALL NEW CB, ISO XFR, VFD, DS, FDR**
76-	P-61	76-E-15	DEWATERING CENTRIFUGE POLYMER FEED PUMP 1	76MCC76C01	X			-5				CONT			X	NO	
76-	P-62	76-E-16	DEWATERING CENTRIFUGE POLYMER FEED PUMP 2	76MCC76C02	X			-5				CONT			X	NO	
76-	P-63	76-E-15	DEWATERING CENTRIFUGE POLYMER FEED PUMP 3	76MCC76C01	X			-5				CONT			X	NO	
76-	P-64	76-E-16	DEWATERING CENTRIFUGE POLYMER FEED PUMP 4	76MCC76C02	X			-5				CONT			X	NO	
76-	P-65	76-E-13	DEWATERING CENTRIFUGE POLYMER FEED PUMP 5	76MCC76B01	X			-5				CONT			X	NO	
76-	P-66	76-E-14	DEWATERING CENTRIFUGE POLYMER FEED PUMP 6	76MCC76B02	X			-5				CONT			X	NO	
76-	P-67	76-E-13	DEWATERING CENTRIFUGE POLYMER FEED PUMP 7	76MCC76B01	X			-5				CONT			X	NO	
76-	P-68	76-E-14	DEWATERING CENTRIFUGE POLYMER FEED PUMP 8	76MCC76B02	X			-5				CONT			X	NO	
76-	VFD-61	76-E-15	DEWATERING CENTRIFUGE POLYMER FEED PUMP 1 VFD	76MCC76C01	X												DEMO EXIST CB, REACTOR, VFD. RECOMMEND DEMO EXIST DS, FDR
76-	VFD-62	76-E-16	DEWATERING CENTRIFUGE POLYMER FEED PUMP 2 VFD	76MCC76C02	X												DEMO EXIST CB, REACTOR, VFD. RECOMMEND DEMO EXIST DS, FDR
76-	VFD-63	76-E-15	DEWATERING CENTRIFUGE POLYMER FEED PUMP 3 VFD	76MCC76C01	X												DEMO EXIST CB, REACTOR, VFD. RECOMMEND DEMO EXIST DS, FDR
76-	VFD-64	76-E-16	DEWATERING CENTRIFUGE POLYMER FEED PUMP 4 VFD	76MCC76C02	X												DEMO EXIST CB, REACTOR, VFD. RECOMMEND DEMO EXIST DS, FDR
76-	VFD-65	76-E-13	DEWATERING CENTRIFUGE POLYMER FEED PUMP 5 VFD	76MCC76B01	X												DEMO EXIST CB, REACTOR, VFD. RECOMMEND DEMO EXIST DS, FDR
76-	VFD-66	76-E-14	DEWATERING CENTRIFUGE POLYMER FEED PUMP 6 VFD	76MCC76B02	X												DEMO EXIST CB, REACTOR, VFD. RECOMMEND DEMO EXIST DS, FDR
76-	VFD-67	76-E-13	DEWATERING CENTRIFUGE POLYMER FEED PUMP 7 VFD	76MCC76B01	X												DEMO EXIST CB, REACTOR, VFD. RECOMMEND DEMO EXIST DS, FDR
76-	VFD-68	76-E-14	DEWATERING CENTRIFUGE POLYMER FEED PUMP 8 VFD	76MCC76B02	X												DEMO EXIST CB, REACTOR, VFD. RECOMMEND DEMO EXIST DS, FDR
76-	**P-61A**	**76-E-15**	**DEWATERING CENTRIFUGE POLYMER FEED PUMP 1A**	**76MCC76C01**		**X**		**10**				**CONT**			**X**	**NO**	
76-	**P-62A**	**76-E-16**	**DEWATERING CENTRIFUGE POLYMER FEED PUMP 2A**	**76MCC76C02**		**X**		**10**				**CONT**			**X**	**NO**	
76-	**P-63A**	**76-E-15**	**DEWATERING CENTRIFUGE POLYMER FEED PUMP 3A**	**76MCC76C01**		**X**		**10**				**CONT**			**X**	**NO**	
76-	**P-64A**	**76-E-16**	**DEWATERING CENTRIFUGE POLYMER FEED PUMP 4A**	**76MCC76C02**		**X**		**10**				**CONT**			**X**	**NO**	
76-	**P-65A**	**76-E-13**	**DEWATERING CENTRIFUGE POLYMER FEED PUMP 5A**	**76MCC76B01**		**X**		**10**				**CONT**			**X**	**NO**	
76-	**P-66A**	**76-E-14**	**DEWATERING CENTRIFUGE POLYMER FEED PUMP 6A**	**76MCC76B02**		**X**		**10**				**CONT**			**X**	**NO**	
76-	**P-67A**	**76-E-13**	**DEWATERING CENTRIFUGE POLYMER FEED PUMP 7A**	**76MCC76B01**		**X**		**10**				**CONT**			**X**	**NO**	
76-	**P-68A**	**76-E-14**	**DEWATERING CENTRIFUGE POLYMER FEED PUMP 8A**	**76MCC76B02**		**X**		**10**				**CONT**			**X**	**NO**	
76-	**VFD-61A**	**76-E-15**	**DEWATERING CENTRIFUGE POLYMER FEED PUMP 1A VFD**	**76MCC76C01**		**X**											**INSTALL NEW CB, REACTOR, VFD. RECOMMEND INSTALL NEW DS, FDR**
76-	**VFD-62A**	**76-E-16**	**DEWATERING CENTRIFUGE POLYMER FEED PUMP 2A VFD**	**76MCC76C02**		**X**											**INSTALL NEW CB, REACTOR, VFD. RECOMMEND INSTALL NEW DS, FDR**
76-	**VFD-63A**	**76-E-15**	**DEWATERING CENTRIFUGE POLYMER FEED PUMP 3A VFD**	**76MCC76C01**		**X**											**INSTALL NEW CB, REACTOR, VFD. RECOMMEND INSTALL NEW DS, FDR**
76-	**VFD-64A**	**76-E-16**	**DEWATERING CENTRIFUGE POLYMER FEED PUMP 4A VFD**	**76MCC76C02**		**X**											**INSTALL NEW CB, REACTOR, VFD. RECOMMEND INSTALL NEW DS, FDR**
76-	**VFD-65A**	**76-E-13**	**DEWATERING CENTRIFUGE POLYMER FEED PUMP 5A VFD**	**76MCC76B01**		**X**											**INSTALL NEW CB, REACTOR, VFD. RECOMMEND INSTALL NEW DS, FDR**
76-	**VFD-66A**	**76-E-14**	**DEWATERING CENTRIFUGE POLYMER FEED PUMP 6A VFD**	**76MCC76B02**		**X**											**INSTALL NEW CB, REACTOR, VFD. RECOMMEND INSTALL NEW DS, FDR**
76-	**VFD-67A**	**76-E-13**	**DEWATERING CENTRIFUGE POLYMER FEED PUMP 7A VFD**	**76MCC76B01**		**X**											**INSTALL NEW CB, REACTOR, VFD. RECOMMEND INSTALL NEW DS, FDR**
76-	**VFD-68A**	**76-E-14**	**DEWATERING CENTRIFUGE POLYMER FEED PUMP 8A VFD**	**76MCC76B02**		**X**											**INSTALL NEW CB, REACTOR, VFD. RECOMMEND INSTALL NEW DS, FDR**

APPENDIX D - TABLE 4: SLUDGE DEWATERING SYSTEM

MBC CAPACITY ASSESSMENT - PROJECTED LOAD MODIFICATIONS

REVISION 1

DRIVEN EQUIPMENT							NOTES	480 V LOAD - AC MOTORS						MOTOR CONTROL			
TAG		DWG	DRIVEN EQUIPMENT NAME	EQUIPMENT STATUS				CONNECTED		MAX RUNNING		DUTY CYCLE		SPEED			ELECTRICAL WORK REQUIRED
NUMBER(S)		NUMBER		EXISTING MCC NAME	EXISTING TO DEMO	**PROPOSED LOAD**		HP	KW/ KVA	HP	KW/ KVA	CONT	INT/ VAR	CONSTANT SPEED	VARIABLE VFD	BYPASS CONTACTOR	
76-	DC-1	SI-E-29	DEWATERING CENTRIFUGE 1 MAIN DRIVE		X		NOTE 4	-300				CONT			X	NO	DEMO EXIST REACTOR, VFD
			DC1 BACKDRIVE		X		NOTE 4	-100				CONT			X	NO	DEMO EXIST REACTOR, VFD
76-	DC-8	SI-E-28	DEWATERING CENTRIFUGE 8 MAIN DRIVE		X		NOTE 4	-100				CONT			X	NO	DEMO EXIST REACTOR, VFD
			DC8 BACKDRIVE		X		NOTE 4	-100				CONT			X	NO	DEMO EXIST REACTOR, VFD
76-	**DC-1A**	SI-E-29	**DEWATERING CENTRIFUGE 1A MAIN DRIVE**			**X**	**NOTE 5**	**200**				**CONT**			**X**	**NO**	**INSTALL NEW CENTRIFUGE DRIVE (NOTE 7)**
			TC1A BACKDRIVE			**X**	**NOTE 5**	**50**				**CONT**			**X**	**NO**	**INSTALL NEW CENTRIFUGE DRIVE (NOTE 7)**
76-	**TC-8A**	**SI-E-28**	**DEWATERING CENTRIFUGE 2A**			**X**	**NOTE 5**	**200**				**CONT**			**X**	**NO**	**INSTALL NEW CENTRIFUGE DRIVE (NOTE 7)**
			TC2A BACKDRIVE			**X**	**NOTE 5**	**50**				**CONT**			**X**	**NO**	**INSTALL NEW CENTRIFUGE DRIVE (NOTE 7)**

NOTES

1. EX. HP'S TAKEN FROM SINGLE LINE - NOT FIELD VERIFIED
2. HP'S FOR A VFD-DRIVEN MOTOR ARE LISTED WITH THE EQUIPMENT
3. SPACE AVAIALABLE IN ORIGINAL MCC FOR UNIT NO. 6
4. 300 HP MAIN DRIVE AND 60 HP BACKDRIVE FIELD VERIFIED
5. BASED ON ALDEC G3-165 DATA SHEET PROVIDED BY COOMBS HOPKINS
6. ORIGINAL PUMPS HAVE ALREADY BEEN REPLACED ONCE. ORIGINAL 10 HP'S ARE NOW 20 HP'S
7. FIELD-VERIFY SPACE FOR NEW EQUIPMENT.

APPENDIX D - TABLE 5: CENTRATE PUMP STATION

MBC CAPACITY ASSESSMENT - PROJECTED LOAD MODIFICATIONS

REVISION 1

DRIVEN EQUIPMENT								NOTES	480 V LOAD - AC MOTORS						MOTOR CONTROL			
TAG		DWG	DRIVEN EQUIPMENT NAME	EQUIPMENT STATUS					CONNECTED		MAX RUNNING		DUTY CYCLE		SPEED			ELECTRICAL WORK REQUIRED
NUMBER(S)		NUMBER		EXISTING MCC NAME	EXISTING TO DEMO	EXISTING TO REMAIN	**PROPOSED LOAD**		HP	KW/ KVA	HP	KW/ KVA	CONT	INT/ VAR	CONSTANT SPEED	VARIABLE VFD	BYPASS CONTACTOR	
94-	P-01	SI-E-37	CENTRATE PUMP 1	94USS	X				-100				CONT			X		
94-	P-02	SI-E-38	CENTRATE PUMP 2	94USS	X				-100				CONT			X		
94-	P-03	SI-E-37	CENTRATE PUMP 3	94USS	X				-100				CONT			X		
94-	P-01	SI-E-37	CENTRATE PUMP 1 (LEAD)	**94USS**			**X**		150				CONT			X		**INSTALL NEW CB, ISO XFR, VFD, DS, FDR (NOTE 3)**
94-	P-02	SI-E-38	CENTRATE PUMP 2 (LAG 1)	**94USS**			**X**		150				CONT			X		**INSTALL NEW CB, ISO XFR, VFD, DS, FDR (NOTE 3)**
94-	P-03	SI-E-37	CENTRATE PUMP 3 (LAG 2)	**94USS**			**X**		150				CONT			X		**INSTALL NEW CB, ISO XFR, VFD, DS, FDR (NOTE 3)**
94-	**P-04**	**SI-E-38**	**CENTRATE PUMP 4 (FUTURE, STANDBY)**	**94USS**			**X**		**150**				**CONT**			**X**		**INSTALL NEW CB, ISO XFR, VFD, DS, CONDUIT, FDR (NOTE 3)**

NOTES

1. EX. HP'S TAKEN FROM SINGLE LINE - NOT FIELD VERIFIED
2. HP'S FOR A VFD-DRIVEN MOTOR ARE LISTED WITH THE EQUIPMENT
3. 94USS 2000 KVA XFR'S ARE REQUIRED TO UTILIZE THEIR FA RATING OR BE REPLACED WITH 2500 KVA UNITS AS AN OPTION. FIELD-VERIFY SPACE FOR NEW EQUIPMENT.

Appendix E: Basis of Estimate Memorandum and Estimate Summary

Memorandum

Date: April 26, 2016

To: Anil Pai, San Diego

From: Don Snowden, West Monroe

Internal ESG Review By: Don Gordon, San Diego

Project No.: 148827-300

Subject: PureWater NCWRP Impact on MBC

Conceptual Design Completion

Basis of Estimate of Probable Construction Cost

The Basis of Estimate Report and supporting estimate reports for the subject project are attached. Please call me if you have questions or need additional information.

DRS

Enclosures (3):

1. Basis of Estimate Report
2. Summary Estimate

Basis of Estimate Report

PureWater NCWRP Impact on MBC

Introduction

Brown and Caldwell (BC) is pleased to present this opinion of probable construction cost (estimate) prepared for the impact of NCWRP expansion on MBC in San Diego, CA.

Summary

This Basis of Estimate contains the following information:

- Scope of work
- Background of this estimate
- Class of estimate
- Estimating methodology
- Direct cost development
- Indirect cost development
- Bidding assumptions
- Estimating assumptions
- Estimating exclusions
- Allowances for known but undefined work
- Contractor and other estimate markups

Scope of Work

Work consists of modifications to the MBC as follows:

1. Grit Removal –
   a. (3) Raw Solids Pumps.
   b. (2) Teacups and Grit Snails.
   c. (1) Classifier and screw conveyor.
   d. (1) ½ sized dumpster.
   e. Existing Building and Expansion Modifications.
2. Thickening Centrifuges
   a. Replacement of (6) centrifuges with associated centrifuge feed pumps and chemical feed pumps.
   b. Replacement of 1,520 linear feet of small diameter sludge pipelines, along with associated bypass pipeline during replacement.
   c. Moving to and from temporary onsite storage, along with cost for temporary onsite storage.
3. (2) two phased Digester Options
   a. There are (2) alternatives; one with FOG, and one without FOG.

   b. There are (2) phases in each alternative. All Phases consists mainly of piping improvements, except on. Phase 2 with FOG adds a 105 ft diameter x 48 ft tall prestressed digester, along with gallery expansion.
4. Dewatering Centrifuges
   a. Replacement of (2) centrifuges with (8) centrifuge feed pumps and chemical feed pumps.
   b. Moving to and from temporary onsite storage, along with cost for temporary onsite storage.
5. Centrate System Improvements consisting of replacing (4) centrate pumps.
6. Various Improvement to Waste Heat Utilization
   a. Conversion of (2) existing boilers to dual fuel capability.
   b. Installation of waste heat recovery equipment for (2) existing MCAS Miramar engines, and re-configuration of existing CHW system into HRS/HRR systems feeding existing MBC HW Loop.
   c. Installation of 400 linear feet of HWS and HWR to FOG.
   d. Relocating the 10-inch HRR tie point to the 16-HRR to prevent short circuiting. Additional temperature sensors are also provided.

Background of this Estimate of Probable Construction Cost

The attached estimate of probable construction cost is based on documents dated April 4, 2016, received by the ESG. These documents are described as ten percent complete based on the current project progression, additional or updated scope and/or quantities, and ongoing discussions with the project team. Further information can be found in the detailed estimate reports.

AACEI Estimate Classification

In accordance with the Association for the Advancement of Cost Engineering International (AACE) criteria, this is a Class 5 estimate. A Class 5 estimate is defined as a Conceptual Level or Project Viability Estimate. Typically, engineering is from 0 to 10 percent complete. Class 5 estimates are used to prepare planning level cost scopes or evaluation of alternative schemes, long range capital outlay planning and can also form the base work for the Class 4 Planning Level or Design Technical Feasibility Estimate.

Expected accuracy for Class 5 estimates typically ranges from -50 to +100 percent, depending on the technological complexity of the project, appropriate reference information and the inclusion of an appropriate contingency determination. In unusual circumstances, ranges could exceed those shown.

Estimating Methodology

This estimate was prepared using quantity take-offs, vendor quotes and equipment pricing furnished either by the project team or by the estimator. The estimate includes direct labor costs and anticipated productivity adjustments to labor, and equipment. Where possible, estimates for work anticipated to be performed by specialty subcontractors have been identified.

Construction labor crew and equipment hours were calculated from production rates contained in documents and electronic databases published by R.S. Means, Mechanical Contractors Association (MCA), National Electrical Contractors Association (NECA), and Rental Rate Blue Book for Construction Equipment (Blue Book).

This estimate was prepared using BC's estimating system, which consists of a Windows-based commercial estimating software engine using BC's material and labor database, historical project data, the latest vendor and material cost information, and other costs specific to the project locale.

Direct Cost Development

Costs associated with the General Provisions and the Special Provisions of the construction documents, which are collectively referred to as Contractor General Conditions (CGC), were based on the estimator's interpretation of the contract documents. The estimates for CGCs are divided into two groups: a time-related group (e.g., field personnel), and non-time-related group (e.g., bonds and insurance). Labor burdens such as health and welfare, vacation, union benefits, payroll taxes, and workers compensation insurance are included in the labor rates. No trade discounts were considered.

Indirect Cost Development

A percentage allowance for contractor's home office expense has been included in the overall rate markups. The rate is standard for this type of heavy construction and is based on typical percentages outlined in Means Heavy Construction Cost Data.

The contractor's cost for builder's risk, general liability and vehicle insurance has been included in this estimate. Based on historical data, this is typically two to four percent of the overall construction contract amount. These indirect costs have been included in this estimate as a percentage of the gross cost, and are added after the net markups have been applied to the appropriate items.

Bidding Assumptions

The following bidding assumptions were considered in the development of this estimate.

1. Bidders must hold a valid, current Contractor's credentials, applicable to the type of project.
2. Bidders will develop estimates with a competitive approach to material pricing and labor productivity, and will not include allowances for changes, extra work, unforeseen conditions or any other unplanned costs.
3. Estimated costs are based on a minimum of four bidders. Actual bid prices may increase for fewer bidders or decrease for a greater number of bidders.
4. Bidders will account for General Provisions and Special Provisions of the contract documents and will perform all work except that which will be performed by traditional specialty subcontractors as identified here:
   - Electrical and Instrumentation
   - HVAC systems
   - Painting and Coatings
   - Prestressed Tank
   - Pile Driving

Estimating Assumptions

As the design progresses through different completion stages, it is customary for the estimator to make assumptions to account for details that may not be evident from the documents. The following assumptions were used in the development of this estimate.

1. Contractor performs the work during normal daylight hours, nominally 7 a.m. to 5 p.m., Monday through Friday, in an 8-hour shift. No allowance has been made for additional shift work or weekend work.
2. Contractor has complete access for lay-down areas and mobile equipment.
3. Equipment rental rates are based on verifiable pricing from the local project area rental yards, Blue Book rates and/or rates contained in the estimating database.
4. Contractor markup is based on conventionally accepted values that have been adjusted for project-area economic factors.
5. Major equipment costs are based on both vendor supplied price quotes obtained by the project design team and/or estimators, and on historical pricing of like equipment.
6. Process equipment vendor training using vendors' standard Operations and Maintenance (O&M) material, is included in the purchase price of major equipment items where so stated in that quotation.
7. Bulk material quantities are based on manual quantity take-offs.
8. There is sufficient electrical power with the existing plant load centers to feed the specified equipment. Neither new power supply, nor transformers by the electric utility are anticipated.
9. Pavement demolition and replacement is based on a 5 inch asphalt course, and a 12-inch crushed stone base course.
10. All replacement equipment received new equipment pads.
11. The temporary storage cost is based upon 20,000 cubic feet required, using ¾ of capacity of (10) 40 ft shipping containers stored onsite.

Estimating Exclusions

The following estimating exclusions were assumed in the development of this estimate.

1. Hazardous materials remediation and/or disposal.
2. O&M costs for the project with the exception of the vendor supplied O&M manuals.
3. Utility agency costs for incoming power modifications.
4. Permits beyond those normally needed for the type of project and project conditions.
5. No Piling is included in this estimate.

Allowances for Known but Undefined Work

Allowances were made in the development of this estimate for equipment header piping.

Contractor and Other Estimate Markups

Contractor markup is based on conventionally accepted values which have been adjusted for project-area economic factors. Estimate markups are shown in Table 1.

Table 2. Estimate Markups

Item	Rate (%)
Net Cost Markups	
Labor (employer payroll burden)	12
Materials and process equipment	10
Equipment (construction-related)	8
Subcontractor	5
Sales Tax (State and local for materials, process equipment and construction equipment rentals, etc.)	8
Material Shipping and Handling	2
Gross Cost Markups	
Contractors General Conditions	10
Start-up, Training and O&M	2
Undesigned/Undeveloped Detail Construction Contingency	40
Builders Risk, Liability and Auto Insurance	2
Performance and Payment Bonds	1.5
Escalation to Midpoint of Construction	Client Applied

Labor Markup

The labor rates used in the estimate were derived chiefly from the latest published State Prevailing Wage Rates. These include base rate paid to the laborer plus fringes. A labor burden factor is applied to these such that the final rates include all employer paid taxes. These taxes are FICA (which covers social security plus Medicare), Workers Comp (which varies based on state, employer experience and history) and unemployment insurance. The result is fully loaded labor rates. In addition to the fully loaded labor rate, an overhead and profit markup is applied at the back end of the estimate. This covers payroll and accounting, estimator's wages, home office rent, advertising and owner profit.

Materials and Process Equipment Markup

This markup consists of the additional cost to the contractor beyond the raw dollar amount for material and process equipment. This includes shop drawing preparation, submittal and/or re-submittal cost, purchasing and scheduling materials and equipment, accounting charges including invoicing and payment, inspection of received goods, receiving, storage, overhead and profit.

Equipment (Construction) Markup

This markup consists of the costs associated with operating the construction equipment used in the project. Most GCs will rent rather than own the equipment and then charge each project for its equipment cost. The equipment rental cost does not include fuel, delivery and pick-up charges, additional insurance requirements on rental equipment, accounting costs related to home office receiving invoices and payment. However, the crew rates used in the estimate do account for the equipment rental cost. Occasionally, larger contractors will have some or all of the equipment needed for the job, but in order to recoup their initial purchasing cost they will charge the project an internal rate for equipment use which is similar to the rental cost of equipment. The GC will apply an overhead and profit percentage to each individual piece of equipment whether rented or owned.

Subcontractor Markup

This markup consists of the GC's costs for subcontractors who perform work on the site. This includes costs associated with shop drawings, review of subcontractor's submittals, scheduling of subcontractor work, inspections, processing of payment requests, home office accounting, and overhead and profit on subcontracts.

Sales Tax (Materials, Process Equipment and Construction Equipment)

This is the tax that the contractor must pay according to state and local tax laws. The percentage is applied to both the material and equipment the GC purchases as well as the cost for rental equipment. The percentage is based on the local rates in place at the time the estimate was prepared.

Contractor Startup, Training, and O&M Manuals

This cost markup is often confused with either vendor startup or owner startup. It is the cost the GC incurs on the project beyond the vendor startup and owner startup costs. The GC generally will have project personnel assigned to facilitate the installation, testing, startup and O&M Manual preparation for equipment that is put into operation by either the vendor or owner. These project personnel often include an electrician, pipe fitter or millwright, and/or I&E technician. These personnel are not included in the basic crew makeup to install the equipment but are there to assist and trouble shoot the startup and proper running of the equipment. The GC also incurs a cost for startup for such things as consumables (oil, fuel, filters, etc.), startup drawings and schedules, startup meetings and coordination with the plant personnel in other areas of the plant operation.

Builders Risk, Liability, and Vehicle Insurance

This percentage comprises all three items. There are many factors which make up this percentage, including the contractor's track record for claims in each of the categories. Another factor affecting insurance rates has been a dramatic price increase across the country over the past several years due to domestic and foreign influences. Consequently, in the construction industry we have observed a range of 0.5 to 1 percent for Builders Risk Insurance, 1 to 1.25 percent for General Liability Insurance, and 0.85 to 1 percent for Vehicle Insurance. Many factors affect each area of insurance, including project complexity and contractor's requirements and history. Instead of using numbers from a select few contractors, we believe it is more prudent to use a combined 2 percent to better reflect the general costs across the country. Consequently, the actual cost could be higher or lower based on the bidder, region, insurance climate, and on the contractor's insurability at the time the project is bid.

Material Shipping and Handling

This can range from 2 to 6 percent, and is based on the type of project, material makeup of the project, and the region and location of the project. Material shipping and handling covers delivery costs from vendors, unloading costs (and in some instances loading and shipment back to vendors for rebuilt equipment), site paper work, and inspection of materials prior to unloading at the project site. BC typically adjusts this percentage by the amount of materials and whether vendors have included shipping costs in the quotes that were used to prepare the estimate. This cost also includes the GC's cost to obtain local supplies; e.g., oil, gaskets and bolts that may be missing from the equipment or materials shipped.

Escalation to Midpoint of Construction for All Project Cost

In addition to contingency, it is customary for projects that will be built over several years to include an escalation to midpoint of anticipated construction to account for the future escalation of labor, material and equipment costs beyond values at the time the estimate is prepared. For this conceptual level of estimating, the PureWater program wished to omit escalation from the base estimate, and apply as appropriate in the future.

Undesigned/Undeveloped Detail Construction Contingency

The contingency factor covers unforeseen conditions, area economic factors, and general project complexity. This contingency is used to account for those factors that cannot be addressed in each of the labor and/or material installation costs. Based on industry standards, completeness of the project documents, project complexity, the current design stage and area factors, construction contingency can range from 10 to 50 percent. Contingency is applied at the estimators discretion based on the amount of Undesigned/undeveloped detail for the particular project

Performance and Payment Bonds

Based on historical and industry data, this can range from 0.75 to 3 percent of the project total. There are several contributing factors including such items as size of the project, regional costs, and contractor's historical record on similar projects, complexity and current bonding limits. BC uses 1.5 percent for bonds, which we have determined to be reasonable for most heavy construction projects.

6/6/2016 1:00 PM

Project Number:	148827-300
Estimate Issue Number:	1
Estimate Issue Date:	6/6/2016
Estimator:	Snowden

San Diego PureWater Program
T.O. 18 - Impact NCWRP to MBC
CLASS V ESTIMATE

BC Project Manager	Anil Pai
BC Office	San Diego
QA/QC Reviewer	Don Gordon
QA/QC Review Date	6/6/2016

Notes

PROCESS LOCATION/AREA INDEX

Base Estimate
- 05. Grit Removal
- 10. Thickening Centrifuges
- 15a Digestion w/FOG; PHASE 1
- 15b Digestion w/FOG; PHASE 2
- 15c Digestion w/o FOG; PHASE 1
- 15d Digestion w/o FOG; PHASE 2
- 20. Dewatering Centrifuges
- 25. Centrate System
- 50. Waste Heat Utilization

Other Improvements for MBC Digesters
- 100. Demolition
- 110. Recirculatin Pumps
- 120. Centrifugal Mixing Pumps
- 130. Vane Axial Mixing Pumps
- 140. HEX

Brown AND Caldwell

Bid Item Summary

6/7/2016 9:24 AM

Project Number: 148827-300
Estimate Issue Number: 1
Estimate Issue Date: 6/6/2016
Estimator: Snowden

T.O. 18 - Impact NCWRP to MBC

TOTALS	Area	Bid Item:	Assembly	Description	Total Gross Amount
01					
	01			Base Estimate	
		05.		Grit Removal	
			02220	Div 2- Demolition	520,557
			03333	Div 3- Small Eq Pad (4x4x1)	4,583
			26001	Electrical and Instrumentaiton (FACTORED)	666,461
			46999	Div 46-WW Equipment	2,615,482
				05. Grit Removal	3,807,081
		10.		Thickening Centrifuges	
			02220	Div 2- Demolition	129,194
			02999	Div 1-Offsite Storage	32,622
			02999	Div 2-Demolition	23,034
			03333	Div 3- Small Eq Pad (4x4x1) Centrifuge Feed Pump	13,748
			03333	Div 3- Centrifuge Pedestals (10x4x2)	137,344
			03333	Div 3- Small Eq Pad (4x4x2) Polymer Pumps	27,496
			03333	Div 3- Small Eq Pad (4x4x1) Digester Feed Pump	9,165
			05127	Div 5- Structrural Steel Beams	29,549
			26001	Div 26-Electrical and Instrumentaiton (FACTORED)	1,896,127
			40120	Div40-Piping	122,665
			40120	Div 40-Piping, 10-inch	227,504
			40120	Div 40-Piping, 6-inch	104,564
			40120	Div 40 Piping, 8-inch	287,711
			40530	Div 1-Pipeline Bypass (No Add'l Pumping Cost)	33,956
			46999	Div 46-WW Equipment	18,191,649
				10. Thickening Centrifuges	21,266,328
		15a		Digestion w/FOG; PHASE 1	
			32999	Asphalt Demo & Replacement (8-inch Biogas to Cogen)	4,788

Note that subtotals include a 40% contingency. The contingency was separated before reporting construction cost values in Table 5.1-1 and 5.1-2.

TOTALS	Area	Bid Item:	Assembly	Description	Total Gross Amount
			32999	Asphalt Demo & Replacement (16-inch Biogas to Cogen)	99,581
			32999	Asphalt Demo & Replacement (16-inch Biogas to Cogen)	10,710
			33500	UG Pipeline - 8 inch Biogas to Cogen	42,892
			33500	UG Pipeline - 16 inch Biogas to Cogen	423,310
			33500	UG Pipeline - 16 inch Biogas to Flares	139,363
			46999	Digester Equip & Piping	1,856,268
			46999	Misc. Wastewater Work	3,284,133
				15a Digestion w/FOG; PHASE 1	5,861,045
		15b		Digestion w/FOG; PHASE 2	
			01600	Hoisting & Craneage Requirements by Installing Vendor	85,544
			03999	Gallery Extension-Structural	1,802,611
			13999	Post-Tensioned Digester Tanks	6,424,379
			26999	Electrical & Instrumentation Subcontracts	854,194
			31240	Dewatering Systems	234,495
			31999	Excavating & Backfill (tank)	492,263
			31999	Sheeting (tank)	786,580
			31999	Excavating & Backfill (Gallery Extension)	399,445
			32999	Asphalt Demo & Replacement (8-inch Biogas to Cogen)	4,788
			32999	Asphalt Demo & Replacement (16-inch Biogas to Cogen)	99,581
			32999	Asphalt Demo & Replacement (18-inch Biogas to Cogen)	11,149
			33500	UG Pipeline - 8 inch Biogas to Cogen	43,000
			33500	UG Pipeline - 16 inch Biogas to Cogen	516,255
			33500	UG Pipeline - 18 inch Biogas to Flares	159,555
			46999	Digester Equip & Piping	3,467,206
			46999	Digester Tank Anciliary Items	799,962
			46999	Misc. Wastewater Work	3,284,133
				15b Digestion w/FOG; PHASE 2	19,465,140
		15c		Digestion w/o FOG; PHASE 1	

TOTALS	Area	Bid Item:	Assembly	Description	Total Gross Amount
			32999	Asphalt Demo & Replacement (8-inch Biogas to Cogen)	4,788
			32999	Asphalt Demo & Replacement (12-inch Biogas to Cogen)	91,556
			32999	Asphalt Demo & Replacement (12-inch Biogas to Cogen)	9,845
			33500	UG Pipeline - 8 inch Biogas to Cogen	41,742
			33500	UG Pipeline - 12 inch Biogas to Cogen	356,948
			33500	UG Pipeline - 12 inch Biogas to Flares	88,511
			46999	Digester Equip & Piping	226,597
			46999	Digester Equip & Piping	810,230
				15c Digestion w/o FOG; PHASE 1	1,630,218
		15d		Digestion w/o FOG; PHASE 2	
			32999	Asphalt Demo & Replacement (8-inch Biogas to Cogen)	4,788
			32999	Asphalt Demo & Replacement (12-inch Biogas to Cogen)	100,890
			32999	Asphalt Demo & Replacement (14-inch Biogas to Cogen)	10,283
			33500	UG Pipeline - 8 inch Biogas to Cogen	41,742
			33500	UG Pipeline - 12 inch Biogas to Cogen	356,948
			33500	UG Pipeline - 14 inch Biogas to Flares	109,770
			46999	Digester Equip & Piping	811,126
				15d Digestion w/o FOG; PHASE 2	1,435,547
		20.		Dewatering Centrifuges	
			02220	Div 2- Demolition	55,536
			02999	Div 1-Offsite Storage	32,622
			03333	Div 3- Small Eq Pad (4x4x1) Centrifuge Feed Pump	17,398
			03333	Div 3- Centrifuge Pedestals (10x4x2)	78,284
			03333	Div 3- Small Eq Pad (4x4x2) Polymer Pumps	9,165
			26001	Div 26-Electrical and Instrumentaiton (FACTORED)	1,013,771
			40120	Div40-Piping	122,665
			40530	Div 1-Pipeline Bypass (No Add'l Pumping Cost)	33,956

Project Number: 148827-300
Estimate Issue Number: 1
Estimate Issue Date: 6/6/2016
Estimator: Snowden

T.O. 18 - Impact NCWRP to MBC

TOTALS	Area	Bid Item:	Assembly	Description	Total Gross Amount
			46999	Div 46-WW Equipment	3,305,347
				20. Dewatering Centrifuges	4,668,744
		25.		Centrate System	
			02220	Div 2- Demolition	2,164
			03333	Div 3- Small Eq Pad (4x4x1)	6,292
			26001	Div 26-Electrical and Instrumentaiton (FACTORED)	262,830
			40120	Div40-Piping	26,285
			46999	Div 46-WW Equipment	1,039,513
				25. Centrate System	1,337,083
		50.		Waste Heat Utilization	
			40140	Boiler-Dual Fuel Conversion	323,735
			40140	Boiler-Dual Fuel Conversion	510,058
			40170	HWS to FOG Receiving Sta	102,003
			40170	HW Loop Interconnection Enhancement @ MBC Cogen	45,175
				50. Waste Heat Utilization	980,971
				01 Base Estimate	60,452,158
	02			Other Improvements for MBC Digesters	
		100		Demolition	
			46999	Misc. Wastewater Work	103,777
				100 Demolition	103,777
		110		Recirculation Pumps	
			46999	Misc. Wastewater Work	255,984
				110 Recirculation Pumps	255,984
		120		Centrifugal Mixing Pumps	

Bid Item Summary

6/7/2016 9:24 AM

Project Number:	148827-300
Estimate Issue Number:	1
Estimate Issue Date:	6/6/2016
Estimator:	Snowden

T.O. 18 - Impact NCWRP to MBC

TOTALS	Area	Bid Item:	Assembly	Description	Total Gross Amount
			46999	Misc. Wastewater Work	698,138
				120 Centrifugal Mixing Pumps	698,138
		130		Vane Axial Mixing Pumps	
			46999	Misc. Wastewater Work	1,291,555
				130 Vane Axial Mixing Pumps	1,291,555
		140		HEX	
			46999	Misc. Wastewater Work	737,941
				140 HEX	737,941
				02 Other Improvements for MBC Digesters	3,087,395
				01	63,539,553

Bid Item Summary

6/6/2016 1:02 PM

Project Number:	148827-300
Estimate Issue Number:	1
Estimate Issue Date:	6/6/2016
Estimator:	Snowden

T.O. 18 - Impact NCWRP to MBC

TOTALS	Area	Bid Item:	Description	Total Gross Amount
01				
	01		Base Estimate	
		05.	Grit Removal	3,807,081
		10.	Thickening Centrifuges	21,266,328
		15a	Digestion w/FOG; PHASE 1	5,861,045
		15b	Digestion w/FOG; PHASE 2	19,465,140
		15c	Digestion w/o FOG; PHASE 1	1,630,218
		15d	Digestion w/o FOG; PHASE 2	1,435,547
		20.	Dewatering Centrifuges	4,668,744
		25.	Centrate System	1,337,083
		50.	Waste Heat Utilization	980,971
			01 Base Estimate	60,452,158
	02		Other Improvements for MBC Digesters	
		100	Demolition	103,777
		110	Recirculation Pumps	255,984
		120	Centrifugal Mixing Pumps	698,138
		130	Vane Axial Mixing Pumps	1,291,555
		140	HEX	737,941
			02 Other Improvements for MBC Digesters	3,087,395
			01	63,539,553

Grand total does not represent project total because it adds together Phase I and Phase II improvements and w/FOG and w/o FOG improvements even though they are separate alternatives and scenarios (software automatically calculates final total).

T.O. 18 - Impact NCWRP to MBC

Estimate Totals

Description	Rate	Amount	Totals
Labor		3,722,170	
Material		18,201,615	
Subcontract		6,572,239	
Equipment		924,126	
Other		5,338,522	
		34,758,672	**34,758,672**
Labor Mark-up	12.000 %	446,660	
Material Mark-up	10.000 %	1,820,162	
Subcontractor Mark-up	5.000 %	328,612	
Construction Equipment Mark-up	8.000 %	73,930	
Other - Process Equip Mark-up	8.000 %	427,082	
		3,096,446	**37,855,118**
Material Shipping & Handling	2.000 %	364,032	
Material Sales Tax	8.000 %	1,224,812	
Other - Process Eqp Sales Tax	8.000 %	32,470	
Net Markups		**1,621,314**	**39,476,432**
E&I Cost (Out)	(100.000) %	(2,791,596)	
		(2,791,596)	**36,684,836**
Contractor General Conditions	10.000 %	3,668,484	
E&I General Conditions	10.000 %	279,160	
GC Electrical Mark-Up	5.500 %	153,538	
E&I Cost (IN)	100.000 %	2,791,596	
		6,892,778	**43,577,614**
Start-Up, Training, O&M	1.250 %	260,303	
		260,303	**43,837,917**
Undesign/Undevelop Contingency	40.000 %	17,535,167	
		17,535,167	**61,373,084**
Bldg Risk, Liability Auto Ins	2.000 %	1,227,462	
		1,227,462	**62,600,546**
Contractor Bonds & Insurance	1.500 %	939,008	
		939,008	**63,539,554**
Escalation to Midpoint (ALL)			
Gross Markups			**63,539,554**
Total			**63,539,554**

Grand total does not represent project total because it adds together Phase I and Phase II improvements and w/FOG and w/o FOG improvements even though they are separate alternatives and scenarios (software automatically calculates final total).

Appendix F: Workshop Presentations and Summary

Task No.018
Technical Memorandum

Evaluate Impacts of NCWRP Expansion on Metropolitan Biosolids Center

Project Workshop – May 18, 2016

Pure Water San Diego

MWH. BUILDING A BETTER WORLD

Brown AND Caldwell

BLP Engineers, Inc.
Environmental Engineers, Scientists, and Planners

WORKSHOP AGENDA

- Introduction and Workshop Agenda
- Projected Biosolids Flows and Loads
- Projected Impacts on Selected Unit Processes:
    - Grit Removal System
    - Raw Solids Thickening
    - Anaerobic Digestion
    - Digested Biosolids Dewatering
    - Centrate System
    - Odor Control System
    - Chemical Storage and Handling System
    - Utilities Extension Needs
    - Siting Impacts
    - Waste Heat Utilization
- Opinions of Probable Costs
- Construction Schedule
- Raw Solids and Centrate Considerations and Impacts
- Discussion of City's Review Comments
- Next Steps
- Thank you! Questions?

PROJECTED BIOSOLIDS FLOW & LOADS

- Excel spreadsheet based flow and loads model
- Models developed to reflect various scenarios
  - Base Case with no FOG addition
  - Two additional cases with FOG addition and Lystek
  - Each of the above three had two scenarios
    - Average volatile solids destruction in digesters
    - Reduced volatile solids destruction in digesters
- All models assumed no Central Area Plant
- Modeled average daily and peak-day flows

PROJECTED FLOWS & LOADS FROM NCWRP

ITEM Phase I Condition Phase II Condition	Min NPR (Avg Day)	Base NPR (Avg Day)	Max NPR (Avg Day)	Min NPR (Peak Day)	Base NPR (Peak Day)	Max NPR (Peak Day)
Flow, MGD Phase I	1.88	2.45	2.90	2.87	3.75	4.43
Flow, MGD Phase II	3.29	3.87	4.28	5.04	5.92	6.55
Total Solids, lb/d Phase I	78,331	102,236	124,597	125,330	163,577	199,355
Total Solids, lb/d Phase II	137,352	161,288	183,930	219,763	258,061	294,288
Volatile Solids, lb/d – Phase I	59,607	77,800	94,819	95,372	124,481	151,710
Volatile Solids, lb/d – Phase II	104,520	122,737	139,969	167,232	196,379	223,950

GRIT REMOVAL SYSTEM

ITEM	PHASE I		PHASE II	
	NCWRP EXPANSION	OTHER IMPROVEMENTS	NCWRP EXPANSION	OTHER IMPROVEMENTS
Install Raw Solids Feed Pumps	All 3 Raw Solids Feed Pumps		Covered at Phase I	
Expand Area 76 Grit Building	Expand Building		Covered at Phase I	
Install Grit Cyclone Separators (Teacups)	Install One New Teacup		Install One Additional Teacup	
Install Grit Clarifiers, Augers (Snails) and Screw Conveyors	Install One New Clarifier, Snail, And Screw Conveyor		Covered at Phase I	

RAW SOLIDS THICKENING SYSTEM

ITEM	PHASE I		PHASE II	
	NCWRP EXPANSION	OTHER IMPROVEMENTS	NCWRP EXPANSION	OTHER IMPROVEMENTS
Raw Sludge Centrifuge Feed Pumps		Replace 3 existing Sludge Feed Pumps with larger pumps		Replace 5 Sludge Feed Pumps with larger pumps, Install 6th pump
Thickening Centrifuges		Replace 3 existing centrifuges with larger centrifuges		Replace 5 existing centrifuges with larger centrifuges, Install 6th centrifuge
Polymer Feed Pumps		Replace 3 existing Polymer Feed Pumps with larger pumps		Replace 5 Polymer Feed Pumps with larger pumps, Install 6th pump
Thickened Sludge (Digester Feed) Pumps		Replace 3 existing Digester Feed Pumps with 4 larger pumps. Install new 8 inch forcemain		Replace 3 existing Digester Feed Pumps with 4 larger pumps, Install new 8 inch forcemain

ANAEROBIC DIGESTERS - BASE CASE

ITEM	PHASE I (W/O FOG)		PHASE II (W/O FOG)	
	NCWRP EXPANSION	OTHER IMPROVEMENTS	NCWRP EXPANSION	OTHER IMPROVEMENTS
Upgrade Axial Mixing Pumps	Refurbish Axial Mixing Pumps and Valves		Covered at Phase I	
Upgrade Biogas Conveyance System	Enlarge Biogas Laterals and Equipment		Phase I Upgrades Plus Enlarge Gas Compressors, Gas Header to Cogeneration	
Install Additional Biogas Flare			Install One New Flare and Enlarge Gas Header to Flares	
Implement Digester Management Safeguards			Implement Digester Management Safeguards	

ANAEROBIC DIGESTERS – FOG & LISTEK

ITEM	PHASE I (W/ FOG & LISTEK)		PHASE II (W/ FOG & LISTEK)	
	NCWRP EXPANSION	OTHER IMPROVEMENTS	NCWRP EXPANSION	OTHER IMPROVEMENTS
Construct 4th Digester			Construct 4th Digester all Appurtenant Pumps, Piping, HEX, and Extension of Gallery	
Upgrade Axial Mixing Pumps and Digester Feed Lines	Refurbish Axial Mixing Pumps and Valves, and Enlarge Digester Feed Lines		Complete at Phase I	
Upgrade Biogas Conveyance System	Enlarge Biogas Laterals and Equipment, Enlarge Biogas Compressors		Phase I Upgrades Plus Enlarge Gas Header to Cogeneration	
Install Additional Biogas Flares	Install One New Flare and Enlarge Gas Header to Flares		Phase I Upgrades Plus Additional Flare and Enlarge Gas Header to Flares	
Implement Digester Management Safeguards			Implement Digester Management Safeguards	

DIGESTED SLUDGE DEWATERING SYSTEM

ITEM	PHASE I		PHASE II	
	NCWRP EXPANSION	**OTHER IMPROVEMENTS**	**NCWRP EXPANSION**	**OTHER IMPROVEMENTS**
Digested Sludge Centrifuge Feed Pumps		Replace existing 8 Sludge Feed Pumps with larger pumps		Replace existing 8 Sludge Feed Pumps with larger pumps
Thickening Centrifuges		Replace DC-1 and DC-8 with larger centrifuges		Replace DC-1 and DC-8 with larger centrifuges
Polymer Feed Pumps		Replace existing 8 Polymer Feed Pumps with larger pumps		Replace existing 8 Polymer Feed Pumps with larger pumps

CENTRATE SYSTEM

ITEM	PHASE I		PHASE II	
	NCWRP EXPANSION	OTHER IMPROVEMENTS	NCWRP EXPANSION	OTHER IMPROVEMENTS
Restore Force Main to Design Conditions		Yes		Covered at Phase I
Replace Existing Centrate Pumps		No Changes		Replace Three Pumps
Install Fourth Centrate Pump		No Changes		Install New Pump

ODOR CONTROL SYSTEM

- Existing odor control system adequate for future
- Increase in foul air from expanded Grit Building would only contribute to minor increase
- Slight reduction expected in treatment efficiency of chemical scrubbers
- Carbon absorbers have adequate capacity to handle slightly increased loading

CHEMICAL HANDLING SYSTEMS

ITEM	PHASE I		PHASE II	
	NCWRP EXPANSION	OTHER IMPROVEMENTS	NCWRP EXPANSION	OTHER IMPROVEMENTS
Ferrous Chloride Feed Pumps – Base Case	Provide 4th off-the-shelf spare pump		Provide 4th off-the-shelf spare pump	
Ferrous Chloride Feed Pumps – with FOG		Furnish and Install 4th Feed Pump with Piping and Appurtenances to 4th Digester		Furnish and Install 4th Feed Pump with Piping and Appurtenances to 4th Digester
Ferrous Chloride Feed Pumps – with FOG and Lystek		Furnish and Install 4th Feed Pump with Piping and Appurtenances to 4th Digester		Furnish and Install 4th Feed Pump with Piping and Appurtenances to 4th Digester
Dilute Polymer Storage and Transfer	No Action	No Action	No Action	No Action

UTILITIES EXTENSION NEEDS

ITEM	PHASE I		PHASE II	
	NCWRP EXPANSION	OTHER IMPROVEMENTS	NCWRP EXPANSION	OTHER IMPROVEMENTS
Utilities Extension Needs – Base Case	Digester MCC Expansion		• Digester MCC Expansion • Utility Piping-Biogas Main to Cogen	
Utilities Extension Needs – with FOG		Digester MCC Expansion		• New MCC for Digester 4 Plus • Digester MCC Expansion • Utility Piping Extensions to Digester 4 and FOG • Biogas Main to Cogen
Utilities Extension Needs – with FOG and Lystek		Digester MCC Expansion		• New MCC for Digester 4 Plus Digester MCC Expansion • Utility piping extensions to Digester 4 and FOG (Lystek not considered) • Biogas Main to Cogen

SITING IMPACTS

ITEM	PHASE I		PHASE II	
	NCWRP EXPANSION	OTHER IMPROVEMENTS	NCWRP EXPANSION	OTHER IMPROVEMENTS
Siting Impacts – Base Case	No significant permanent impacts		No significant permanent impacts	
Siting Impacts – with FOG		FOG location N. of Maintenance Yard		FOG location N. of Maintenance Yard
Siting Impacts – with FOG and Lystek		• FOG location N. of Maintenance Yard • Lystek Siting to be determined in future		• FOG location N. of Maintenance Yard • Lystek siting to be determined in future

WASTE HEAT UTILIZATION

ITEM	PHASE I		PHASE II	
	NCWRP EXPANSION (W/ FOG)	OTHER IMPROVEMENTS	NCWRP EXPANSION (W/ FOG)	OTHER IMPROVEMENTS
Modify Hot Water Supply/ Return Piping/Controls		Modify HWS/HWR Connection to Cogeneration Waste Heat Piping and Controls		Covered at Phase I
Extend Hot Water Supply/ Return Piping to Digester 4			Extend HWS/HWR Piping in the Gallery (FOG & Lystek cases only)	
Extend Hot Water Supply/ Return Piping to FOG Receiving Station	Extend HWS/HWR Piping to the FOG Receiving Station (FOG & Lystek cases only)		Covered at Phase I (FOG and Lystek cases only)	
Harvest Additional Waste Heat for External Heating Demands				Harvest Additional Waste Heat from Cogeneration Engines 5 and 6; Convert Existing Boilers to Biogas; Utilize Waste Heat from New Cogeneration System
Evaluate Potential Waste Heat Utilization Options				Evaluate Thermophilic Digestion, Pasteurization, Direct Heat Drying, Thermal Oxidation, Heat Augmentation for Greenhouse Drying

OPINION OF PROBABLE COSTS, PHASE I

Construction Cost	NCWRP Expansion	FOG Addition	Other
Grit Removal	$0	$0	$0
Thickening Centrifuges	$9,119,000	$0	$0
Digester System	$1,165,000	$4,189,000	$0
Dewatering Centrifuges	$0	$0	$0
Centrate System	$0	$0	$0
Odor Control	$0	$0	$0
Chemical Storage	$0	$0	$0
Evaluation of Utilities	$0	$0	$0
Additional Facilities Siting	$0	$0	$0
Waste Heat Utilization	$0	$73,000	$628,000
Subtotal Construction Cost	$10,284,000	$4,262,000	$628,000
Contingency (40%)	$4,113,600	$1,704,800	$251,200
Subtotal Delivery Costs	$3,787,000	$1,571,000	$230,000
Subtotal Other Costs	$302,000	$125,000	$18,000
Grand Total Without Fog Addition Other Upgrades Included	$18,486,600	$0	$1,127,200
Grand Total With Fog Addition And Other Upgrades Included	$14,896,000	$7,662,800	$1,127,200

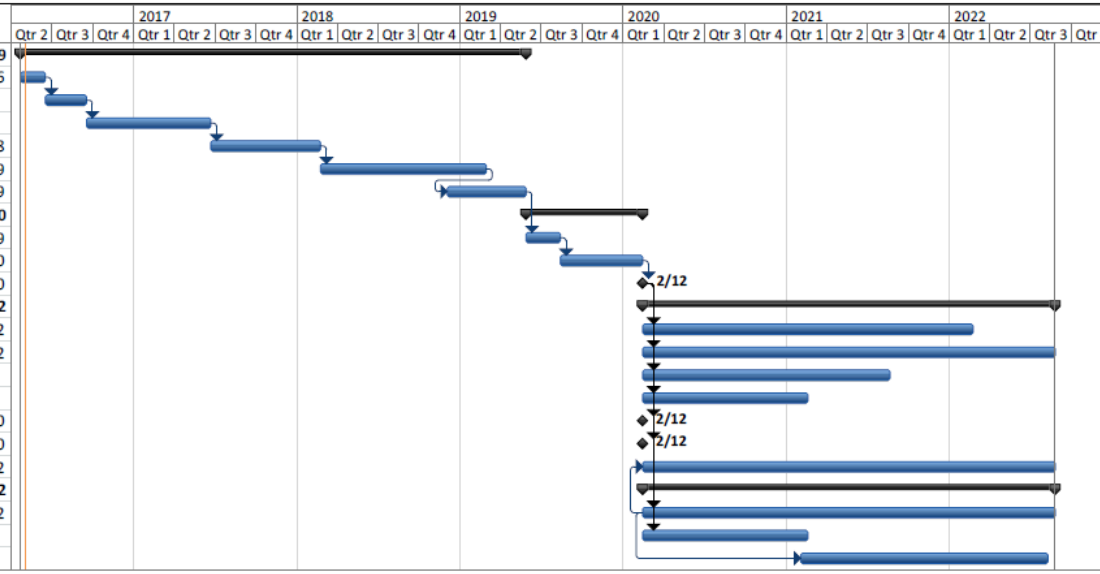
OPINION OF PROBABLE COSTS, PHASE II

Construction Cost	NCWRP Expansion	FOG Addition	Other
Grit Removal	$2,721,000	$0	$0
Thickening Centrifuges	$15,199,000	$0	$0
Digester System	$1,026,000	$14,764,000	$0
Dewatering Centrifuges	$0	$0	$3,337,000
Centrate System	$956,000	$0	$0
Odor Control	$0	$0	$0
Chemical Storage	$0	$0	$0
Evaluation of Utilities	$0	$0	$0
Additional Facilities Siting	$0	$0	$0
Waste Heat Utilization	$0	$73,000	$628,000
Subtotal Construction Cost	$19,902,000	$14,837,000	$3,965,000
Contingency (40%)	$7,960,800	$5,934,800	$1,586,000
Subtotal Delivery Costs	$7,327,000	$5,463,000	$1,461,000
Subtotal Other Costs	$585,000	$436,000	$117,000
Grand Total Without Fog Addition Other Upgrades Included	$35,774,800	$0	$7,128,000
Grand Total With Fog Addition And Other Upgrades Included	$32,184,000	$26,670,800	$7,129,200

CONSTRUCTION SCHEDULE

TO 18 - MBC IMPACTS FROM NCWRP EXPANSION
FIGURE 6.1-1

ID		Task Mode	Task Name	Duration	Start	Finish
1			**Design**	**808 days**	**Thu 4/21/16**	**Mon 5/27/19**
2			Complete PDR(Study)	40 days	Thu 4/21/16	Wed 6/15/16
3			Procure 10% Designer	66 days	Thu 6/16/16	Thu 9/15/16
4			10% Design Development	198 days	Fri 9/16/16	Tue 6/20/17
5			Procure Final Designer	176 days	Wed 6/21/17	Wed 2/21/18
6			Final Design Development	265 days	Thu 2/22/18	Wed 2/27/19
7			Permitting	126 days	Mon 12/3/18	Mon 5/27/19
8			**Construction Bid and Award**	**187 days**	**Tue 5/28/19**	**Wed 2/12/20**
9			Advertise and Bid	55 days	Tue 5/28/19	Mon 8/12/19
10			Award Construction Contract	132 days	Tue 8/13/19	Wed 2/12/20
11			Contractor NTP	0 days	Wed 2/12/20	Wed 2/12/20
12			**Procure/Construct/Commissioning**	**660 days**	**Wed 2/12/20**	**Wed 8/24/22**
13			Grit Removal	528 days	Thu 2/13/20	Mon 2/21/22
14			Thickening Centrifuges	660 days	Thu 2/13/20	Wed 8/24/22
15			Digester Improvements without FOG	396 days	Thu 2/13/20	Thu 8/19/21
16			Centrate System	264 days	Thu 2/13/20	Tue 2/16/21
17			Odor Control (No Improvements)	0 days	Wed 2/12/20	Wed 2/12/20
18			Chemical Systems (No Improvements)	0 days	Wed 2/12/20	Wed 2/12/20
19			Extension of Utilities	660 days	Thu 2/13/20	Wed 8/24/22
20			**FOG Related & Other Improvements**	**660 days**	**Thu 2/13/20**	**Wed 8/24/22**
21			Digester Improvements with FOG	660 days	Thu 2/13/20	Wed 8/24/22
22			Dewatering Centrifuges	264 days	Thu 2/13/20	Tue 2/16/21
23			Waste Heat Utilization	396 days	Mon 2/1/21	Mon 8/8/22



RAW SOLIDS AND CENTRATE CONVEYANCE –CONSIDERATIONS & IMPACTS

- DIGESTER MANAGEMENT SAFEGUARDS
- SOLIDS TRANSMISSION MAINS

DISCUSSION OF CITY REVIEW COMMENTS

NEXT STEPS

- WORKSHOP MINUTES: May 25, 2016
- ADDRESSING CITY'S COMMENTS: June 2, 2016
- FINAL EDITING/PRODUCTION: June 9, 2016
- FINAL TM: June 10, 2016

THANK YOU! QUESTIONS?

Pure Water San Diego

WORKSHOP SUMMARY

Subject: Draft Technical Memorandum Workshop for Evaluation of Impacts of NCWRP Expansion on MBC

Date: Wednesday, May 18, 2016

Time: 1:30 pm to 4:30 pm

Participants: Amer Barhoumi(PUD), Monika Smoczynski(PUD), Dwight Correia(PUD), Neil Tran(PUD), Raymond Ngo(PUD), Christine Waters(MWH), Victor Occiano(BC), Boris Pastushenko(BLP), Tim Cooper(BLP), Anil Pai(BC)

Location: MOC 2, Conference Room 2E

1. Following introduction by Monika, the following handouts were distributed to participants:

- Agenda
- Power Point Presentation Slide printouts
- Site Plan(11x17)
- Schedule(11x17)
- General Recommendations(Excerpt from TM, Section2.2)
- High and Low Flow Biosolids Wasting Scenarios
- PUD Review Comments.

2. Boris, Anil and Tim conducted Power Point presentation outlining the following:

- Projected Flows and Loads

- Projected Impacts on Selected Unit Processes:

    -- Grit Removal System
    -- Raw Solids Thickening
    -- Anaerobic Digestion
    -- Digested Biosolids Dewatering
    -- Centrate System
    -- Odor Control System
    -- Chemical Storage and Handling System
    -- Utilities Extension Needs
    -- Siting Impacts
    -- Waste Heat Utilization

- Opinion of Probable Costs

- Construction Schedule
- Raw Solids and Centrate Conveyance Considerations and Impacts
- High and Low Biosolids Wasting Scenarios from NCWRP and their impacts on equipment sizing and costs.

3. Boris, Tim and Anil have presented PUD's Review Comments and an Action Plan on how to address them. All attendees were engaged in extensive and collaborative discussion of PUD Comments Nos. 2,3, 6, 19, 21, 23, 24, 29, 30, 32, 33, 35, 38, 40, 43, 49, 50, 52-54, 59 and GC Comments Nos. 1-9. The remainder of the comments were agreed to and will be addressed in the Final TM. Project team will provide formal responses to the review comments to reflect specific details discussed at the meeting, and will incorporate the review comments in the Final TM.

Comments from Dwight Correia will be received at a later date, but it has been indicated that the comments discussed at the workshop cover, pretty much the extent of his comments.

4. The following principal decisions have been made and/or directions received by the project team:

- Provide formal responses to PUD review comments as an appendix to the TM.
- Modify Site Plan exhibit (Figure 2.1-1) to show fenceline and site boundary per EIR. Grit Building extension to be shown in this figure as well. Clean up MBC site boundary callouts and leader lines as applicable. Also consider removing section numbers to allow figure to stand alone. Indicate using color which items are PW related and which are FOG or "Other" improvements.
- Modify Project Schedule to incorporate accelerated consultant procurement, permitting and pre-purchase of the centrifuges to arrive on end of 2021 project completion, and include scheduling assumptions needed for expediting the work.
- Define specifically what is related to NCWRP Expansion (Pure Water Program), FOG, and Other Recommended Improvements (oriented on improvements to MBC's reliability and efficiency).
- Define specifically whether some of the items require design efforts or just simple equipment replacement without designing changes to the MBC (if any).
- Delete language referring to 2:1 peaking factors and clarify that short term operational conditions require MBC to run at double its maximum design output.
- Revise "14" PLWTP sludge forcemain to read "12"/14"" PLWTP forcemain
- Consider revisions to install all required teacups in a single phase.
- Comment on suction manifold deletion for thickened sludge pumps.
- MBC digesters will not be used in future for wet weather storage or for NCAWPF off-spec water diversion considering digester capacity limitations at the MBC.
- Indicate that valves for digesters 1 and 2 have already been replaced and that valves for digester 3 are on site and ready for replacement.
- Indicate that the dewatering transfer pumps were replaced with chopper pumps by the plant staff, and that connection of the 4th digester to the suction of the dewatering transfer pumps will be a challenging project.
- Infrequent diversion of biosolids to PLWTP from NCWRP is a safeguard built into the MBC's flow management philosophy that will be maintained by PUD and utilized in case one digester is taken out of service at maximum loading conditions. Future MBC pre-design and final design consultants will be required to evaluate the NCWRP biosolids diversion infrastructure, PLWTP solids reserve capacity and ability to sustain additional soluble BOD loads, and means and methods of conveyance biosolids from

MBC to PLWTP without shorting flows to MPS. One way to do this is to use diversion structures in the Rose Canyon system.

- Follow current project phasing structure (Phase I/Phase II) but remove indication on what timing/duration and/or spread of activities is going to be with understanding that eventually it could be more phases of the project.
- Assess at least strategically what impacts of Padre Dam Municipal Water District program of flows and solids could be and provide an indication of potential increase/decrease of solids/loadings. Rough modeling might be required. Model a 15 mgd (assume product water) scalping plant returning solids to sewer – eventually arrive at Morena Blvd PS.
- Include potential replacement of existing digester recirculation, mixing, axial mixing pumps for all digesters, and heat exchangers for Digesters 1 and 2, as other recommended improvements and include in the cost estimate. Indicate that axial pump replacement (non-propeller pumps) and recirculation and mix pump replacement (chopper pumps) will take place as part of ongoing equipment replacement by maintenance at the end of its useful life and that outside engineering services will not be needed.
- Assessment of the blended sludge and centrate pipelines between NCWRP and MBC, conveyance of digested sludge from PLWTP, and PLWTP and NCWRP solids diversion and retention capacities is not a part of the scope of this project.
- Projected NCWRP impacts on MBC presented in the TM are based on high NCWRP biosolids flow wasting scenario that represents a conservative approach with biosolids flows up to 6.55 mgd at 0.5% TS. The low biosolids flow wasting scenario resulting in capping NCWRP biosolids flow at 3.9 mgd (0.85-1 % TS) due to the blended sludge pipeline restrictions, as proposed under 10% EDR for NCWRP expansion may represent certain costs savings that will not developed to the same level of analysis as the more conservative, high biosolids wasting scenario. The associated cost savings for the low flow biosolids wasting scenario will be presented as a high level, order of magnitude assessment of potential savings as a separate section in the TM.
- Food waste and green waste co-digestion evaluation is not included in the scope of this project.
- Evaluations presented in the subject TM are limited to principal items of equipment and do not include the support or auxiliary facilities , Raw Solids Receiving Tanks, Cake Conveyance, Storage and Loading.
- Agreed as part of the discussion that additional biogas holding tank will not be required.

5. Next Steps:

- Workshop Summary: May 25, 2016
- Addressing City's Comments: June 2, 2016
- Final Editing/Production: June 9, 2016
- Final TM: June 10, 2016.

Appendix G: Comment Log

Pure Water Program **Date:** 5/25/2016

Description: Draft Technical Memorandum-Impacts of NCWRP Expansion on MBC

TM distributed to: Wastewater Treatment & Disposal, Engineering & Program Management, and Pure Water

NO	REFERENCE	CITY COMMENT	REVIEWER	ACTION	RESPONSES TO CITY COMMENTS
1	General	The TM should include a discussion on other future projects at MBC including alternatives to Lystek (other technologies to create class A fertilizer) and the cogeneration expansion.	K. Balo	Noted. No action.	Included in other Documents(refer to TM Ref 19). Will be analyzed soon under upcoming update by BC.
2	General	Would any of the outlined improvements be in conflict with future improvements and expansions of MBC including cogeneration?	K. Balo	Noted. No action	No conflicts known with future improvements. Potential future biosolids drying, thermopohilic digestion, or cogeneration projects should analyze potential for conflicts.
3	General	Following a determination on what improvements are necessary to support the NCWRP Expansion, environmental staff at the City need a list and description. This scope will need to be included in the overall North City Project EIR/EIS. Details will be needed to perform an environmental analysis of the additional project components at MBC. A PDSS is requested for this project.	K. Balo	Noted. No action.	Will be done under 10% design effort. Proper scoping and funding should be allocated.
4	General	Heat exchangers for digester #1 and #2 are in need of replacement	Richard Pitchford	Noted. Will be included in other recommended improvements.	
5	General	In the report, "Program" is referenced. Is this referring to the Pure Water Program? If so, please clarify in table of abbreviations or within report.	Raymond Ngo	Noted. “Program” will be replaced with “Pure Water”	“Pure Water” is listed in the abbreviations as the “Pure Water San Diego Program”
6	Page 10	How will TM-4 findings change if assumptions are low? Exclusion of Morena and CEPT are significant.	Jesse Pagliaro	Noted. No action.	TM-4 is not being updated at this time. If the assumed removal efficiencies with CEPT are low, the

Pure Water Program **Date:** 5/25/2016

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NO	REFERENCE	CITY COMMENT	REVIEWER	ACTION	RESPONSES TO CITY COMMENTS
					only mechanism for addressing this question in this TM is the safety factor in the sizing of the unit process equipment. The projected loadings using average removals with CEPT should be assessed as part of the 10% pre-design effort.
7	Page 10, Section 2.1.1.3, 5th row	Change to: large units because (a) this approach avoids increasing the size of the building and other supporting systems; and (b) newer centrifuges are significantly more energy efficient than their existing counterparts.	Raymond Ngo	Revised as noted.	
8	Page 13, Section 2.1.1.4	<u>2rd paragraph</u> 2nd Row: Insert space between PLWTP and but 3rd Row: Change emission rate to MER for consistency. <u>3rd paragraph</u> 2nd row: add period between condition and it. <u>4th paragraph</u> 1st row: change required to requires. 3rd row: change to "existing biogas with 3 new blowers; (3) increase the size of the biogas feed line from the blowers to the cogeneration facility; and (4) install an additional biogas flare."	Raymond Ngo	Noted. Will be reflected, as pointed.	
9	Page 11: Figure 2.1-1	Are all of the proposed/recommended improvements located within the footprint of the facility? The MBC Site facility boundary is very	K. Balo	Noted. Will be reflected, as pointed.	

Pure Water Program **Date:** 5/25/2016

Description: Draft Technical Memorandum-Impacts of NCWRP Expansion on MBC

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NO	REFERENCE	CITY COMMENT	REVIEWER	ACTION	RESPONSES TO CITY COMMENTS
		hard to see on the figure and blends in with topo lines.			
10	Page 13	Any number of issues can influence plant performance. Consideration of PLWTP as receiver of additional waste streams may pose issues due to vulnerabilities associated with highly solubilized BOD.	Jesse Pagliaro	Noted. No action.	This will need to be further evaluated by pre-design and design consultants.
11	Page 13, 1st sentence	Change condition to conditions.	Raymond Ngo	Noted. Will be corrected.	
12	Page 13, Section 2.1.1.4	<u>2rd paragraph</u> 2nd Row: Insert space between PLWTP and but 3rd Row: Change emission rate to MER for consistency. <u>3rd paragraph</u> 2nd row: add period between condition and it. <u>4th paragraph</u> 1st row: change required to requires. 3rd row: change to "existing biogas with 3 new blowers; (3) increase the size of the biogas feed line from the blowers to the cogeneration facility; and (4) install an additional biogas flare."	Raymond Ngo	Noted. Will be corrected.	
13	Page 14	2nd Row: The last sentence was cut off.	Raymond Ngo	Noted. Will be corrected.	
14	Page 14, 2.1.1.6	2nd paragraph, 2nd row: change to "available and the other three"	Raymond Ngo	Noted. Will be corrected.	
15	Page 15	2nd row: change 2.1.1.12 to 2.1.1.11	Raymond Ngo	Noted. Will be corrected.	

Description: Draft Technical Memorandum-Impacts of NCWRP Expansion on MBC

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NO	REFERENCE	CITY COMMENT	REVIEWER	ACTION	RESPONSES TO CITY COMMENTS
16	Page 15-19	Update all tables to ensure that all X's are lined up with the respective bullet points and that each bullet point has its corresponding X.	Raymond Ngo	Noted. Will be corrected.	
17	Page 17	Recommend consideration of other waste streams (food waste, etc.).	Jesse Pagliaro	Noted. No action.	Other waste streams utilization will be evaluated under a separate project. See assumptions and clarifications.
18	Page 17	5th row: change to "a design consultant."	Raymond Ngo	Noted. Will be corrected.	
19	Page 20	Bypass to PLWTP is potentially problematic; recommend consideration of 4th digester at MBC	Jesse Pagliaro	Noted. 4th digester is recommended for Phase II conditions with FOG.	Infrequent diversion of biosolids to PLWTP from NCWRP is a safeguard built in the MBC's flow management philosophy that will be maintained by PUD and utilized in case one digester us taken out of service at maximum loading conditions. Future MBC pre-design and final design consultants will be required to evaluate the NCWRP biosolids diversion infrastructure, PLWTP solids reserve capacity and ability to sustain additional soluble BOD loads, and means and methods of conveyance biosolids from MBC to PLWTP without shorting flows to MPS.
20	Page 20	for 2nd bullet point, change "must address should include" to either "must address" or "should		Noted. Will be corrected.	Could not locate "f" on Page 20. Removed the "of" from the 5th line

Description: Draft Technical Memorandum-Impacts of NCWRP Expansion on MBC

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NO	REFERENCE	CITY COMMENT	REVIEWER	ACTION	RESPONSES TO CITY COMMENTS
		include" 3rd paragraph 5th row: remove the "f"			of the second bullet item.
21	Page 21	Bypass to PLWTP needs to be further evaluated; assumptions that include potential for discharge of solubilized material need to be considered.	Jesse Pagliaro	Noted.	Refer to Response to Comment No.19
22	Page 21	1st row: remove colon and add the following ", which results in the following:"		Noted. Will be corrected.	1st row to be revised per Dwight's comments. 6th row revised as noted
23	Page 22: 20 inch centrate line restoration	The TM concludes that restoration of the 20 inch centrate line would be required. Is any additional information available on how this may be done and what the scope of the work may include?	K. Balo	Noted. No action.	Analysis of the centrate pipeline and potential methods of restoration is done under a separate project.
24	Page 25: padre dam reclamation	The report mentions that Padre dam may increase water reclamation. Padre Dam's current plan (available on their webpage) indicates as expanded reclamation facility would not operate in scalping mode and would reduce the solids/waste stream currently discharged into the metro system. They would handle their own biosolids. How does the planning study address Padre Dam's project or would their project have any measurable effect on biosolids processing at MBC?	K. Balo	Noted. Will be strategically analyzed.	Project team will provide an order of magnitude assessment of impacts of PDMWD program of flows and solids, and provide an indication of potential increase/decrease of solids/loadings.
25	Page 3	Paragraph 1: There is a significant effort to offload organics (food waste, etc.) from landfill (AB1826); may be advisable to evaluate potential impacts of other waste streams.	Jesse Pagliaro	Noted. No action.	Food waste and green waste co-digestion evaluation is not included in the scope of this project. See Section 7.10 – See Assumptions and Clarifications.

Pure Water Program **Date:** 5/25/2016

Description: Draft Technical Memorandum-Impacts of NCWRP Expansion on MBC

TM distributed to: Wastewater Treatment & Disposal, Engineering & Program Management, and Pure Water

NO	REFERENCE	CITY COMMENT	REVIEWER	ACTION	RESPONSES TO CITY COMMENTS
26	Page 35	First paragraph under 4.1.1.1.1 states pumps capable of being operated at two speeds. These pumps are on VFD.	Richard Pitchford	Noted. Will be corrected.	
27	Page 35	Second paragraph under 4.1.1.1.1 Should be receiving tank not gank	Richard Pitchford	Noted. Will be corrected.	
28	Page 36	Second paragraph under 4.1.1.2 states two units out of service for maintenance. Unit #3 needs to be completely refurbished	Richard Pitchford	Noted. Will be corrected.	
29	Page 38	Are there any other options then teacups	Richard Pitchford	Noted. No action.	Only teacups were evaluated per City direction. Other systems deemed cost-prohibitive.
30	Page 4	Need to evaluate discharge to PLWTP; consider 4th digester for all potential additional waste streams	Jesse Pagliaro	Noted. No Action.	Refer to Response to Comment No.19.
31	Page 42	Second paragraph 4 sentence starts off "the lag" should be the lead	Richard Pitchford	Noted. Will be corrected.	
32	Page 42	Whole 5 paragraph needs to be redone. Why does this talk about dewatering when it should be thickening and the whole assumption is wrong as written.	Richard Pitchford	Paragraph deleted. See Section 7.	There is no current operating experience with running multiple thickening centrifuges at MBC. The City only runs one. But there is operating experience with multiple dewatering centrifuges. Hence the reference to dewatering centrifuges. The team is extrapolating from the one system how the City might run multiple units of the other system. This paragraph has been deleted and expanded upon in Section 7 – Assumptions and Clarifications.

Pure Water Program **Date:** 5/25/2016

Description: Draft Technical Memorandum-Impacts of NCWRP Expansion on MBC

TM distributed to: Wastewater Treatment & Disposal, Engineering & Program Management, and Pure Water

NO	REFERENCE	CITY COMMENT	REVIEWER	ACTION	RESPONSES TO CITY COMMENTS
33	Page 43	Recommend evaluation of completely offloading discharge to PLWTP; evaluation of discharge of all waste streams from NCWRP and AWPF to MBC	Jesse Pagliaro	Noted. No Action.	Refer to Response to Comment No.19.
34	Page 43	Second paragraph should say "day tank" not mix tank	Richard Pitchford	Noted. Will be corrected.	
35	Page 51	4.3.1.1.1 States normal operating level of 45 ft. This is not what appears on DCS, does this include the cone? Needs to be clarified as most people looking at this would assume we operate at 35 ft	Richard Pitchford	Noted. Will be clarified in the text.	Current operating level is 45' above top of cone. Level reading although shows 35' because the level sensor is installed 10' above top of cone.
36	Page 53	4.3.1.2 New isolation valve have been installed on Digester #1 and #2. Valve are on site for #3 awaiting digester cleaning to install.	Richard Pitchford	Noted. Will be clarified in the text.	
37	Page 56	If 4th digester is built, scenario cited in last paragraph is no longer an issue.	Jesse Pagliaro	Noted. Will be clarified in the text.	
38	Page 64	Was PLWTP Staff involved in assessment? Re last paragraph.	Jesse Pagliaro	Noted. No action.	Refer to Response to Comment No.19.
39	Page 67	Concur with additional digester.	Jesse Pagliaro	Noted. No action.	
40	Page 72	Add chopper pumps at time of upgrade – Phase I	Jesse Pagliaro	Noted. Will be included in other recommended improvements.	
41	Page 73	Change 4th paragraph to feet instead of elevation. 9 to 11	Richard Pitchford	Revised as noted.	One of the common problems in working with depth readings is that the EOI (Elevation Of Instrument) is not documented in the As-Built Drawings. There is no way for the

Description: Draft Technical Memorandum-Impacts of NCWRP Expansion on MBC

TM distributed to: Wastewater Treatment & Disposal, Engineering & Program Management, and Pure Water

NO	REFERENCE	CITY COMMENT	REVIEWER	ACTION	RESPONSES TO CITY COMMENTS
					Team to correlate the depth reading seen at the HMI to an elevation on the Contract Drawings. The EOI has been noted in this case so that the reader can relate the levels displayed at the HMI to the elevations on the drawings.
42	Page 76	Concur with recommendation in 4.4.2.2	Jesse Pagliaro	Noted. No action.	
43	Page 78	What is the status of the evaluation of onsite centrate treatment?	Jesse Pagliaro	Noted. No action.	Evaluation of on-site treatment options was done under a separate project. It is our understanding that it has been decided by the City to proceed with centrate disposal versus on-site treatment with potential discharge of the centrate through the brine line.
44	Page 82	Improvements outlined in 4.5.2.2 should occur.	Jesse Pagliaro	Noted. No action.	
45	Page 88	4.7.1 third paragraph 4th line should be “day tank” not mix tank also 4.7.1.1 first line should be “day tank” not mix tank	Richard Pitchford	Noted. Will be corrected.	
46	Page 105	Concur with recommendations outlined in 4.10.3.2	Jesse Pagliaro	Noted. No action.	
47	Page 107	Pursue recommendations outlined in Strategy 3	Jesse Pagliaro	Noted. No action.	
48	Page 110	May need to consider other waste flows that will be generated as a result of AB1826 implementation	Jesse Pagliaro	Noted. No action.	Refer to Response to Comment No.25

Pure Water Program **Date:** 5/25/2016

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NO	REFERENCE	CITY COMMENT	REVIEWER	ACTION	RESPONSES TO CITY COMMENTS
49	Pg 9, Section 2.1.1	Suggest deleting sentence referring to 4-year separation between Phase I and II.	Christine Waters	Noted. Will be corrected per discussion at the project workshop.	
50	Page 3, 2nd paragraph	Does existing 16" blended sludge line from NCWRP to MBC have capacity for the increased flows? If not, should WRP Upgrades scope be changed to require RAS surface wasting and not allow option of mixed liquor wasting?	Christine Waters	Noted.	As agreed, projected NCWRP impacts on MBC presented in the TM are based on high NCWRP biosolids wasting scenario that represents a conservative approach with biosolids flows up to 6.55 mgd at 0.5% TS. The low biosolids flow wasting scenario resulting in capping NCWRP biosolids flow at 3.9 mgd(0.85-1 % TS) due to the blended sludge pipeline restrictions, as proposed under 10% EDR for NCWRP expansion may represent

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NO	REFERENCE	CITY COMMENT	REVIEWER	ACTION	RESPONSES TO CITY COMMENTS
					certain costs savings that will not be developed to the same level of analysis as the more conservative, high biosolids wasting scenario. The associated cost savings for the low flow biosolids wasting scenario will be presented as a high level, order of magnitude assessment of potential savings as a separate section in the TM.
51	Page 11 Figure 2.1-1	Please show MBC site boundary.	Christine Waters	Noted. Will be provided.	
52	Page 17 Section 2.1.1.13	Are there options to complete MBC Improvements before end of 2021 for startup of NC Pure Water facilities?	Christine Waters	Noted. Corrections will be made.	As agreed at the project workshop, the Project Schedule will be modified to incorporate accelerated consultant procurement, permitting and sole-source procurement and pre-purchase of the centrifuges to arrive on end of 2021 project completion.
53	Page 22 1st paragraph	Does the jumper/crossover piping identified in footnote 3 allow centrate be pumped back to NCWRP (and overflow diversion to PLWTP) via the raw sludge pipeline to avoid shutdown of MBC if the centrate pipeline is out of service (avoiding the last two bulleted items listed)?	Christine Waters	Noted. No action.	The subject arrangement is for a temporary operation that would not be possible to maintain when Pure water Program will go on-line.
54	Page 98 Section 4.10.1.1.2	Will proposed upgrades increase the power demand at MBC above the 6.4 MW existing from Fortistar?	Christine Waters	Noted. No action.	Existing demand is 2-2.5 MW of the existing 6.4 MW FortiStar generating capacity and the remainder is supplied to SDG&E. Potential increase in

Pure Water Program **Date:** 5/25/2016

Description: Draft Technical Memorandum-Impacts of NCWRP Expansion on MBC

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NO	REFERENCE	CITY COMMENT	REVIEWER	ACTION	RESPONSES TO CITY COMMENTS
					electrical demands associated with proposed improvements will not exceed the current generating capacity.
55	Section 5 Pg 112	$7.011,000 Subtotal for Delivery Costs for Other Projects appears to by a typo. Should Subtotal Delivery Costs be $1,461,000? ($7.128M Total appears correct)	Christine Waters	Noted. Will be corrected.	
56	Pg. 42, second paragraph, first sentence	Under the current operational strategy, three existing progressing cavity pumps are able to take suction from the thickened solids wetwell and pump thickened raw sludge directly to the anaerobic digesters. Are the existing biosolids screens and the blending tanks being bypassed? Is it worth noting that the operational strategy of the biosolids screens and the blending tanks has been revised?	Monika Smoczynski	Noted. Will be referenced in the text.	
57	Pg. 59	Does the common overflow pipeline from the three digesters to the digested biosolids storage tanks have sufficient capacity?	Monika Smoczynski	Will be noted in the text.	
58	Pg. 59	Will the additional gas flare tie into the emergency power supply?	Monika Smoczynski	Will be noted in the text.	
59	Section 5-Schedule	The schedule which has presented for the improvements at MBC must be revised to align with the completion of the NCWRP Expansion project in 2021. Are there any opportunities to accelerate the schedule to complete the necessary improvements at MBC by 2021?	Monika Smoczynski	Noted. Will be revised.	Refer to response to Comment No.52.
60	GC-1	The report talks about Phase I and Phase II projects that split the 30 mgd Pure Water flow at North City	GC	Noted. No action.	As discussed at the project workshop, current project phasing structure(Phase

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NO	REFERENCE	CITY COMMENT	REVIEWER	ACTION	RESPONSES TO CITY COMMENTS
		into Phase I of 15 mgd and Phase 2 of the other 15 mgd. This is confusing because the Pure Water Program goals are Phase I at 30 mgd (by 2021) and Phase II and additional 53 mgd for a combined 83 mgd (by 2035).			I/Phase II) will be maintained by PUD with understanding that eventually it could be more phases of the project.
61	GC-2	There should be discussion about increase sludge production from the central area facility when brought on line in 2035 (additional 53 MGD) and just say not addressed here.	GC	Noted. No action.	The central area sludge generation is outside of the scope of this project.
62	GC-3	There is discussion about co digestion with FOG, but nothing about co-digestion with Food Waste. Food Waste should be mentioned as potential feed stock in the future.	GC	Noted. No action.	Refer to response to Comment No. 25
63	GC-4	Are the peak loadings and flows that occur one every five years, are these due to digester cleaning at Point Loma? If so, can this be explicitly stated?	GC	Noted. Will clarify in the text.	The peak loading referenced are related to construction and maintenance activities.
64	GC-5	I understand that one out of the three digesters is dedicated to wet-weather storage. This fact should be stated or discussed. The digester capacity could be freed up if the wet weather discharge project were allowed to move forward. There is discussion that wet weather storage discharge will not be needed once Pure Water goes online, however, it is nice to build flexibility into the system. We never know when a plant or process will go down or if off-spec water will need to be discharged.	GC	Noted. No action.	As directed by the City, MBC digesters will not be used in future for wet weather storage or for NCAWPF off-spec water diversion considering digester capacity limitations at the MBC.
65	GC-6 Section 2.1.1.4	First paragraph states that if one digester is out of service, a portion of the solids generated at NCWRP can be bypassed to PLWTP. How will this be accomplished, via the brine line that	GC	Will be noted in the text in general	Infrequent diversion of biosolids to PLWTP from NCWRP is a safeguard built in the MBC's flow management philosophy that will be maintained by

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NO	REFERENCE	CITY COMMENT	REVIEWER	ACTION	RESPONSES TO CITY COMMENTS
		discharge downstream of the proposed Morena Blvd. Sewer Pump Station?		terms.	PUD and utilized in case one digester us taken out of service at maximum loading conditions. Future MBC pre-design and final design consultants will be required to evaluate the NCWRP biosolids diversion infrastructure, PLWTP solids reserve capacity and ability to sustain additional soluble BOD loads, and means and methods of conveyance biosolids from MBC to PLWTP without shorting flows to MPS. Potentially this could be accomplished either via existing 54" Rose Canyon sewer, JB 1, 42" sewer down to 45" interceptor with diversion to 60" sewer leading to a 60" interceptor straight to North Metro Interceptor bypassing the MBS, or via pumping flow through the brine line.
66	GC-7 Sxn 2.1.1.13	A start-up date of November 2022 is given. This is after the Pure Water Program target date of 2021.	GC	Noted. Will be revised.	Refer to Response to Comment No. 52
67	GC-8	The 20-in centrate line has been identified as the weak link in the system. A recent condition assessment has demonstrated this line needs cleaning. If this line were to go down, the whole system would be brought down. Should a second centrate line be installed for redundancy?	GC	Noted. No action.	Analysis of the centrate pipeline and potential methods of restoration is done under a separate project.
68	GC-9	An impact that was not fully discussed is the impact of the centrate. Currently the centrate is	GC	Noted. No action.	Refer to Response to Comments No.43 and No.67

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		discharged and goes to Point Loma. If centrate is discharged in the sanitary sewer, it will end up at Morena Boulevard and be pumped back to North City. There was some discussion about discharging the centrate to the brine line that discharges downstream of the proposed MBPS or constructing a centrate treatment process. This report is about impacts of NC on MBC, but the concepts need to be coordinated and integrated as they tend to impact one another.			
69	Page 38 Section 4.1.2.2	Replacement of the 3 raw solids feed pumps should include VFD's and should not be two speed like the existing pumps. This would allow for better control of the teacup and TC feed loop.	Dwight Correia	Per Comment 26, pumps are already on VFDs	Text in Section 4.1.2.2 has been corrected.
70	Table 4.1-3 and 4.1-4	New grit separators have a different capacity compared to the existing units. Is this intentional?	Dwight Correia	Will be corrected.	Incorrect capacity was entered. Will correct to 1042 gpm.
71	Page 42 5th paragraph	I agree with Richard Pitchford's comment that this whole paragraph is incorrect	Dwight Correia	See Response to Comment 32.	
72	Page 50 Section 4.2.3.2	1. Consider including a discussion on the need for mixing in the wetwell 2. Will the digester feed pump suction header need to be upgraded in size or will the operating level in the wetwell need to be raised? If the operating level is raised, will there be sufficient operating volume in the wetwell? 3rd paragraph states that 3 of the 4 digester feed pumps will deliver 650 gpm. Past experience	Dwight Correia	1. Noted. See revised paragraph 2. Noted. See revised Paragraph 3. Noted	1&2. Items 1 and 2 to be evaluated in detail by the pre-design consultant for the 10% design. 3. Capacity of the overflow pipes should be analyzed in detail by pre-design consultant. It seems that with the modification to the emergency overflow weir made by the plant staff,

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		indicates that the 650 gpm may be in excess of the capacity of the digester overflow pipes to the biosolids storage tanks when the levels in the biosolids storage tanks are high. Please confirm the capacity in the digester overflow pipes to the biosolids storage tanks.			two 6-inch lines(normal overflow and emergency overflow) are available now for conveyance of overflow from each digester via two 10-inch lines.
73	Page 52 Footnote #15 Second sentence	Problems with plugging heat exchangers was only one of many problems that prompted bypassing the screens and the blending tanks. FYI, other problems included: • Unreliable operations of the screens due to the non-continuous flow from the thickened solids wetwell • Unbalanced mixing flows in the blending tanks that resulted in all of the sludge being transferred to one blending tank only • Undersized original digester feed pumps that tripped offline frequently (pumps were sized for static head only; no pipeline head loses were included in hydraulic calculations) • No check valve or reliable motorized valve to prevent high backflows from the digesters when the pumps tripped offline. High backflows to the low elevation blending tanks overwhelmed the small blending tanks overflow pipes causing spills from the blending tanks which are located at the low point of the plant and adjacent to storm drain inlets	Dwight Correia	Noted. Will be referenced in the text.	

Pure Water Program **Date:** 5/25/2016

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NO	REFERENCE	CITY COMMENT	REVIEWER	ACTION	RESPONSES TO CITY COMMENTS
74	Page 52 Footnote #16 Second sentence	1. 1st line, the statement "…could be transferred between the digesters…" should read "…could be transferred to the digesters…" 2. 3rd line, 3rd sentence describes the original dewatering transfer pumps which were replaced 10 years ago with higher capacity, constant speed, chopper pumps	Dwight Correia	1.Noted. Will be corrected. 2. Noted. Will be referenced.	
75	Page 56 and several other locations	Typical comment. All of the valves on Digesters 1 & 2 have already been replaced so that their axial mix pumps can be isolated and repaired when necessary. When digester #3 is taken out of service all of its valves will be replaced so that in the future the axial mix pumps can be isolated and repaired when needed.	Dwight Correia	Noted. Will be referenced in the text.	
76	Table 4.3-2	Statement is made regarding stress testing a digester. How is this accomplished? Where will the solids come from?	Dwight Correia	Noted. Will be explained, in principle.	The pre-design consultant should be required to develop a stress test protocol and conduct a test that should include holding a portion of biosolids load within the NCWRP and in the Raw Solids Tanks to develop an inventory necessary for the stress test. Pre-design consultant, should be required to evaluate whether digester stress test is possible to accomplish until multiple digesters are in service.
77	Table 4.3-2, Biogas production parameter and other following	Typical comment. The comment states that the "system is adequate for Phase I and Phase II loads. Digester biogas laterals need to be upsized." When do the laterals need to be upsized? The buried header may be adequate but the system is	Dwight Correia	Noted. Will be further elaborated in the text.	The laterals will need to be upsized at Phase I loads.

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	parameters	not adequate if the laterals need to be upgraded. Please re-word to clarify intent.			
78	Table 4.3-2 Detention time parameter	Test does not fit in the Comments box. Please increase row height.	Dwight Correia	Noted. Will be corrected.	
79	Page 58, 4th paragraph, 6th line	The sentence that starts "However, the energy used will be….." makes no sense. Please re-word to clarify intent.	Dwight Correia	Noted. Will be reworded.	
80	Page 59, Top paragraph	The statement that MBC could receive peak flows and loadings that are twice those under average conditions is incorrect. It may be more correct to state that MBC occasionally has the need to process stored flows at twice the average design flows. Consider changing the wording.	Dwight Correia	Noted. Will be reworded.	
81	Table 4.3-6	Typical. 1. The comments column needs to be reformatted so that it is readable and understandable. 2. Comments box sizes need to be increased 3. Statements in the comments box need to be separated so that it is obvious to what sub-parameter they pertain. 4. In several locations the statement ".. slightly exceeds borderline" is made. What does this mean? First comment for the "Biogas Production" parameter states "SYSTEM IS INADEQUATE FOR PHASE I LOADS AND BORDERLINE FOR PHASE II LOADS" Should the work "inadequate" be changed to "adequate"?	Dwight Correia	1-3. Noted. Will be corrected. 4. Noted. Will be clarified. 5. Noted. Will be assessed and corrected.	In general, "slightly exceeds borderline" means that if a parameter or criterion reaches or slightly(within 1-5%) exceeds target firm capacity or recognized criterion, it is understood as reaching or exceeding a limit(or borderline) of the capacity at which it is still seems to be functional but with an apparent risk of not meeting the capacity or criterion.

Pure Water Program **Date:** 5/25/2016

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NO	REFERENCE	CITY COMMENT	REVIEWER	ACTION	RESPONSES TO CITY COMMENTS
82	Page 67 Section 4.3.3.2	For the new digester, please include digester transfer equipment or a connection to the existing digester transfer pumps.	Dwight Correia	Noted. Will be referenced.	
83	Page 72 2nd bullet	Future cogeneration will be by a 2nd cogenerator. The will require a new parallel header with new dedicated compressors. Please delete the option of increasing the size of the biogas line.	Dwight Correia	Noted. This will be reworded and clarified.	In fact, the cost take offs included construction of a new header to the cogeneration facility. It is understood that if a new cogeneration facility is constructed, this header will need to be constructed to bring gas to the new facility/not old cogeneration facility.
84	Page 74 Footnote #24	Where did this information come from? I am not familiar with the information.	Dwight Correia	A reference will be added to the text.	The information comes from an examination of Seepex pump curves. For a given unit and horsepower, the set of curves shows the influence of pressure on flow at a given speed. Whether the change in pressure is inlet or discharge pressure, the correlation remains the same. It is easier to visualize flow versus pressure compared to speed versus pressure at a given flow.
85	Page 79 Section 4.5.1.1.3	• The pressure sustaining station has been physically bypassed. • The air release valves located at the pipeline high point have been upgraded. The pressure monitoring station is no longer used or maintained.	Dwight Correia	Noted, text will be updated.	
86	Page 79 Section 4.5.1.2	Please include statements that the pipeline condition is being assessed under the condition assessment program which has conducted hydraulic	Dwight Correia	Noted, will update text.	

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		testing already.			
87	Section 3 All versions of Figure 3.1	The blending tanks cannot be used as they have been physically bypassed. They should be deleted from the process flow diagram.	Dwight Correia	Noted. Will be deleted.	
88	Page 31	1. The last 2 sentences on this page do not make sense to me. Please clarify the intended meaning. 1st paragraph, 4th line. Delete sentence that begins with "Struvite is much more…" It is a repeat of the information in the prior sentences.	Dwight Correia	Noted, will update.	1. Intent was to indicate that flow from PLWTP was not a large impact to dewatering processes. Agreed. Sentence will be deleted.

Attachment 6

Agreement with CH2M Hill Engineers, Inc. for Design Engineering Services for No. City MBC Improvements

METRO JPA/TAC Staff Report Date: 3/15/2017		
Project Title: Pure Water-Agreement with CH2M Hill Engineers, Inc. for Design Engineering Services for the North City Metropolitan Biosolids Center (MBC) Improvements (H176825)		
Requested Action: Approve design engineering services agreement between the City of San Diego and CH2M Hill Engineers, Inc. for the North City Metropolitan Biosolids Center (MBC) Improvements and forward item to Metro JPA/ Metro Commission for approval.		
Recommendations: Approve the contract request		
	Metro TAC:	Forward the subject item to Metro JPA/ Metro Commission for approval.
	IROC:	N/A
	Prior Actions: (Committee/Commission, Date, Result)	None
Fiscal Impact:		
	Is this projected budgeted? Yes _X_ No ____	
	Cost breakdown between Metro & Muni:	It is estimated that the funding will be allocated as follows: Wastewater: Metro: 100%, Muni: 0% Pure Water Improvements: $4,451,090 Non-Pure Water Improvements: $600,000 The total contract amount is $5,051,090.
	Fiscal impact to the Metro JPA:	33.5% of Metro cost (approximately $1,700,000 million)
Capital Improvement Program:		
	New Project? Yes _X_ No ___ N/A ___	
	Existing Project? Yes ___ No _X_ Upgrade/addition ___ Change ___	
Previous TAC/JPA Action: None		
Additional/Future Action: Present the proposed agreement to Metro JPA/ Metro Commission on April 6, 2017 prior to City Council approval.		
City Council Action: City Council approval of the proposed agreement is anticipated on May 16, 2017.		
Background: Please view discussion below.		

Discussion:
Pure Water Program implementation includes design and construction of new treatment and conveyance facilities. To ensure quality design and construction of future Pure Water facilities, the Public Utilities Department has elected to obtain professional engineering and technical services for completing the design work.

One of the projects that is being proposed under the Pure Water Program is the improvements to the existing Metropolitan Biosolids Center (MBC) which is the City's regional solids processing facility that receives biosolids from the Point Loma Wastewater Treatment Plant and from the North City Water Reclamation Plant (NCWRP). As part of the Pure Water Program implementation, the NCWRP will be expanded to increase its treatment capacity to 52 mgd. Due to the expansion of NCWRP, the MBC will receive higher biosolids flows than it is currently receiving. Therefore, to accommodate the additional flows, equipment improvement and upgrade at MBC will be necessary. The table below summarizes the major scope elements for the necessary equipment improvements at the MBC. The table also includes other recommended improvements that are not driven by the Pure Water Program.

Unit Process	Description of Improvements (Pure Water Related)	Other Recommended Improvements (Non Pure Water)
Grit Removal	▪ Install two grit separators for a total of five ▪ Expand Area 76 Building, if required, to accommodate expanded grit system ▪ Other related equipment: raw solids feed pumps, VFD's, grit dewatering units and screw conveyors	
Biosolids Thickening	▪ Install six new larger centrifuges to replace the existing ▪ Other related equipment: digester feed pumps, thickening centrifuge feed pumps, and polymer feed pumps	
Anaerobic Digestion	▪ Construct new biogas laterals and upgrade digester gas-handling equipment ▪ Install one new flare for a total of three	▪ Replace recirculation pumps, mixing pumps, and axial mixing pumps
Sludge Dewatering	▪ None	▪ Install eight new sludge feed pumps and polymer feed pumps
Centrate Pump Station	▪ Install three new 250-hp centrate pumps	
Note: The table does not include other miscellaneous equipment (ex. pumps, valves, PRV's, flame arrestors, etc.) which will be installed as part of the MBC improvements project.		

In September 2016, the Public Utilities Department requested proposals from qualified firms for the Design of the North City Metropolitan Biosolids Center (MBC) Improvements contract. In October 2016, a total of three (3) firms submitted proposals pursuant to the Request for Proposals. Subsequently, the Selection Panel (which included one member from the Metro TAC) evaluated all the proposals and determined that all three (3) firms were highly qualified to participate in the interview process. In November 2016, the Selection Panel interviewed all the firms. Based on the selection rating criteria, CH2M Hill Engineers, Inc. was selected as the most qualified firm.

The proposed engineering services for the design of the North City MBC Improvements agreement with CH2M Hill Engineers, Inc. has a total not to exceed amount of $5,051,090 for a duration of five (5) years effective from the date of City Council's approval.

Project Schedule: The table below presents the anticipated schedule.

Activity	Date
Metro JPA/ Metro Commission	4/6/2017
Environment Committee	4/13/2017
City Council Approval	5/16/2017
Issue Notice to Proceed	6/20/2017

Bid Results: *If bidding was done provide bidding format and results*
Not applicable.

Public Utilities Department
Pure Water Division

Agreement with CH2M Hill Engineers, Inc. for Design Engineering Services for the North City Metropolitan Biosolids Center (MBC) Improvements Project

Presentation to Metro Technical Advisory Committee

Amy Dorman, Program Manager
Monika Smoczynski, Associate Engineer

March 15, 2017

The City of SAN DIEGO

Project Objective/ Purpose

- Component of North City Phase - Pure Water
- NCWRP will undergo an expansion to process additional wastewater flows
- MBC will experience higher biosolids flows
- To accommodate additional flows, upgrades and improvements at MBC will be required
- Project scope includes other recommended improvements not driven by the Pure Water Program

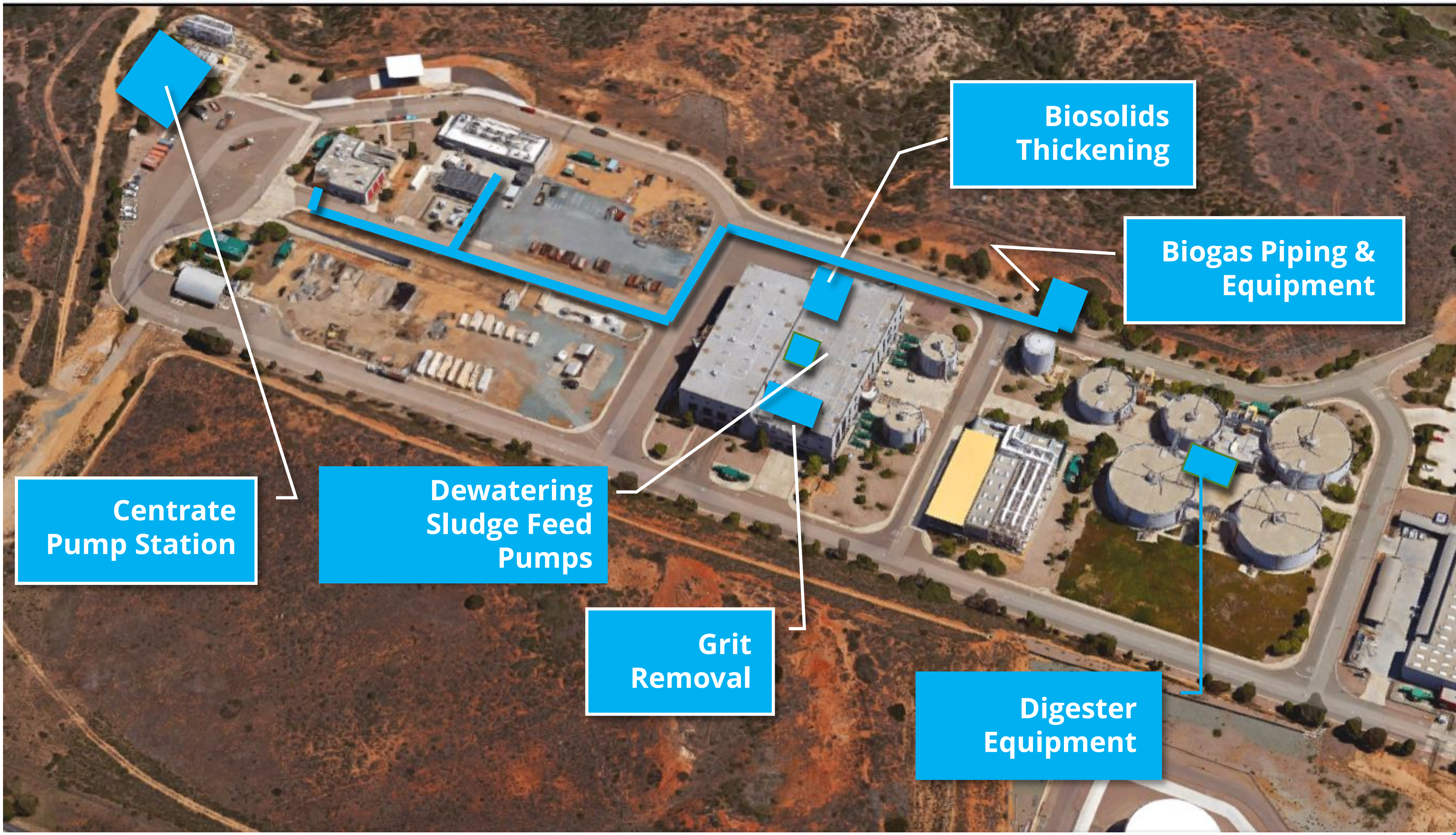
Project Scope

Unit Process	Description of Improvements (Pure Water Related)	Other Recommended Improvements (Other facility Improvements)
Grit Removal	▪ Install two grit separators for a total of five ▪ Expand Area 76 Building, if required, to accommodate expanded grit system ▪ Other related equipment: raw solids feed pumps, VFD's, grit dewatering units and screw conveyors	
Biosolids Thickening	▪ Install six new larger centrifuges to replace the existing ▪ Other related equipment: digester feed pumps, thickening centrifuge feed pumps, and polymer feed pumps	
Anaerobic Digestion	▪ Construct new biogas laterals and upgrade digester gas-handling equipment ▪ Install one new flare for a total of three	▪ Replace recirculation pumps, mixing pumps, and axial mixing pumps
Sludge Dewatering	▪ None	▪ Install eight new sludge feed pumps and polymer feed pumps
Centrate Pump Station	▪ Install three new 250-hp centrate pumps to replace existing pumps	

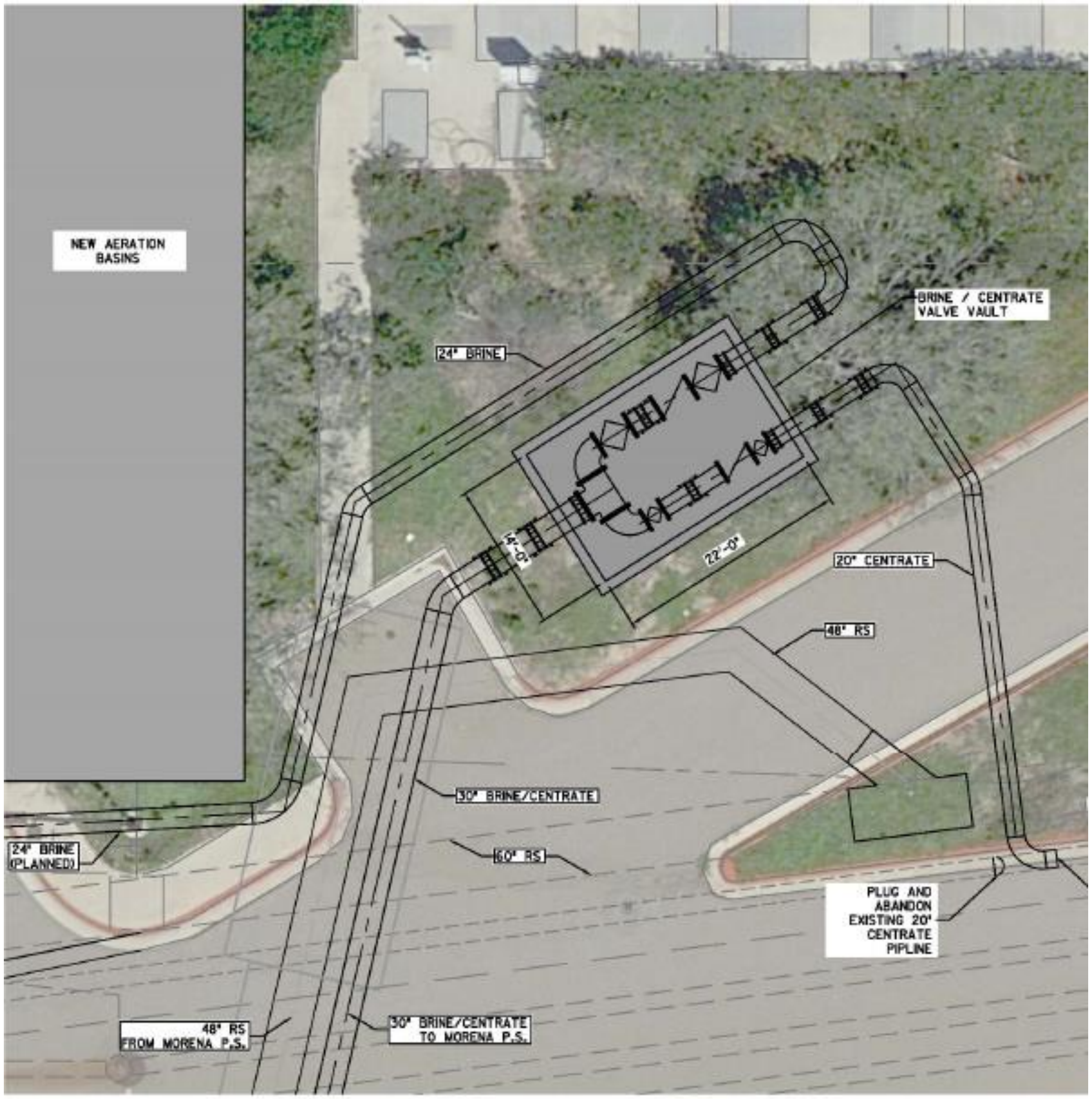
Note:

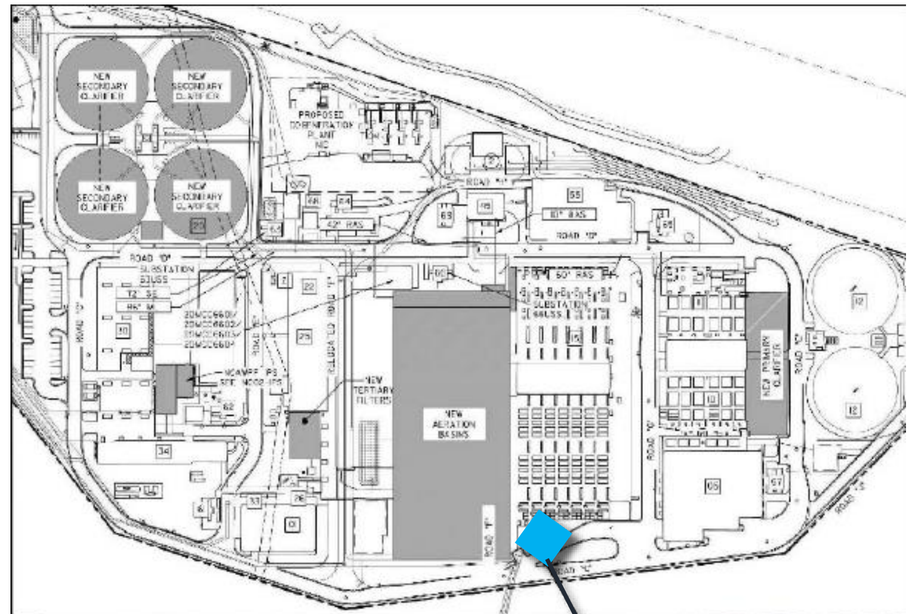
1. **The table does not include other miscellaneous equipment (ex. pumps, valves, PRV's, flame arrestors, etc.) which will be installed as part of the MBC improvements project.**
2. **Drivers behind "Other Recommended Improvements"-increased O&M costs, equipment age, and redundancy.**

MBC Aerial View - Proposed Upgrades



MBC Centrate





New Centrate Valve Vault

Proposed Contract

- In September 2016, PUD advertised a Request for Proposal for design engineering services in support of the MBC Improvements project
- Three firms submitted proposals; all were interviewed
- Interview Panel: 4 City, 1 Metro TAC and 1 IROC members
- CH2M Hill Engineers, Inc. was selected as the most highly qualified firm
- Total contract amount: $5,051,090
    - Fiscal Impact to Metro JPA: $1,700,000 (33.5% of Metro Cost)
- Contract duration: 5 years

Q & A

Attachment 8

JPA Mid Year Budget Review

Metro Wastewater Joint Powers Authority
Treasurer's Report
Six months ending December 31, 2016

Metro Wastewater JPA
Treasurer's Report

Six months ending December 31, 2016
Unaudited

Beginning Cash Balance at July 1, 2016	$	231,585
Operating Results		
Membership Dues & Interest Income		56,855
Expenses		(69,518)
Change in Net Position		(12,663)
Net change in Receivables & Payables		81,452
Cash used in Operations		68,789
Ending Cash Balance at December 31, 2016	$	300,374

Submitted by:

Karen Jassoy, Treasurer, 3/9/17

Metro Wastewater JPA
Statement of Net Position
As of Dec 31, 2016 and Jun 30, 2016
Unaudited

	Dec 31, 2016	Jun 30, 2016	$ Change
ASSETS			
Checking/Savings	$ 300,374	$ 231,585	$ 68,789
Accounts Receivable	-	35,278	(35,278)
Total Assets	**$ 300,374**	**$ 266,863**	**$ 33,511**
LIABILITIES			
Accounts Payable	$ 6,170	$ 16,821	$ (10,651)
Unearned Membership Billings	56,825	-	56,825
Total Liabilities	**$ 62,995**	**$ 16,821**	**$ 46,174**
NET POSITION			
Total Net Position at Beginning of Period	$ 250,042	$ 126,475	$ 123,567
Change in Net Position	(12,663)	123,567	(136,231)
Total Net Position at End of Period	**$ 237,379**	**$ 250,042**	**$ (12,663)**

Net Position at 12/31/16	*$ 237,379*
FY '17 JPA Required Operating Reserve	
(based on 4 months of Operating Expenses)	*75,783*
Over required reserve	*$ 161,596*

Metro Wastewater JPA
Statement of Operations
Budget vs. Actual

Six months ending December 31, 2016
Unaudited

	Actual	Budget	Over (Under) Budget
Income			
Membership Dues	$ 56,825	$ 56,838	$ (13)
Interest Income	30	25	5
Total Income	$ 56,855	$ 56,863	$ (8)
Expenses			
Administrative Assistant	$ -	$ 4,000	$ (4,000)
Admin & Treasury Services-Padre	8,214	9,500	(1,286)
Bank Charges		100	
Dues & Subscriptions	-	300	(300)
JPA/TAC meeting expenses	2,732	2,500	232
Miscellaneous		125	(125)
Professional Services			
Engineering - Atkins	6,000	25,000	(19,000)
Audit - White Nelson Diehl Evans	-	6,000	(6,000)
Financial - Kese Group	24,560	32,500	(7,940)
Legal - BB&K	19,610	22,500	(2,890)
Per Diem - Agency	7,050	9,000	(1,950)
Postage	54	-	54
Printing	3	250	(247)
Telephone	-	700	(700)
Website Maintenance & Hosting	1,295	1,200	95
Total Expenses	$ 69,518	$ 113,675	$ (44,057)
Change in Net Position	$ (12,663)	$ (56,812)	$ 44,149

Metro Wastewater JPA
Statement of Cash Flows

Six months ending December 31, 2016
Unaudited

OPERATING ACTIVITIES		
Change in Net Position	$	(12,663)
Adjustments to reconcile Change in Net Position to net cash provided by operations:		
Accounts Receivable		35,278
Accounts Payable		(10,651)
Deferred Revenue		56,825
Net cash provided by Operations		68,789
Net cash increase for period		68,789
Cash at beginning of period		231,585
Cash at end of period	**$**	**300,374**

Metro Wastewater JPA
Vendor Accrual Summary
As of December 31, 2016

Atkins North America	$	375	*
Best, Best and Krieger		1,055	*
Jerrold Jones		300	*
Keze Group		240	*
Padre Dam		4,000	*
Vision Interrnet Providers		200	
Total	**$**	**6,170**	

***Accruals; bills received and paid after 12/31/16**

Attachment 9

JPA Hypothetical Financing Schedule

FIELDMAN | ROLAPP & ASSOCIATES

METRO WASTEWATER JPA
2017 Financing
HYPOTHETICAL SCHEDULE / DISCUSSION VERSION

Revised on:
February 14, 2017

I = Issuer - Metro Wastewater JPA
MA = Member Agencies
FA = Financial Advisor - Fieldman, Rolapp & Associates
BC = Bond and Disclosure Counsel - Best, Best U Krieger
T = Trustee / Escrow Agent - TBD
UW =Underwriter - TBD
UWC = Underwriter's Counsel - TBD

Day #	Description	Responsible Parties	Status
1	Initial Meeting to confirm overall deal structure	All	
7	Underwriter RFP distributed	I, FA	
15	Distribution of 1st draft legal documents and authorizing resolution(s)	BC	
22	Underwriter responses received	I, FA	
22	Distribution of 1st draft Preliminary Official Statement (POS) - Shell Only With Member Agency Information Required Highlighted	BC	
26	Conference call @ TBD - discuss legal documents, timing on Member data	All	
42	Underwriter Selection made	I, FA	
43	Distribution of 2nd draft legal documents and authorizing resolution(s)	BC	
52	Substantially all Member Agency data / financial projections provided to BC	All	
73	Distribution of 2nd draft Preliminary Official Statement (POS) - including substantially all Member Agency information	BC	
80	Conference call @ TBD	All	
87	Distribution of 1st draft of Credit Presentation	FA	
87	Legal documents / POS distributed to rating agencies / analysts assigned	FA	
87	Distribution of Bond Purchase Agreement (BPA)	UWC	
94	Conference call @ TBD to review Credit Presentation	All	
101	Distribution of 3rd draft Preliminary Official Statement (POS)	BC	
101	Distribution of 2nd draft of Credit Presentation	FA / UW	
108	Conference call @ TBD to finalize Credit Presentation	I, FA, UW	

FIELDMAN | ROLAPP & ASSOCIATES

METRO WASTEWATER JPA
2017 Financing
HYPOTHETICAL SCHEDULE / DISCUSSION VERSION

Day #	Description	Responsible Parties	Status
122	Rating agency presentation(s) / conference calls	I, FA, UW	
129	Final Document / Docketing Agenda deadlines	All	
136	Rating(s) received from rating agencies	I, FA, UW	
141	Due Diligence conference call	All	
143	JPA Board meeting to approve: a) legal documents / resolutions b) POS c) Bond Purchase Agreement	I	
150	Financing Documents and POS Appendix approved by each Member Agency Governing Body	I, MA	
152	Post Preliminary Official Statement electronically	BC	
162	Bond Pre-Pricing Conference Call TBD	I, FA, UW	
163	Bond Pricing Conference Call @ TBD Execute Bond Purchase Agreement	I, FA, UW	
170	Post Final Official Statement electronically	BC	
184	Closing and receipt of funds	All	

Financing Schedule Assumptions:

- Prior to Day 1 in the financing schedule, Metro JPA members have made decision to participate in JPA financing
- Financing team assumes the member agencies participating have all financial and disclosure information available per the schedule and are in a generally acceptable condition

Attachment 11

Invite

Pure Water

Brewing Event

March 116th

Stone Brewery

Liberty Station

Pure Stone San Diego

Thursday, March 16, 2017

5 p.m. - 7 p.m.

Stone Brewing World Bistro & Gardens - Liberty Station
2816 Historic Decatur Road #116
San Diego, CA 92106

Join Mayor Faulconer for a refreshing Stone beer brewed with San Diego's "Pure Water."

Taste beer brewed with purified water from the City's demonstration Pure Water Facility!
Join us for this historic event and celebrate Stone Brewing and the City of San Diego's continued commitment to sustainability and ingenuity.

Please be our guest!
RSVP by Friday, March 10, 2017 to ngot@sandiego.gov

Don't miss remarks from Mayor Faulconer and Stone Brewing at 5:15 p.m.!

Thanks to our sponsors who helped make this event possible!
carollo Engineers...Working Wonders With Water®
ch2m
AECOM

Learn more about Pure Water San Diego at www.purewatersd.org.

Stone Brewing World Bistro and Gardens Liberty Station

Pure Water San Diego

Attachment 12

Metro CIP and Funding Sources

THE CITY OF SAN DIEGO

M E M O R A N D U M

DATE: March 8, 2017

TO: Metro Technical Advisory Committee (Metro TAC)

FROM: Surraya Rashid, Deputy Director, Public Utilities Department

SUBJECT: FY2017 Capital Improvements Projects (CIP) Report – 2nd Quarter

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The Public Utilities Department hereby submits the FY2017 CIP updates for the period of October 1, 2016 through December 31, 2016.

The report includes the following:

- Projects highlights
- Forecast versus actual expenditures report
- Projects expenditure updates

Project Highlights

Project	Cost	Highlight
W PTL Intercept & PS 2 FM Siphon Repair	$2.3 M	Completed construction

Figure 1 – Before

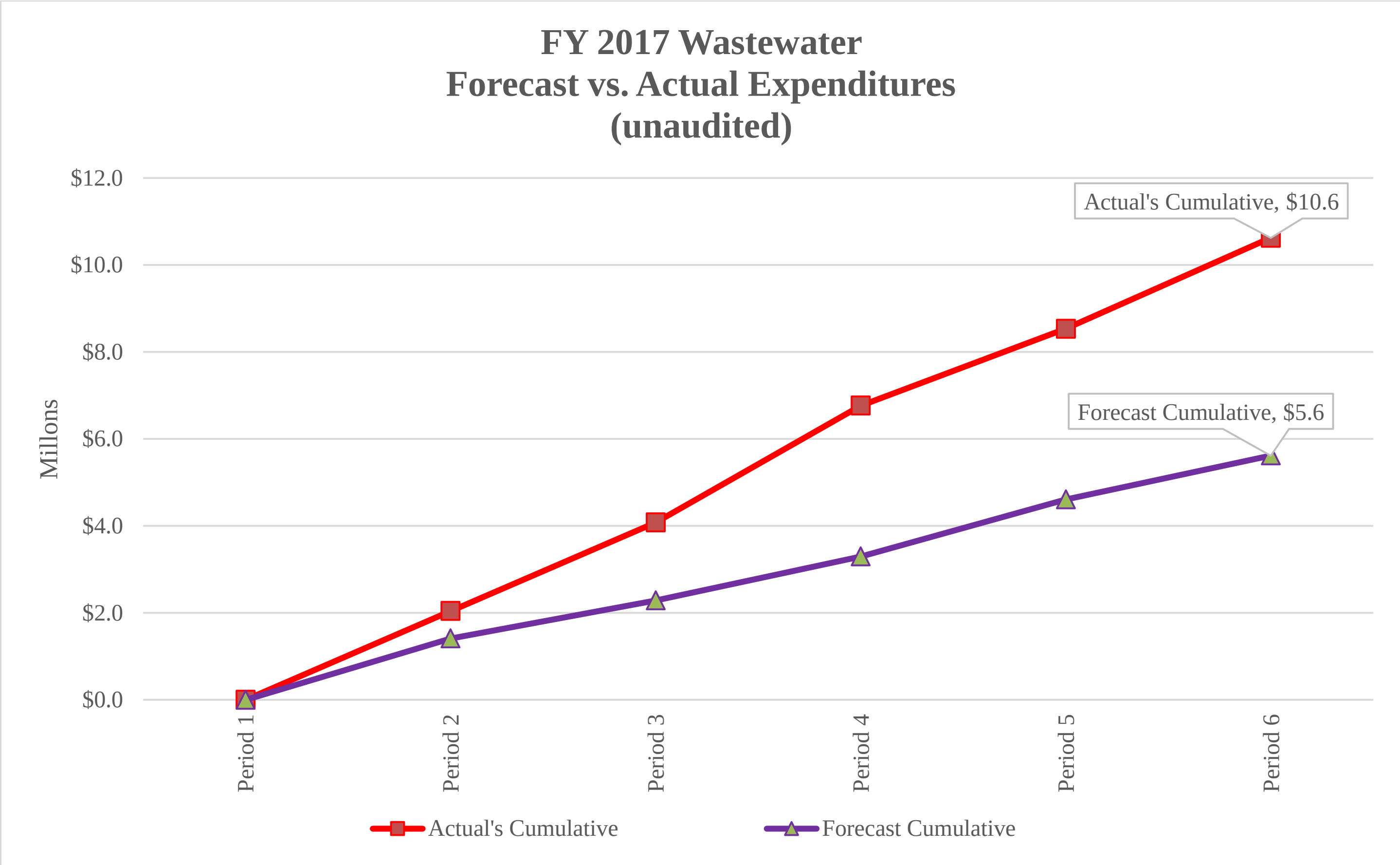
Figure 2 - After

114-inch West Point Loma Interceptor Pipeline – Before and After Lining repair

This project consists of lining repairs on the 87-inch Pump Station 2 Force Main and the 114-inch West Point Loma Interceptor pipelines. The PS2 Force main is a reinforced concrete pipe (RCP) that runs from Pump Station 2 to the East Portal Structure and is approximately 15,000 feet long. Lining was performed to repair the T-lock liner near the access structure on the Anti-Submarine Warfare channel side.

The West Point Loma Interceptor Sewer (WPLIS) pipeline conveys all the raw sewage to the Point Loma Wastewater Treatment Plant (PLWTP). Lining was performed on the T-lock liner at 26 locations.

FORECAST VERSUS ACTUAL EXPENDITURES UPDATES



WASTEWATER PROJECTS

COST OF SERVICE STUDY (COSS) vs ACTUALS

FY 2017 - 2nd Quarter (Financial Data run January 9, 2017)

NOTES:
- Projects are listed from highest to lowest revised project cost
- Original COSS Estimates use July 1, 2015 P6 Data Date
- Wastewater projects are separated into Muni and Metro
- TBD are projects being implemented but have not yet established a baseline

- Does not include AMI or Pure Water projects with the exception of Morena (B15141)

Projects with $1 mil or more in estimated project cost change (increase/decrease)
Projects six or more months behind schedule in design/construction phases
Projects on the radar

COSS - Cost of Service Study
BO/BU -Beneficial Occupancy/Beneficial Use, ie., Substantial Completion
Variance - difference between COSS and current dates

CH = Project Charter in place
CA = Charter Amendment
P = New charter. Project was in planning/scope was being defined

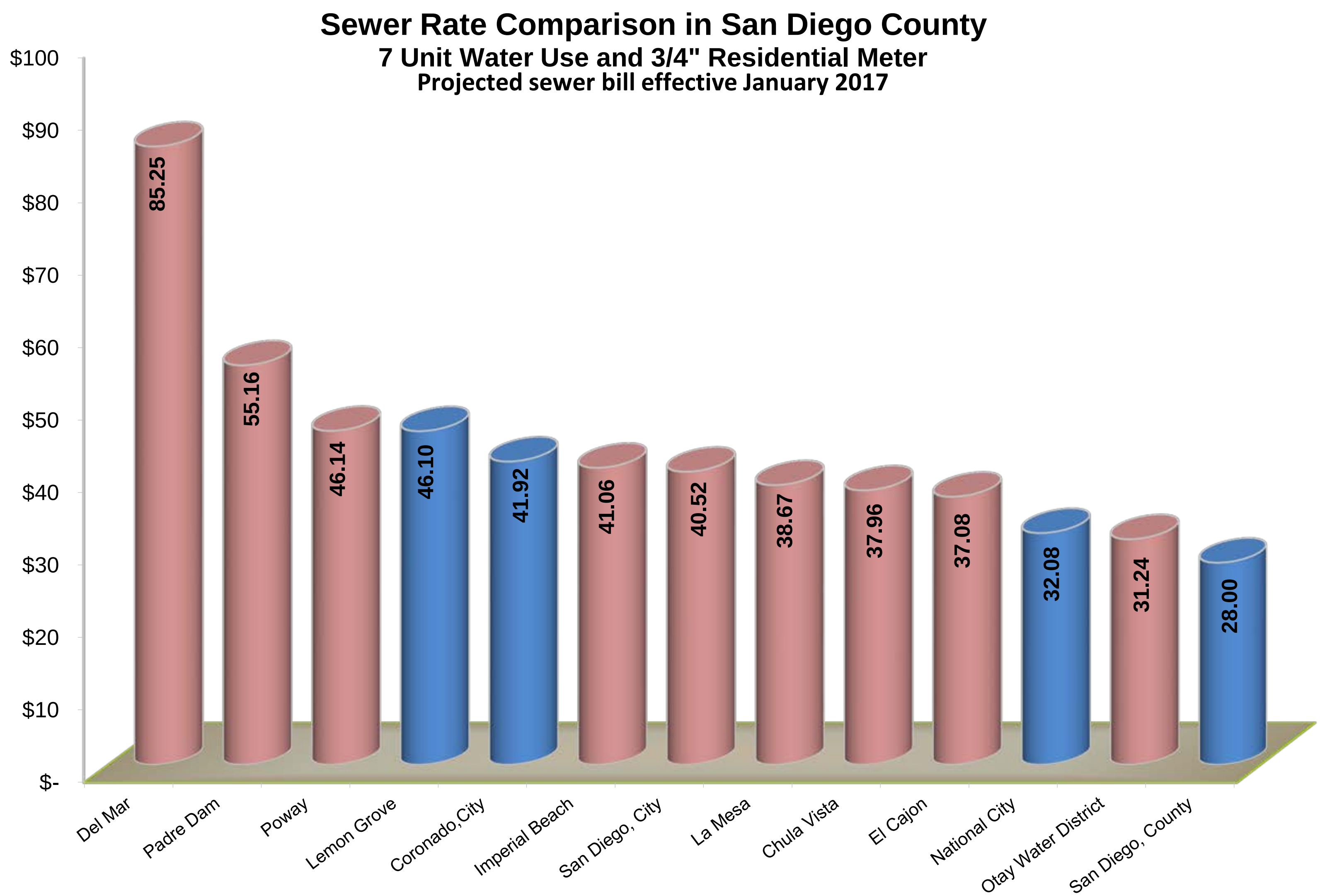
WASTEWATER PROJECTS									Planning/Design/Award Phase			Construction Phase			
WBS	Project Name	COSS Estimated Total Project Cost	Revised Estimated Total Project Cost	Project to Date Expenditures (thru FY17, Pd 6)	Encumbrance at FY17, Pd 6	Project Balance (Revised Proj Cost less Expenditures less Encumbrances)	% Spent (Expenditures /Revised Project Cost)	Start Date	COSS Final Design Approval - End	Final Design Approval - End	Final Design Approval - End Variance	COSS BO/BU	BO/BU	BO/BU Variance	Project Charter/Amendment P6 Info as of January 1, 2017 Data Date
	LARGE SEWER PUMP STATIONS - METRO														
S00312	PS2 Power Reliability & Surge Protection	$43,100,000	$48,030,000	$2,913,188	$355,146	$44,761,666	6.07%	11/1/2010	2/8/2016	8/15/2016	139	8/30/2019	8/17/2020	259	No Project Charter or Amendment
	OTHER - METRO														
S00314	Wet Weather Storage Facility - Live Stream Discharge (D/B)	$5,000,000	$5,000,000	$2,366,274	$20,730	$2,612,996	47.33%	1/3/2011	3/7/2016	TBD		1/24/2018	TBD		
S00319	EMT&S Boat Dock & Steam Line Relocation	$2,304,000	$2,304,000	$78,816	$33,979	$2,191,205	3.42%	11/23/2011	11/30/2012	TBD		6/30/2018	TBD		
	SEWER TREATMENT PLANTS - METRO														
S00309	NCWRP Sludge PS Upgrade	$636,294	$1,207,096	$835,712	$5,239	$366,145	69.23%	4/1/2010	1/27/2012	1/27/2012	0	3/17/2016	4/6/2016	15	No Project Charter or Amendment
S00315	PLWWTP Grit Processing (GIP)	$37,095,037	$37,095,037	$36,178,861	$317,164	$599,012	97.53%	12/12/2000	9/30/2010	9/30/2010	0	8/17/2015	11/24/2015	73	No Project Charter or Amendment
S00339	MBC DEWTRING CNTRFGS RPLMT (SA)JO#141590	$12,122,443	$12,122,443	$7,261,489	$3,803,431	$1,057,523	59.90%	7/1/2011	3/21/2012	3/21/2012	0	4/12/2016	6/1/2018	572	Charter Amendment Only
S00323	MBC ODOR CONTROL FACILITY UPGRADES	$6,615,612	$7,715,612	$5,150,677	$2,077,581	$487,354	66.76%	12/2/2010	3/19/2015	3/19/2015	0	3/14/2017	3/14/2017	0	No Project Charter or Amendment
B10178	MBC Chemical System Improvements Phase 2	$6,090,354	$7,137,628	$6,069,016	$583,010	$485,602	85.03%	2/14/2011	2/27/2015	2/27/2015	0	3/24/2017	11/21/2016	-90	No Project Charter or Amendment
S00310	SBWRP DEMINERALIZATION	$5,973,695	$5,973,695	$4,697,521	$156,723	$1,119,451	78.64%	8/1/2012	11/30/2012	11/30/2012	0	9/17/2015	2/28/2017	389	Charter Amendment Only
B14167	SBWRP Sludge Pump & Grinder Installation	$789,000	$939,000	$504,638	$213,855	$220,507	53.74%	8/1/2014	9/1/2015	7/31/2015	-23	4/21/2016	4/3/2017	254	Charter Only
B13227	Emergency Strobe Lights at MBC, NC, SB	$754,000	$754,000	$466,378	$2,965	$284,657	61.85%	9/3/2013	9/30/2015	10/28/2016	289	8/3/2015	4/28/2017	465	Charter Only
B16165	MBC Cooling Water System Chiller Upgrade	TBD	TBD	$34,594	$0				TBD	TBD		TBD	TBD		
B16132	SBWRP Valve Mstr Sta & Loop Control Sys	TBD	$1,500,000	$24,027	$0			12/28/2015	TBD	2/24/2017		TBD	7/11/2018		
	TRUNK SEWERS - METRO														
B11025	ROSE CANYON TS (RCTS) JOINT REPAIR	$6,233,000	$14,252,295	$811,566	$168,436	$13,272,293	5.69%	5/1/2013	1/20/2016	8/5/2016	145	3/30/2017	6/19/2019	595	Charter Only
	OTHER - MUNI/METRO														
S14000	I AM San Diego Project (Metro)	TBD	$7,841,449	$5,943,868	$5,493,904	-$3,596,323	75.80%	2/1/2014	TBD	TBD		TBD	12/31/2018		
S14022	MOC Complex Solar Project	$2,675,000	$2,675,000	$120,544	$0	$2,554,456	4.51%	8/1/2014	9/1/2015	10/29/2015	43	9/2/2016	1/2/2018	357	Charter Only
	POST CONSTRUCTION/COMPLETE PROJECTS														
S00322	MBC - Biosolids Storage Silos	$9,047,838	$9,047,837	$8,492,965	$0	$554,872	93.87%	10/12/2006	11/15/2012	11/15/2012	0	7/16/2015	9/23/2015	51	No Project Charter or Amendment
L100002	Ovation Upgrade at North City WRP	$3,070,000	$3,070,000	$2,559,395	$0	$510,606	83.37%	10/27/2009	3/22/2010	3/22/2010	0	11/24/2014	6/5/2014	-126	
B16015	PS2 Emergency Generators	TBD	$3,000,000	$1,976,420	$0	$1,023,580	65.88%	8/28/2015	TBD	TBD		TBD	TBD		
B11098	W PTL Intercept & PS 2 FM Siphon Repair	$1,500,000	$2,300,000	$2,555,732	$39,562	-$295,294	111.12%	3/1/2009	TBD	3/1/2010		6/30/2014	8/15/2016	570	
B00313	PS1 & 2 Electrical Upgrade & New Building at PS2 Proj.	$10,085,000	$10,445,000	$10,442,284	$0	$2,716	99.97%	1/8/2007	TBD	1/24/2008		2/10/2015	2/11/2015	1	No Project Charter or Amendment
	POST CONSTRUCTION/COMPLETED PROJECT - MUNI/METRO														
S12036	Backup Generators at SPS's, TP & EMTS	$17,745,600	$17,745,600	$15,063,678	$159,622	$2,522,299	84.89%	12/13/2011	9/23/2013	10/1/2013	6	10/1/2014	6/30/2016	468	

Attachment 15

MetroTAC
Work Plan

Active Items	Description	Member(s)
Sample Rejection Protocol Working Group	7/16: The sample rejection protocol from the B&C 2013 report has been under discussion between PUD staff and Metro TAC. A working group was formed to deal with this highly technical issue and prepare draft recommendations on any changes to current sampling procedures. The existing protocol is to be used through FY17. If changes are approved to the protocol they will be implemented in FY18. *1/17: Work group continues to meet monthly.*	Dennis Davies Dan Brogadir Al Lau Dexter Wilson SD staff
PLWTP Permit Ad Hoc Work Group	1/17: Greg Humora and Scott Tulloch continue to meet with stakeholders. . Milestones are included in each month Metro TAC and Commission agenda packet.	Greg Humora Scott Tulloch SD staff & consultants Enviro members
Flow Commitment Working Group	6/16: Upon the request of Metro Com Chair Jim Peasley Chairman Humora created a working group to review the Flow Commitment section of the Regional Agreement and make recommendations on the fiscal responsibilities of members who might withdraw their flow from the Metro System. The Work Group held their first meeting June 24, 2016. Yazmin Arellano chairs the work group. *1/17: Work group continues to meet monthly.*	Yazmin Arellano Roberto Yano Eric Minicilli Al Lau SD staff Karyn Keese
Social Media Working Group	6/16: Upon the request of Metro Com Chair Jim Peasley Chairman Humora created a working group to research and provide input on the creation of policies and procedures for Metro JPA social media. Mike Obermiller will chair this work group. He sent out an email to all Metro TAC members requesting copies of their agency's policies. 9/16: A draft policy has been approved by Metro TAC and will be presented to the Commission in October by Alexander Heide. *1/17: Draft policy and consultants contracts to be reviewed by Finance Committee in March 2017.*	Mike Obermiller Alexander Heide
Secondary Equivalency	5/14: Definition of secondary equivalency for Point Loma agreed to be enviros 12/14: Cooperative agreement signed between San Diego and enviros to work together to pass legislation for secondary equivalency (until 8/1/19) San Diego indicated that passage of Federal legislation is not possible under the current political environment. San Diego is exploring options for State legislation 9/15: Letter received from EPA endorsing modified permit for Point Loma 6/16: Pursuit of Federal Legislation will be held off until after the November 2016 election. City of San Diego to consult with DC lobbyists on 2/4/17	Greg Humora Scott Tulloch
Pure Water Program Cost Allocation Ad Hoc Work Group	A working group was formed to discuss Pure Water program cost allocation. 9/16: Concepts to be refined by Metro TAC and San Diego staff for presentation to Commission 1/17.	Greg Humora Scott Tulloch Roberto Yano Karyn Keese SD staff & consultants
Pure Water Program Cost Allocation Metro TAC Work Group	5/14: Draft facility plan and cost allocation table provided to Metro TAC working group 3/15: Draft cost allocation presentation provided to Metro TAC	Greg Humora Scott Tulloch Rick Hopkins Roberto Yano Al Lau Bob Kennedy Karyn Keese
Exhibit E Audit	6/16: FY 2013 audit accepted by Metro Commission; 9/16: FYE 2014 audit accepted by Metro Commission. FYE 2015 audit report to be issued by end of 2016 and then all audits will be caught up. *1/17: FYE 2015 to be issued in February 2017. FYE 2016 fieldwork is underway with anticipated draft 7/17.*	Karyn Keese Karen Jassoy

Active Items	Description	Member(s)
Amend Regional Wastewater Disposal Agreement	The addition of Pure Water facilities and costs will likely require the amendment of the 1998 Regional Wastewater Disposal Agreement. The Padre Dam billing errors have led to a need to either amend the Agreement and/or develop administrative protocols to help resolve potential future billing errors. After Pure Water cost allocation had been agreed to this effort will begin.	Greg Humora Roberto Yano Dan Brogadir Paula de Sousa Mills Karyn Keese
Management of Non-Disposables in Wastewater	9/13: Eric Minicilli handed out a position paper prepared by the NEWEA. 6/15 Chairman Humora provided attached from SCAP. 2/16: Chairman Humora distributed Robbins Geller Rudman & Dowd memorandum.	Eric Minicilli
2015/16 Transportation Rate Update	5/14: Metro TAC approved 2014 transportation rate w/caveat that PUD staff hires a consultant to review/revise methodology for 2015.	Al Lau Dan Brogadir Karyn Keese
IRWMP	8/15 RAC minutes included in August Metro TAC agenda. Padre Dam received a $6 million grant for their project. 9/16: June 2, 2016 and August 3, 2016 minutes presented to Metro TAC. *12/16: Roberto Yano and Yazmin Arellano appointed to IRWMP.*	Roberto Yano Yazmin Arellano
"No Drugs Down the Drain"	The state has initiated a program to reduce pharmaceuticals entering the wastewater flows. There have been a number of pharmaceutical collection events within the region sponsored by law enforcement.	Greg Humora
Strength Based Billing Evaluation	San Diego will hire a consultant every three years to audit the Metro metered system to insure against billing errors.	Al Lau Dan Brogadir Karyn Keese
Grease Recycling	To reduce fats, oils, and grease (FOG) in the sewer systems, more and more restaurants are being required to collect and dispose of cooking grease. Companies exist that will collect the grease and turn it into energy.	Eric Minicilli
Point Loma Modified NPDES Permit	1/15: Permit was submitted. EPA has begun their review. 11/16 first possible date at the Regional Board for consideration. *12/16: First hearing of Permit Application held at San Diego Regional Board.*	Greg Humora Scott Tulloch Karyn Keese
Changes in water legislation	Metro TAC and the Board should monitor and report on proposed and new legislation or changes in existing legislation that impact wastewater conveyance, treatment, and disposal, including recycled water issues	Paula de Sousa Mills
Border Region	Impacts of sewer treatment and disposal along the international border should be monitored and reported to the Board. These issues would directly affect the South Bay plants on both sides of the border.	*New Board Members to be Appointed*


Sewer Rate Comparison in San Diego County
7 Unit Water Use and 3/4" Residential Meter
Projected sewer bill effective January 2017
$100
$90
$80
$70
$60
$50
$40
$30
$20
$10
$-
85.25
55.16
46.14
46.10
41.92
41.06
40.52
38.67
37.96
37.08
32.08
31.24
28.00
Del Mar
Padre Dam
Poway
Lemon Grove
Coronado,City
Imperial Beach
San Diego, City
La Mesa
Chula Vista
El Cajon
National City
Otay Water District
San Diego, County

Metro TAC
Participating Agencies
Selection Panel Rotation

Agency	Representative	Selection Panel	Date Assigned
Padre Dam	Neal Brown	IRWMP – Props 50 & 84 Funds	2006
El Cajon	Dennis Davies	Old Rose Canyon Trunk Sewer Relocation	9/12/2007
La Mesa	Greg Humora	As-Needed Piping and Mechanical	11/2007
National City	Joe Smith	MBC Additional Storage Silos	02/2008
Otay Water District	Rod Posada	As-Needed Biological Services 2009-2011	02/2008
Poway	Tom Howard	Feasibility Study for Bond Offerings	02/2008
County of San Diego	Dan Brogadir	Strategic Business Plan Updates	02/2008
Coronado	Scott Huth	Strategic Business Plan Updates	09/2008
Coronado	Scott Huth	As-needed Financial, HR, Training	09/2008
PBS&J	Karyn Keese	As-needed Financial, Alternate HR, Training	09/2008
Otay Water District	Rod Posada	Interviews for Bulkhead Project at the PLWTP	01/2009
Del Mar	David Scherer	Biosolids Project	2009
Padre Dam	Neal Brown	Regional Advisory Committee	09/2009
County of San Diego	Dan Brogadir	Large Dia. Pipeline Inspection/Assessment	10/2009
Chula Vista	Roberto Yano	Sewer Flow Monitoring Renewal Contract	12/2009
La Mesa	Greg Humora	Sewer Flow Monitoring Renewal Contract	12/2009
Poway	Tom Howard	Fire Alarm Panels Contract	12/2009
El Cajon	Dennis Davies	MBC Water System Improvements D/B	01/2010
Lemon Grove	Patrick Lund	RFP for Inventory Training	07/2010
National City	Joe Smith	Design/Build water replacement project	11/2010
Coronado	Scott Huth	Wastewater Plan update	01/2010
Otay Water District	Bob Kennedy	RFP Design of MBC Odor Control Upgrade/Wastewater Plan Update	02/2011
Del Mar	Eric Minicilli	Declined PS 2 Project	05/2011
Padre Dam	Al Lau	PS 2 Project	05/2011
County of San Diego	Dan Brogadir	RFP for As-Needed Biological Services Co.	05/2011
Chula Vista	Roberto Yano	North City Cogeneration Facility Expansion	07/2011
La Mesa	Greg Humora	confined space RFP selection panel	10/2011
Poway	Tom Howard	COSS's for both Water and WW	10/2011
El Cajon	Dennis Davies	Independent Accountant Financial Review & Analysis – All Funds	01/2012

Lemon Grove	Mike James	MBC Dewatering Centrifuges Replacement (Passed)	01/2012
National City	Joe Smith	MBC Dewatering Centrifuges Replacement (Passed)	01/2012
Coronado	Godby, Kim	MBC Dewatering Centrifuges Replacement (Passed)	01/2012
Otay Water District	Bob Kennedy	MBC Dewatering Centrifuges Replacement (Accepted)/Strategic Planning Rep	01/2012
Del Mar	Eric Minicilli	New As Need Engineering Contract	02/2012
Padre Dam	Al Lau	PA Rep. for RFQ for As Needed Design Build Services (Passed)	05/2012
County of San Diego	Dan Brogadir	PA Rep. for RFQ for As Needed Design Build Services (Cancelled project)	05/2012
Chula Vista	Roberto Yano	As-Needed Condition Assessment Contract (Accepted)	06/2012
La Mesa	Greg Humora	New programmatic wastewater facilities condition (Awaiting Response)	11/2012
Poway	Tom Howard	Optimization Review Study	01/2013
El Cajon	Dennis Davies	PUD 2015 Annual Strategic Plan	1/15/14
Lemon Grove	Mike James	As-Needed Engineering Services (Passed)	7/25/14
National City	Kuna Muthusamy	As-Needed Engineering Services	7/25/14
Coronado	Ed Walton	Strategic Planning	01/2014
Otay Water District	Bob Kennedy	Strategic Planning (Volunteered, participated last year)	01/2014
Del Mar	Eric Minicilli	Pure Water Program Manager Services	9/1/14
Padre Dam	Al Lau	Pure Water Program Manager Services	9/1/14
County of San Diego	Dan Brogadir	As-Needed Condition Assessment Contract	3/24/2015
Chula Vista	Roberto Yano	Out on Leave	6/10/15
La Mesa	Greg Humora	North City to San Vicente Advanced Water Purification Conveyance System	6/10/15
Poway	Mike Obermiller	Real Property Appraisal, Acquisition, and Relocation Assistance for the Public Utilities Department	11/30/15
El Cajon	Dennis Davies	PURE WATER RFP for Engineering Design Services	12/22/15
Lemon Grove	Mike James	PURE WATER RFP Engineering services to design the North City Water reclamation Plant and Influence conveyance project	03/16/15
National City	Kuna Muthusamy	Passes	04/04/2016
Coronado	Ed Walton	As-Needed Environmental Services - 2 Contracts	04/04/2016
Otay Water District	Bob Kennedy	As Needed Engineering Services Contract 1 & 2	04/11/2016
Del Mar	Eric Minicilli	Pure Water North City Public Art Project	08/05/2016
Padre Dam	Al Lau	Biosolids/Cogeneration Facility solicitation for Pure Water	08/24/2016
County of San Diego	Dan Brogadir	Pure Water North City Public Art Project	08/10/2016
Chula Vista	Roberto Yano	Design Metropolitan Biosolids Center (MBC) Improvements Pure Water Program	9/10/2016
La Mesa	Greg Humora	Design of Metropolitan Biosolids Center (MBC) Improvements	9/22/16
Poway	Mike Obermiller	Electrodialysis Reversal (EDR) System Maintenance	12/7/16
El Cajon	Dennis Davies		

Lemon Grove	Mike James		
National City	Kuna Muthusamy		
Coronado	Ed Walton		
Otay Water District	Bob Kennedy		
Del Mar	Eric Minicilli		
Padre Dam	Al Lau		
County of San Diego	Dan Brogadir		
Chula Vista	Roberto Yano		
La Mesa	Greg Humora		
Poway	Mike Obermiller		
El Cajon	Dennis Davies		
Lemon Grove	Mike James		
National City	Kuna Muthusamy		
Coronado	Ed Walton		

Attachment 16

Pt. Loma Permit Renewal

03/02/2017

Point Loma Permit/Potable Reuse
KEY MILESTONE DATES

DATE	TASK	FOLLOW UP ACTION/STATUS
2014	Begin outreach to regulators, legislators, key stakeholders and public	San Diego signed contract with Katz Assoc. 5/14
~~01/23/2014~~	San Diego meet with JPA on cost allocation. 1) Agree on methodology 2) Insert construction costs from facilities plan	San Diego to look at comparing PR facilities construction through secondary to secondary at Point Loma.
February	First draft of legislative language	Draft prepared
~~03/05/2014~~	San Diego (Ann, Brent, Bob, Allan) meet with EPA staff	Pure Water program was well received by EPA
~~10/08/2014~~	City of San Diego Environmental Committee	Consideration of Pt Loma Permit
~~10/16/2014~~	Metro Commission - VOTE on Supporting Permit	
~~11/18/2014~~	City of San Diego City Council Meeting	Consideration of Pt Loma Permit and Side Agreement. Passed 9-0
2015		
~~January~~	Submit NPDES Permit to the Environmental Protection Agency	Submitted! Regional Board expected to act on permit 9/16 or 11/16
	Prepare proposed language for admin fix to Clean Water Act	
	Be ready to provide lang for legislative fix to Clean Water Act	
~~05/20/2015~~	Present Phase 1 of cost allocation to Metro TAC	
~~06/04/2015~~	Metro JPA Strategic Planning Meeting at Pt Loma	
~~07/01/2015~~	Water Reliability Coalition Potable Reuse Media Training	
~~09/15/2015~~	City of San Diego City Council Request to set Prop 218 Public Hearing for water rate increase	218 Notice for water rates approved to be mailed out
~~09/17/2015~~	Letter received from EPA endorsing Pt Loma modified permit	
~~11/17/2015~~	City of San Diego Public Hearing for water rate increases	Water rate increases approved
2016		
~~09/21/2016~~	Pure Water Program EIR to Metro TAC	
~~09/21/2016~~	Pure Water Program Update to Metro TAC	
~~10/06/2016~~	Pure Water Program EIR to JPA	
~~10/06/2016~~	Pure Water Program Update to JPA	
~~10/19/2016~~	Pure Water Cost Allocation to Metro TAC	
~~11/08/2016~~	Election day	
~~12/14/2016~~	Pt Loma Permit Public Hearing at RWQCB	Comment Letter submitted requesting permit condition remain unchanged
2017		
	Political strategy for OPRA II approval in DC	
01/05/2017	Pure Water Cost Allocation to JPA	
02/10/2017	Revised Pt Loma Permit Issued with Pure Water construction milestones in 2022 (14 day comment period)	Comment letter submitted requesting continuance of public hearing
04/12/2017	Pt Loma Permit Second Public Hearing at RWQCB	
5/10-12/17	Coastal Commission Meeting in San Diego (supposed to have Pt Loma permit on agenda)	
05/17/2017	FY19-FY23 Sewer rates to Metro TAC	
	Begin drafting updated wastewater dispoal agreement	

Milestone Progress Dashboard