CHAPTER 3 – SOLIDS TREATMENT FACILITIES

3.0 General

The condition of the various process facilities at the Metropolitan Biosolids Center are discussed in this chapter. For each process facility, a description of the treatment process and function, the design criteria's used for sizing and determining number of units, process equipment and its existing condition, problems relating to capacity issues, its physical, mechanical and operational conditions, and lastly recommended improvements to address the problems are identified. The problems relating to the non-process systems are discussed separately in Chapter 4 while problems related to electrical instrumentation and controls are discussed in Chapter 5.

3.1 Solids Process Facilities

All biosolids from NCWRP are sent to MBC NSPF's raw biosolids receiving tanks. Biosolids from future northern and central water reclamation plants (e.g. MVWRP) will be also received by these tanks. The raw biosolids (combined primary and waste activated biosolids) are then degritted and thickened by high-solids rate scroll-type centrifuges. All thickened biosolids are screened and blended prior to discharge to anaerobic digesters. The thickened biosolids are anaerobically digested in circular, mesophilic pre-stressed concrete digesters.

The MBC facility includes a storage tank to receive digested biosolids from both the PLWTP and the NSPF digesters. The biosolids are then mechanically dewatered using centrifuges. Silos are provided to store dewatered biosolids before transferring to the truck loading facilities. Biosolids are trucked offsite for beneficial use or landfill disposal. The centrate is collected and pumped back to the sewers.

3.1.1 Design Criteria

Table 3-1 presents the sizing criteria used in designing each process system for projected average and peak load conditions during Phase I (Year 2010) of the Consumer's Alternative.

TABLE 3-1
FIRP/NSPF Process Unit Sizing Criteria [1]

Process	Unit	For 2010 Average Load	For 2010 Peak Load
NSPF RAW SOLIDS RECEIVING			
Number of Tanks (Duty/Total) [2]		1 / 2	1 / 2
Diameter	ft	45	45
Depth	ft	42	42
Total Volume	gal	528,000 [3]	528,000 [3]
RAW SOLIDS DEGRITTING			
Number of Degritters (Duty/Total) [2]		3/3	3/3
Type		Eutek	Eutek
Capacity	mgd	1.5	1.5

TABLE 3-1 (Continued) FIRP/NSPF Process Unit Sizing Criteria [1]			
Process	**Unit**	**For 2010 Average Load**	**For 2010 Peak Load**
THICKENING WITH CENTRIFUGES			
Number of Centrifuges (Duty/Total) [2]		2/5	3/5
Type		high solids	high solids
Feed solids concentration	%	0.5	0.5
Unit capacity	gpm	600	750
THICKENED BIOSOLIDS SCREENS			
Number of Screens (Duty/Total) [2]		1/3	2/3
Type		inline	inline
Unit Capacity, max.	gpm	250	250
THICKENED BIOSOLIDS BLENDING			
Number of Tanks (Duty/Total) [2]		2/2	2/2
Type		rectangular	rectangular
Length /Width	ft/ft	12/12	12/12
Depth	ft	11	11
Total Volume	gal	24,000	24,000
ANAEROBIC DIGESTION			
Number of Digesters (Duty/Total) [2]		1/3	2/3
Type		cylindrical w/	cylindrical w/
-Shape		bottom cone	bottom cone
-Cover		fixed	fixed
-Mixing		pumped	pumped
VSS Loading	Lb VSS/cu ft	0.10	0.15
Detention Time	days	20	20
Volatile Solids Destroyed	%	50	50
Diameter	ft	105	105
Liquid sidewater depth	ft	35	35
Volume	gal	2,900,000	2,900,000
Pump mix power	hp/1000 cf	0.3	0.3
Pump mix flow	gpm	20,000	20,000
Biogas production	cf/lb VSS destroyed	15	15
Operating Temperature	Deg-F	95	95
DIGESTED BIOSOLIDS STORAGE			
Number of Tanks (Duty/Total) [2]		2/4	3/4
Type			
-Shape		cylindrical	cylindrical
-Cover		fixed	fixed
-Mixing		pumped	pumped
Diameter	ft	70 [3]	70 [3]
Liquid Depth	ft	40	40
Working Volume	gal	1,300,000 [3]	1,300,000 [3]
Pump mix power	hp/1000 cf	0.3	0.3
CENTRIFUGE DEWATERING			
Number of Centrifuges (Duty/Total) [2]		5/8	6/8
Type			
-Machine		centrifuge	centrifuge
Model		high solids	high solids
Unit Capacity	gpm	225	225
Solids Capture	%	95	95

TABLE 3-1 (Continued) FIRP/NSPF Process Unit Sizing Criteria [1]			
Process	**Unit**	**For 2010 Average Load**	**For 2010 Peak Load**
DEWATERED BIOSOLIDS STORAGE			
Number of Silos (Duty/Total) [2]		10	13
Type			
-Shape		cylindrical	cylindrical
Diameter	ft.	18	18
Operating Depth	ft.	24	24
Working Volume	cu. ft.	6,950 [3]	6,950 [3]
Solids capacity	tons	220	220

[1] From Table 3-6 of the FIRP/NSPF Design Concept Report, August 1993
[2] Number of units (Duty/ Total) is not provided in the original Table 3-6
[3] Based on as-built drawings

Table 3-2 shows the projected number of major process units required during Phase 1 (up to Year 2010) and Phase II (up to year 2050).

TABLE 3-2 Number of Process Units Required[1]			
Process Unit	**Consumer's Alternative**		**Existing Units**
	2010	**2050**	**2005**
Raw Solids Receiving Tank	1	1	2
Thickening Centrifuges	5	7	5
Thickened Solids Blending Tanks[2]	2	2	2
Thickened Biosolids Screens	5	5	3
Anaerobic Digesters	3	4	3
Digested Biosolids Storage Tanks -NSPF -Point Loma	 1 2	 1 2	 1 2
Dewatering Centrifuges -FIRP & NSPF -NSPF only -Point Loma only	 8 2 6	 11 3 8	 8 2 6
Dewatered Biosolids Storage Silos	10[3]	13	8

[1] From Appendix B Final FIRP/NSPF Design Concept Report, August 1993.
[2] No stand-by limits provided
[3] Only 8 silos built

3.2 Description of the MBC Solids Treatment Process Facilities - General

The following describes the various MBC solids processing facilities, beginning with the MBC pig receiving facility for the two biosolids forcemains from the Point Loma WWTP and the North City WRP, and ending with the dewatered biosolids storage and truck load out facility. Each facility or process system description includes discussions of existing conditions (equipment, quantity, design capacity, process arrangement, and design flow). These operational conditions described herein were taken from the MBC Maintenance Report prepared by the FIRP/NSPF design engineer as required for state certification of state funded biosolids processing facilities. Also discussed are current and past physical, mechanical and/or operational problems. Also included are recommended improvements to correct or alleviate the identified problems, or suggested steps or alternative solutions to address a problem. Discussions related to electrical and instrumentation and controls issues are discussed separately in a later section. Figures 2-2 and 2-3 in the previous Chapter 2 show the design flows for the phase 1 facilities.

3.2.1 Condition Assessment -"Capacity Limiters"

As noted in the previous chapter, the current MBC process units appear to have adequate capacity to meet the biosolids average and peak flows identified for Phase I of the Consumer's Alternative Plan. However, experience during the first five years of operation indicates that can only be accomplished if all processes or facilities are functioning ideally. Process complexities, inadequacies in installed systems including physical deficiencies, mistakes in control strategies, redundant conceptual flaws and other factors, have significantly reduced the operational efficiency. During some peak operating conditions in the past, the plant is unable to fully process the flows.

Three major factors were identified as "capacity limiters". The term "capacity" here refers to the capacity of the MBC Plant to process the biosolids inflow to the plant. These "capacity limiters" or "capacity constraints" have significantly impacted the entire process thereby reducing MBC's biosolids production.

1. *Low Design Peaking Factor*: For the MBC biosolids storage and dewatering facilities, the design peaking factor used for both the solids loading and hydraulic flow was 1.38. A peaking factor of 2.0 or higher would be typical. Occasions of 8-hour plant shutdowns in the past have shown that MBC is unable to recover to provide a second shut down the next day, even with stand-by systems running. This limits the speed of constructing upgrades and increases the risk of spills should an unexpected event occur.

2. *Complexity of Treatment Processes*: The MBC solids treatment processes are highly complex and difficult to operate. An operator generally requires a full year to understand all the operation and maintenance requirements of the various process facilities, systems and equipment. Complexity of control strategies and a multitude of operational functions and procedures have resulted in high turnover of O&M personnel, contributing to slow response to process events, equipment damage and other problems.

3. *Inadequacies in Design, Poor As-Built Drawings, and Inaccurate Operations/ Maintenance Manuals*: MBC suffers from several errors in design, equipment, sizing and specifications, piping configurations, control strategies, and materials specifications. The as-built drawings including the operations and maintenance manuals are inaccurate and incomplete, leading to more difficulties for plant engineers, maintenance staff and operators trying to resolve problems. This also results in a significant increase in the design cost and duration of upgrades.

3.2.2 Facility Descriptions and Problems Identification

PIG RETRIEVAL (P-1)

Raw biosolids from the NCWRP and digested biosolids from PLWTP are transported to MBC through two biosolids forcemains (5 miles long, NCRSP-16-inch diameter and 17 miles long, FIRP-12 and 14-inch diameter). In the future, a third forcemain may be constructed to convey raw biosolids from the Mission Valley Water Reclamation Plant (MVWRP) to MBC. These pipelines were designed to permit pigging the line without interruption of the biosolids pumping operations. The MBC pig retrieval facilities are located besides the associated receiving tanks.

The PLWTP sludge forcemain to MBC has been pigged three times since its installation in 1998 and there are no known problems related to the facility. Likewise, there are no known problems with the pigging facility for the NCWRP pipeline. The NCWRP sludge forcemain has not been pigged since the plant was commissioned in 1998. Therefore, the operational effectiveness of this facility has not been tested.

Recommended Improvements

It is recommended to trend the NCRSP pipeline pressures and pig pipeline when pressures increase.

RAW SOLIDS RECEIVING (P-2)

Design Flows:
Average 1,200 gpm; Peak 2,000 gpm @ 0.5% solids
Current Flows: 600/800/1,000 gpm (min/avg/peak)

Process Description

Raw solids (primary and waste activated sludge) is pumped at 1,000 gpm average and 1,300 gpm maximum from the North City Water Reclamation Plant to MBC's two (2)

Raw Solids Receiving Tanks. Each tank has a volume of 528,000 gallons with both tanks providing a total design storage volume of less than one day at current maximum flow. As NCWRP has the ability to redirect the raw solids flow to the sewer system, the limited quantity of raw solids storage available at MBC is not currently a concern but will need to be evaluated when the MVWRP is constructed.

Mixing of the biosolids in the tanks is provided by six Raw Solids Mixing Pumps (3 per tank) each rated at 1,500 gpm at 40 ft head, driven by dual-speed 25-hp motors. Three (2 duty plus 1 standby) Raw Solids Transfer pumps (rated at 1,500 gpm at 90 ft head with 60-hp motors and variable frequency drives (VFD)) send the biosolids to the raw solids feed loop which feeds the degritting system and the thickening centrifuges.

Currently, there are no capacity problems with the transfer and mix pumps.

RAW SOLIDS RECEIVING TANKS

Problems

1. *Clogging of suction piping*: The long suction piping header from the duty receiving tank to the raw solids transfer pumps is prone to clogging and the flushing connections provided are too small.

2. *Lack of isolation valves at the tank outlet pipes*. The receiving tanks are fitted with flexible rubber connectors adjacent to the wall connections. When the connectors inevitably develop leaks or rupture, there will be no means to isolate the leak from the tank and the contents of the tank may spill.

Recommended Improvements

No additional storage tank or pumps are needed as NCWRP has the capability to send its raw solids to PLWTP in the event that all MBC storage is exhausted.

1. Provide isolation valves and larger connections to facilitate flushing and draining the long header suction pipe to remove accumulated solids.

2. Install isolation valves between the tank walls and flexible pipe connectors to prevent emptying of a tank in the event that a connector possibly ruptures during a seismic or abnormal hydraulic surge event.

3. Have NCWRP implement a periodic schedule for pigging the raw sludge pipeline.

RAW SOLIDS DEGRITTING (P-3)

Design Flows:
Average @ 1,200 gpm; Peak @ 2,000 gpm @ 0.5% solids

Process Description

Flows in the raw solids feed loop are fed to three 1.5 mgd constant flow Eutek "Teacup" degritters. (1 unit running normally with 2 units on standby). From the Teacups, grit slurry flows by gravity into two "Snail" grit dewatering units (1 duty plus 1 spare, each rated at 2 cubic yards/hr) and then into two screw conveyors each rated at 2,400 lbs grit per hour. Dewatered grit is finally discharged into a 34 cubic yard disposal bin. This degritting facility is designed to produce grit with 50% to 60% solids to be trucked out to landfills at 4,550 lbs/hr (55 tons per day).

The grit system can be by-passed but this will result in increased wear and tear on the thickening centrifuges.

TEACUP DEGRITTERS

GRIT DEWATERING UNIT AND SCREW CONVEYOR

Problems

The need for a 4th "Teacup" degritter for 2030 flows is not necessary which is fortunate as the space reserved for the 4th unit is not accessible. The existing degritting system will be able to handle the future Phase 2 flows.

1. *Inaccessible teacup valves*: The teacups, associated valves and accessories are very difficult if not impossible to access for repair and maintenance without putting plant staff at safety risk. This results in reduced reliability due to inability of plant staff to perform needed maintenance.

2. *Inadequately-designed grit hoses:* Lack of vertical separation between the grit teacups and the dewatering units result in minimally sloped 3-inch diameter discharge hoses. These hoses develop low spots that collect grit and cause frequent plugging. In addition, the utility water connection to these grit hoses is too small to provide the needed flushing action.

3. *Faulty feed pumps control strategy*: As designed, the control strategy to operate the degritting system automatically requires close coordination with the Raw Solids transfer pumps which feed the degritting system. The strategy has timing problems and cannot start up the system automatically. Plant staff has been operating the system manually.

4. *Foul odors problem:* Strong foul odors from the open snails, screw conveyors and grit bins are present because of poor foul air collection from these odor sources. Two open wastewater discharge lines from the snails to a floor drain also contribute to room odors.

Recommended Improvements

The following improvements are recommended:

1. Install access platforms and hoisting equipment in the teacup and screen area. Construction work on the Grit Teacup Access Platforms and Hoists Installation Project will be completed in late 2005.

2. Provide proper supports for the grit hoses to minimize low spots and provide a larger (2 or 3 inch) UW connection to facilitate flushing.

   When replacing the snails in the future, evaluate the feasibility of installing longer and steeper units that could be mounted directly on the floor. This would provide more slope for the grit hoses and would eliminate low spots. This would also allow the hoses to be run below the access platform and would eliminate tripping hazard.

3. Review and tune the control strategy so that the degritters function automatically under a wide range of operating conditions.

4. Included in the Brown & Caldwell Odor Control Facility Evaluation done in 2003 are alternatives for enclosing the snails and grit/screenings bins. These alternatives should be revised and the most feasible alternative should be selected for implementation.

   Additionally, the snail waste discharge line should be piped directly into a domestic sewer drain pipe or the pipe connections to the floor drain should be enclosed. (This has been installed recently as part of the Grit Teacup Access Platforms Installation Project)

BIOSOLIDS THICKENING (P-4)

Design Flows:
Minimum @ 800 gpm; Average @ 1,200 gpm; Peak @ 2,000 gpm @ 0.5% solids
Current Flows: 800-1,500 gpm

Process Description

From the grit teacups, the degritted raw solids are sent to the thickening centrifuges area. Five (5) progressing cavity-type pumps feed the degritted raw solids into the five (5) thickening centrifuges (3 duty and 2 standby units). Each pump discharges at 300 to 1,000 gpm at 65 ft head and are driven by a 50 hp variable frequency drive motor. Any degritted flow that is not sent to the thickening centrifuges is returned to the raw solids receiving tanks. These centrifuge feed pumps are operating satisfactorily and do not have flow capacity or head problems.

Except for the first feed pump which can feed into any of the 5 thickening centrifuges, each of the other 4 pumps is dedicated to a centrifuge.

The 3 duty 300 hp scroll/bowl-type thickening centrifuges are designed to handle 800 to 2,000 gpm total flow of thickened biosolids (0.5 to 0.8 % solids content). Each centrifuge is designed to handle average and maximum flows of 600 and 750 gpm respectively with 95% solids capture. Currently, a maximum of 2 units operate to handle peak flows at 1, 500 gpm while 3 units are on standby. There is space available for one additional centrifuge.

THICKENING CENTRIFUGES

Problems

Thickening Centrifuge Feed Pumps and Polymer Feed Pumps

Initially, the thickening centrifuge feed pumps plugged frequently at their suction piping due to the vertical connection to the suction header as designed originally. The header connections have been revised to horizontal connections which eliminated the plugging. These centrifuge feed pumps are now operating satisfactorily and do not have flow capacity or head problems.

While the #1 pumps for both the centrifuge and polymer feed systems are tasked to provide redundant capability if any of the other 4 pumps breaks down, this can only be accomplished if thickening centrifuge #1 is solely on standby and never on duty service. Redundancy is lost anytime thickening centrifuge #1 is ran.

Thickened Solids Wetwell

1. Only a single wetwell observation and access hatch is provided. A second hatch is needed over the far end of the wetwell to facilitate wetwell monitoring during thickening operations and ventilation during maintenance activities.

2. No lighting is provided at the thickened sludge wetwell for proper monitoring of the thickening operation.

3. No means of mixing the wetwell contents to prevent solids accumulation is provided. The installation of the second hatch opening will also allow installation of a permanent mixer.

Thickened Biosolids Transfer Pumps

4. Plugging occurs at the transfer pumps suction bells. Because of the suction action at the inlet bells, the protective liner on the wetwell floor has become loose and plugs the suction inlet. The bells have been removed which eliminated this plugging problem. Their removal however can aggravate the solids accumulation in the wetwell. The damaged protective liner requires repair or removal and replacement with a more reliable liner.

5. O&M staff would like the ability to send thickened sludge directly to the digesters when the screens and blending tanks are bypassed during repair/maintenance procedures. However, the thickened sludge transfer pumps do not have sufficient head to accomplish this task.

Recommended Improvements

Thickening Centrifuge Feed Pumps and Polymer Feed Pumps

Although the original design did not correctly address redundancy of the feed pumps and the polymer pumps, no corrective action is recommended at this time as flow projections indicate that additional thickening capacity is not needed.

Thickened Solids Wetwell

1. Install a second hatch on the wetwell roof.
2. Install lighting in the wetwell.
3. Evaluate options for the installation of a wetwell mixing system.

Thickened Biosolids Transfer Pumps

4. Remove the T-lock liner from the floor of the wetwell and apply a painted coating. Re-install the pump suction bells.
5. Install a pipe connection between the thickened sludge transfer pumps discharge piping and the TSL feed piping into the digesters. This will significantly reduce the length of the pipe and the headlosses in the system.

THICKENED BIOSOLIDS SCREENING (P-5)

Design Flows:
Minimum @ 90 gpm; Average @ 125 gpm; Peak @ 280 gpm @ 5% solids.

Process Description

Thickened biosolids from the centrifuges are discharged to a common thickened solids wetwell. Three progressing cavity-type pumps (2 duty and 1 standby) withdraw the thickened biosolids cake from the wetwell at 150 gpm, 76 ft head each with 10 hp constant speed motor and send the cake to the sludge screens.

Three "Strainpress" inline-type screen/ compactor units (2 duty plus 1 standby) each rated for 125 gpm average flow are provided to remove fibrous materials to increase the efficiency of the digestion process and to reduce the frequency of digester cleaning.

Each screen can process a maximum flow of 250 gpm. Screened biosolid flows range from 90 to 280 gpm at a maximum discharge pressure of 14.5 psig. The screenings are conveyed by two (1 duty plus 1 standby) 2 hp shaftless screw conveyors (250 lbs/hr capacity) into a 295 cu. ft. screenings hopper which discharges to a trash bin.

Problems

1. *Cyclic operation problem*: The screens which need to operate continuously are interlocked with the thickened sludge transfer pumps. However, the thickened sludge (TSL) transfer pumps have constant speed drives and thus cycle on and off frequently. This cycling causes the screens to cycle frequently also which results in their premature wear and high torque and amperage conditions when restarting the screens.

2. *Control timing problem*: Additionally, a control timing problem exists which prevents the screens and the TSL transfer pumps from starting simultaneously when set to full AUTO mode in the DCS.

Recommended Improvements

1. The screens are interlocked with the upstream thickened sludge transfer pumps and need to be running continuously. The following options are suggested for addressing this problem:

Alternative 1

Investigate the proposal to install a valved thickened sludge (TSL) recycle line that will return sludge continuously to the wetwell to maintain sufficient liquid level (See discussion on alternative solutions to screen problems in next section on Thickened Biosolids Blending). Though more expensive operationally, this would allow the TSL transfer pumps and screens to operate continuously with less maintenance/ repair works and extended equipment life.

Alternative 2

Another proposed improvement to eliminate the screen problem of intermittent operation is to bypass the screens and blending tanks and have the thickened biosolid transfer pumps discharge directly to the digesters. This would require replacing the existing transfer pumps with higher head pumps.

These two alternative screens solutions are evaluated further in the next Thickened Biosolids Blending section because the operation and controls of the thickening and blending processes are directly interrelated.

2. MBC staff will be addressing the control timing problem in conjunction with the recommend solution for Problem 1 above.

THICKENED BIOSOLIDS BLENDING (P-6)

Design Flows: Minimum @ 90 gpm; Average @ 120 gpm; Peak @ 250 gpm @ 5% solids

Process Description

Screened thickened biosolids are sent to one of two (2) thickened biosolids blending tanks (with one unit on standby) each having 24,000 gallons capacity. Detention time is about 3 hours at average flows.

Three (3) centrifugal mixing (or recirculation) pumps, each rated at 300 gpm and 35 feet head, and coupled to a 10-hp belt-driven motor, keep the tank contents stirred. Two (2) spiral heat exchangers provide pre-heating of the thickened and screened biosolids and also provide back-up heating for the digesters.

Thickened sludge from the Blending tanks is sent to the digesters by three (3) progressing cavity-type Digester Feed (DF) Pumps (2 duty plus 1 standby). Each pump is rated at a flow of 300 gpm at 46 ft head and driven by a 15 hp electric motor.

TOP OF BLENDING TANKS

Problems

1. *Inadequate pump head*: In order to send thickened biosolids to the digesters, the digester feed pumps must overcome 46-feet of static head plus piping and equipment friction losses. With a total head of only 46-feet, the design of digester feed pumps gave no allowance to overcome any headloss in the discharge pipeline or in the heat exchangers (which typically have higher friction headlosses than the pipeline) and are therefore undersized for their intended purpose. This has resulted in the digester feed pumps frequently tripping off service due to high discharge pressure. To alleviate this head problem, the discharge piping was disconnected from the heat exchangers and instead routed to the suction side of the digester mix pumps. Although this reduced the TDH on the digester feed pumps, it did not completely eliminate the pump operational problems.

2. *Reverse flow and spill at the blending tanks:* Any planned or unplanned shutdown of the digester feed pumps results in a reverse flow from the digesters through the digester feed pumps and into the blending tanks. Due to the high head imposed by the liquid level in the digesters, this reverse flow can exceed 300 gpm. However, the blending tank overflow pipes are not sized to accommodate this large backflow which means that the blending tanks can fill quickly and spill. This has occurred in the past and resulted in the spilled flow getting into a nearby storm drain inlet.

   Any attempt to start or restart a pump while the reverse flow is occurring creates high torque on the pump shaft and on some occasions has caused it to break or required the pump to start on a high amperage. Neither a ratchet device on the pump to prevent impeller back-spin nor a discharge pipe check valve is provided to address this reverse flow problem.

Plant staff tried out several operational strategies for the digester feed pumps to prevent the reverse flow from the digesters and thereby reduce a spill risk. A strategy found to be most effective is to run the digester feed pumps continuously for longer periods of time. The control strategy was modified to limit the maximum pump speed and to ramp it up and down so as to maintain a set liquid level in the blending tanks. Although this reduces the spill risk, the pump operation is still subject to low liquid level shutdown failures, power outages and forced shutdowns required for pump maintenance.

The risk of spilling at the blending tanks is comprised of the following factors:

a. High head differential between the liquid level in the digesters and that in the blending tanks causing reverse flow from the digesters during pump shutdowns

b. Inadequate capacity on the blending tanks overflow pipes

c. Small volume of blending tanks results in tanks filling quickly giving operators very limited response time

d. Close proximity of spill outlet to the storm drain inlet

3. *Under-designed emergency overflow pipes*: The blending tanks are provided with emergency overflow pipes and valves. However, due to their relatively flat slopes and the thickness of the biosolids, these overflow pipes do not have sufficient capacity to handle the reverse flow from the digesters. On a few occasions, these overflow pipes have plugged. To minimize spills, the overflow valve on each blending tank has been locked shut. However, this only delays a similar spill from the tank's ventilation air inlet by a few minutes.

4. *Plugging- prone solids heat exchangers*: Because they plug easily, the spiral-plate heat exchangers designed to heat the recirculated thickened biosolids of the blending tanks are now permanently bypassed. The manufacturer has confirmed that the plugging problem will continue because the heat exchangers were never intended for use on undigested biosolids. Because of this, the heat exchangers were taken off service and no preheating is presently being provided for the digesters.

Recommended Improvements

1. The digester feed pumps need to be upgraded to attain the required operating head for the process. Remove the existing pumps and replace with higher head pumps.

2. The following nine (9) alternative solutions were developed to address the problems with the screen control/operation, digester biosolids backflow, and the spill risk at the blending tanks. Figure 3-1 shows the existing process diagram while Figures 3-2 through 3-10 illustrate the nine proposed solutions.

   Alternative 1
   Keep screens as they are and install a downstream recycle line which will reroute flows in excess of the screen capacity back to the Thickened Biosolids Wetwell.

   Alternative 2
   Keep screens, add a downstream recycle line with a flow diversion valve to the TSL wetwell and bypass the blending tanks. This results in a two-stage pumping configuration to send screened solids to the digesters.

   Alternative 3
   Bypass both the screens and blending tanks. This also results in a 2-stage pumping operation.

   Alternative 4
   Bypass screens, blending tanks and digester feed pumps. Upgrade TSL pumps to feed directly into digesters.

   Alternative 5
   Provide one-stage pumping to send screened solids directly from the screens to the digesters. Keep screens, add a downstream recycle line with a flow diversion valve to the TSL wetwell. Remove or bypass the blending tanks and digester feed pumps.

   Alternative 6
   Install a variable frequency drive on each TSL transfer pump motor. The VFD/ pump speed would be based on the sludge level in the Thickened Sludge Wetwell thereby allowing the pump discharge rate to match the sludge production rate of the centrifuges. Cycling of the pump would thereby be eliminated.

   Alternative 7
   Keep screens. Install a check valve on the digester feed line and/or install a non-reverse ratchet device on the digester feed pump.

   Alternative 8
   Combine alternatives 1 and 7. Install a flow diversion valve, a recycle line to the TSL wetwell and a check valve on the digester feed piping.

   Alternative 9
   Combine alternatives 6 and 7. Install VFDs on the TSL transfer pumps and check valve/s on the digester feed piping.

These nine alternatives along with their advantages and disadvantages are shown in the table below.

TABLE 3-3 Alternative Solutions to Screens and Blend Tanks Problems			
Alternative	**Description**	**Advantages**	**Disadvantages**
Alternative No. 1	Keep screens. Install a recycle line to the thickened biosolids wetwell. (2-stage pumping)	1. Minimal additional DCS reprogramming needed 2. Low capital cost 3. Solves screens wear problem from intermittent operation	1. Spill risk at blending tanks remains 2. High O&M cost 3. DCS control of multiple process equipment remains 4. DPU capacity limits 5. DF pump upgrade still needed
Alternative No. 2	Keep screens. Install recycle line; and bypass blend tanks. (2-stage pumping)	1. Eliminates spill risk at blending tanks 2. Solves screens wear problem from intermittent operation 3. Relatively low equipment cost to implement 4. Eliminates maintenance on blend tanks and pumps	1. Tricky 2-stage pumping controls 2. Lots of existing control strategy modifications 3. Significant amount of new controls to reprogram 4. Numerous pieces of equipment to maintain remains-high maintenance cost 5. DPU capacity limits
Alternative No. 3	Do 2-stage pumping from cake wetwell to digesters. Bypass screens and blend tanks.	1. Minimum DCS reprogramming 2. Low equipment cost 3. Eliminates blending tank spill risk 4. Eliminates maintenance on screen and reduces odor	1. Tricky 2-stage pumping controls 2. Lots of existing control strategy modifications
Alternative No. 4	Do 1-stage pumping to the digesters. Bypass screens and blend tanks and digester feed pumps.	1. Eliminates screen and blending tank problems 2. Eliminates several DCS strategies 3. Frees up many I/Os badly needed in Area 76 4. Low OM cost (no screens, blend tanks, and digester feed pumps) 5. Eliminates spill risk at blend tanks	1. Reprogramming of TSL pump control strategy 2. Requires TSL pump upgrade

TABLE 3-3 (Continued) Alternative Solutions to Screens and Blend Tanks Problems			
Alternative	**Description**	**Advantages**	**Disadvantages**
Alternative No. 5	Do 1-stage pumping thru screens and to the digesters, bypassing blending tanks and digester feed pumps. Add a downstream recycle line to TSL wetwell.	1. Eliminates spill risk at blending tanks 2. Solves screen wear problem from intermittent operation 3. Simplifies existing DCS control strategies 4. Less equipment to maintain remains	1. Costly control strategy modifications 2. Significant amount of controls reprogramming
Alternative No. 6	Install a variable frequency drive on the TSL transfer pump motor.	1. Solves intermittent wear problem on screens 2. Moderate change in control strategy 3. No re-pumping of recycled sludge 4. VS operation well understood by OM staff	1. VFD installation is relatively expensive 2. VFD's require significant additional DCS monitoring points 3. DCS control of multiple process equipment remains
Alternative No. 7	Keep screens. Install check valve on digester feed line to digesters. Or a non-reverse ratchet on the digester feed pump.	1. Simple and very inexpensive solution 2. Does not require additional DCS monitoring	1. Check valves need constant maintenance 2. Changing digester feed pumps may still be required to match head requirements. New pump could possibly be fitted with an anti-rotation ratchet.
Alternative No. 8	Combine Alternatives 1 and 7 –Install recycle pipe and flow diversion valve and install check valves on digester feed piping.	See Alternatives 1 and 7 advantages	See Alternatives 1 and 7 disadvantages
Alternative No. 9	Combine Alternatives Nos. 6 and 7- Install VFD on TSL transfer pumps and check valve on digester feed piping.	See Alternatives 6 and 7 advantages	See Alternatives 6 and 7 disadvantages

The following five criteria were used to evaluate the above nine alternatives:

1. *Feasibility*: Is the alternative technically feasible?
2. *Meet Objectives*: Does the alternative meet both objectives of mitigating the screen operational problems and reduce the risk of overflows at the blending tanks from the digester backflow?
3. *Impacts*: What are the construction and implementation impacts of the alternative?
4. *DCS Resources*: What is the relative impact on DCS requirement?
5. *Cost*: What are relative construction and operation costs?

Preferred Solution:

Based on an evaluation workshop conducted between MWWD and MBC Design Consultant Metcalf & Eddy in April 2005, the participants ranked Alternative 8 as the best among the 9 alternative solutions. M&E has been tasked to perform preliminary hydraulic analysis to define pump head requirements on two operational systems: 1) the thickened sludge transfer pumps and screens system; and 2) the digester feed system. Operational parameters will also have to be defined in this evaluation effort. A design task order will be issued to M&E for this evaluation work.

After discussions with MBC staff, it was decided to revise the operational strategy of the sludge screens. Because of this, a request was made to M&E to consider in addition to the evaluation work identified above alternatives which totally bypass both the screens and the blending tanks and upgrade the TSL pumps to provide one- or two-stage pumping from the thickening centrifuges to the digesters (Alternatives No. 3 and No. 4).

3. See item #2 above for mitigation of the spill risk at the blending tanks.

4. Presently only one spiral heat exchanger is provided at each digester. It is recommended that these two blending tanks heat exchangers be relocated to the digester facility to provide standby heating and flexibility. These relocated heat exchangers could be trailer-mounted for easier installation.

ANAEROBIC DIGESTION (P-7)

Design Flows:
Minimum @ 90 gpm; Average @ 120 gpm; Peak @ 250 gpm @ 5% solids

Process Description

Biosolids Digestion in MBC is provided by three (3) fixed cover, single-stage, high-rate, complete-mix mesophilic (98^{o}F operation) circular digesters each at 3 million gallons capacity. These pre-stressed concrete tanks are 105 ft in diameter with 45 ft side water depth, and operate within a biogas pressure range of 9 to 14 inches water column. Currently, only one digester is in service which provides approximately 21 days detention time at average flows. The minimum required is 15 days.

Each digester is provided with the following equipment: 1) two (2) recirculation pumps at 550 gpm, 65 feet, 20 hp; three (3) centrifugal digester mixing pumps at 2,200 gpm with 41 feet head, 40 hp (two duty and one standby units); 2) three (3) axial mixing pumps 4,400 gpm, 18 feet head, 40 hp; 3) one (1) spiral-type sludge heat exchanger at 2.5 million Btu/hr heating capacity with 550 gpm sludge flow; and 4) three (3) digested

biosolids transfer pumps each rated at 550 gpm, 85 feet head and driven by 30-hp constant-speed motor for common use of the 3 digesters.
With the first digester utilized to handle average and maximum daily process flows, the second digester is reserved for standby emergency storage (overflows or transfers). The third digester is presently reserved for MWWD's peak wet weather flow management.

ANAEROBIC DIGESTERS

Problems

1. *Poor design of the ferric chloride (FC) system:*

    a. The FC injectors are mounted in steel pipe sleeves that penetrate the digester side walls near the base of the digesters. These pipe sleeves are subject to FC concentrations that can corrode the sleeve and cause a digester spill.

    b. The actuators provided are too large for the size of the PVC piping in the FC system. These oversized actuators can exert too much torque on the valve operators and can break the valves. A valve breakage will cause a chemical spill.

2. *Undersized overflow pipe:* The common overflow pipe from the 3 digesters to the Digested Biosolids Storage Tanks (DBST) has insufficient capacity when the receiving DBST is near its high operating level. In addition, this common overflow pipe is inadequately sized to handle flows generated during digester transfer operations and in the past resulted in overfilling the digester and spilling from the digester overflow boxes.

3. *High overflow weir level.* The Digester Emergency Overflow Weir Level is too high: This has caused the digester liquid to rise above the digester's roof level before it can overflow to the emergency overflow system. This could result in hydraulic uplift force that can potentially damage the roof structure. This was of great concern after construction to the plant's designer.

4. *Unstable gas and foaming operations*: These occur due to excessive digester mixing (to prevent solids accumulation). MBC O&M staff has alleviated the gas foaming problem by reducing the axial mixing pumps operating duration to 2 days per week.

Recommended Improvements

1. Recommended corrective measures for the FC feed piping /valves problems:

   a. On one of the digesters, MBC O&M staff has capped the ferric chloride injection pipes (at 3 locations) and instead extended the FC feed pipe up to roof level and into a roof-mounted injector so that the corrosive chemical is dripped down onto the digester liquid eliminating risk of corroding any ferrous digester material. Modify the FC injector piping for the other digesters similarly.

   b. Reduce the risk of breaking the FC valves by eliminating unnecessary actuators in the FC system and modifying the strategies accordingly. Routinely check with equipment vendors for smaller actuators that are better suited for this type of service.

2. The operating high water level in the digested biosolids storage tanks (DBSTs) needs to be lowered to provide more capacity in the common overflow pipe. The 10-inch overflow main splits into two 6-inch pipe branches each discharging to a DBST. This pipe size reduction restricts the overflow. If space allows, these 6-inch branches need to be enlarged to 10 inches.

   It is recommended that a hole be cored through the wall between the overflow boxes and the emergency overflow box to avoid submerging the digester roof.

3. The emergency overflow weir level needs to be lowered to eliminate this risk of structural damage to the digester roof. Core a hole through the wall between the overflow box and the emergency overflow box to avoid submerging the digester roof.

4. It is recommended that the current 2 days per week operation of the mixing pumps be maintained.

BIOGAS COLLECTION AND STORAGE (P-8)

Design Flows:
Biogas flow: 268,000 std. cu. ft./ day (minimum) / 383,000 std. cu. ft./day (average) 575,000 std. cu. ft./day (peak)

Process Description

Biogas is collected from the 3 digesters and 2 biosolids receiving tanks via 12-, 24-, and 30-inch diameter gas piping. The biogas is compressed and transferred to the COGEN Facility where it is mixed with the landfill gas and used as fuel for the electric generators. Any biogas not sent to COGEN is burned using biogas flares. The biogas system consists of the following equipment:

- One 40 ft. diameter biosolids gas holder provides 25,000 cu. ft. capacity, at 12 inches WC design pressure (8 to 16 inches WC operating pressure)

- Two 25-hp gas compressors withdraw biogas from the biogas collection header and/or from the biogas holder and each discharge between 75 to 350 scfm (designed for 550 scfm) at 2 to 5 psig for use at the COGEN facility. Standby natural gas feed from SDGE is available for safety to avoid low pressure delivery and to prevent drawing air into the gas pipeline. Compressors currently deliver about 300 scfm as set by plant O&M staff.

- The system also consists of two biogas burners or flares plus auxiliary equipment: collection headers, condensate sediment traps, condensate wet wells and pumps. The flares use natural gas to ignite the pilots which in turn ignite the biogas burners.

WASTE BIOGAS FLARES

Problems

1. *No emergency power to the gas flares*: During a plant power outage, the gas flares shut off and fail to reignite as they are not connected to any emergency power supply. Flares become inoperative during an outage.

2. *Condensate accumulation*: Problems associated with condensate accumulation in the biogas piping are present.

    a. Condensate accumulates at condensate traps installed in valve pits. Each trap (total of 6) is at the terminus of a branch pipe connected to a low point of the gas collection header (low pressure). At each trap, the occasional failure of the automatic (motorized) drain valve combined with gas pressure transients resulting from sudden increase in flows from PLWTP have caused the water in the trap to be blown out and resulted in occasional hazardous biogas emissions. Because of this, operators have opted to close the upstream manual isolation valve and perform the daily task of manually draining any accumulated condensate in the gas header. The installed condensate trap device itself has thus become, manually-operated instead of automatic.

    b. Condensate accumulation in biogas pipe: Due to its design, the high pressure discharge piping of the biogas compressors is subject to condensate accumulation. Cooling of the hot gas as it travels through the buried cooler pipe may form condensate. The low point of the biogas piping is buried under a road with a vertical curve section to avoid interference with utility pipes. Per construction drawings, this pipe section is not provided with a condensate trap or drain. Installing a condensate drain will be very tricky. With the 5 psig gas pressure, the condensate can collect at this low point and carry over by the biogas flow to the COGEN engines. Presently, it is not known if the moisture observed in the biogas feed to the COGEN facility is from the MBC biogas or from the Miramar landfill biogas.

Recommended Improvements

1. A recommendation to provide emergency power from Area 76 diesel engine-generator sets to the flares and its biogas motorized valves is under review for implementation.

2. a. In 4 of the 6 condensate traps, plant staff installed a water U-trap with a utility water connection. The upstream manual isolation valve operator was fitted with an extended shaft to allow manual operation from ground level. These modifications need to be done on the two remaining traps.

b. Before implementing a corrective action, plant staff needs to continue monitoring for evidence of condensate accumulation in the buried pipe. Once confirmed, evaluate alternative solutions and develop the design of the drain installation.

DIGESTED BIOSOLIDS STORAGE (P-9)

Design flows:
NSPF: Average @ 125 gpm; Peak @ 280 gpm @ 3% solids
PLWTP: Average @ 800 gpm; Peak @ 2,100 gpm @ 3% solids
Total: Average @ 925 gpm; Peak @ 1480 gpm

Process Description

Biosolids storage and pumping equipment consists of the following: 1) Two (2) receiving tanks (one duty, one stand-by) at 1.3 million gallons each at 70 ft diameter, 45 feet sidewater depth; 2) Three (3) Dewatering Transfer (DWT) Pumps each rated at 750 gpm, 67 ft TDH, with 20 hp variable-speed motor: 3) Five (5) digested biosolids mixing pumps (4 duty and 1 stand-by); and 4) one pig receiver.

The Digested Biosolids Storage Tanks (DBST):
1. Receive digested biosolids at a rate of 90-300 gpm from the MBC Anaerobic Digesters (biosolids from NCWRP)
2. Receive digested biosolids from PLWTP (800 gpm ave and 2,100 gpm peak)
3. Provide over one day of storage at average biosolids flows from PLWTP

DIGESTED BIOSOLIDS STORAGE TANKS

Problems

1. *Gas venting at PLWTP sludge feed pipeline:* Small increases in flow from PLWTP result in unstable inflows into the DBSTs. These abnormal flow spikes are observed for a period of 15-20 minutes after PLWTP varies its flow. This is of particular concern when restarting the sludge flow in the PLWTP forcemain. At a minimum starting sludge flow of 350 gpm from PLWTP, MBC can see peak inflows exceeding the PLWTP flow by a factor of 5. During these spike events, upsurge can cause the biogas to be vented from the DBSTs. (See problem #4 in previous Biosolids Storage section). This problem is believed to be caused by “gas binding” at a high point in the incoming pipeline. Although an air-vacuum and air-relief (AVAR) was provided at this high point, it has been isolated from the pipeline to avoid continuous venting of methane gas immediately upwind of the Area 19 Main Plant Switchgear (MPSG) air intake. The continuous venting is a result of the AVAR being at an elevation higher than the DBST low operating level. MBC O&M resorted to periodic manual venting of the pipeline. This practice was discontinued due to compliance concerns with the APCD and due to safety concerns.

2. *Incorrectly located pressure relief device:* A rupture disc installed to protect the PLWTP sludge pipeline from abnormal high pressures is incorrectly located. This pressure relief device was installed on a piping section near the DBST’s area which has the lowest pressure rating at 150 psig. Plugging of the pipeline at the intermediate upstream pipe section (250 psig rated) can potentially result in higher pressures (up to 405 psig). This pipe clog could rupture this important pipeline.

3. *Undersized dewatering transfer pumps:* The existing dewatering transfer pumps are undersized in flow capacity. Most of the time, all three pumps (including standby) are required to run to keep pace with the dewatering process biosolids inflows. Additionally, the existing control strategy for these pumps is needlessly complicated and further handicaps the output of the pumps.

4. *Too much grit in PLWTP inflow:* On inspection of the DBSTs, the PLWTP inflow was found to have a large amount of grit. This abnormal grit volume causes plugging of the dewatering transfer pumps, its suction piping, and results in more frequent cleaning of the storage tanks. These problems are magnified anytime PLWTP draws down one of its digesters for maintenance.

5. *Risk of biosolids tank wall punch-through:* One of two overflow pipes between the biosolids storage tank and the emergency storage tank is hard-piped. This rigid piping is not recommended by the tank designer. Rubber expansion joints are provided at the wall connection to one tank but not on the overflow piping tank connection. Without the expansion joint, even a moderate seismic event could cause this hard piping to punch through a tank wall, damaging the tank and risking a spill.

Recommended Improvements

1. Investigate the cause of the unstable inflows and develop a corrective plan.

2. A technically feasible solution is to install a new pressure relief device or relocate the existing device on the intermediate pressure section of the pipeline. The exact location of this new pressure relief device will be further investigated.

3. Install pumps with the necessary flow and head capacities. A project to reestablish the intended design flows and redundancies and to simplify the control strategy has already been designed and bid. Completion of this project is recommended.

4. Several improvements are implemented to address the grit problem:

    a. As part of the dewatering pump upgrade project (under construction, to be completed in October 2005), chopper-type pumps will be installed to better handle the grit and unscreened solids.

    b. Also included in the dewatering transfer (DWT) pumps upgrade project is the installation of an 8-inch reclaimed water flushing connection on the pump suction header.

    c. All of PLWTP's digester sludge screens are now on-line and should help reduce the grit amount in the MBC inflow. Continued operation of the PLWTP screens is recommended.

    d. The design of a PLWTP project to upgrade its existing grit tanks and equipment has been completed and bid but construction is currently on hold. Depending on acceptance by the City of the BAF and the secondary treatment technology that will be selected, construction of the grit tanks project should be implemented as soon as possible.

5. An in-house project is underway to reconfigure the overflow piping between the DBSTs and install expansion joints at the tank wall connections for seismic protection. The project is being constructed in conjunction with the DWT pumps upgrade.

CENTRIFUGE DEWATERING (P-10)

Design flows:
Minimum @ 700 gpm; Average @ 920 gpm; Peak @ 1900 gpm
Design Dewatered Biosolids: flows: Minimum @ 70 gpm; Average @ 90 gpm; Peak @ 130 gpm

Process Description

The 250-hp dewatering centrifuges process the digested biosolids sent from MBC's anaerobic digesters and from the Point Loma Wastewater Treatment Plant. There are a total of eight (8) solid bowl, scroll-type centrifuges each designed for biosolids flows of 180 gpm average and 300 gpm maximum. Actual flows are at 200 gpm and 225 gpm respectively with 2.5 to 3.5 % solids. Solids capture rates are from 95% average to 97% peak. Four units operate on average plant flows while 5 or 6 units run on "catch-up" or "recovery" mode or during peak flows. The remaining two units are assigned standby duty due to lengthy repair times needed.

Cake from the 8 centrifuges is discharged to 4 centrifuge bins each with two reversible screws. Each cake bin can unload 10 tons per hour of cake to 2 cake hoppers. A piston-type cake pump withdraws cake from each cake hopper and sends the cake to the Biosolids Storage silos. There are a total of eight (8) cake transfer pumps (Schwing Model KSP 25), each capable of pumping the cake at 150 gpm with 1740 psi head.

DEWATERING CENTRIFUGES

Problems

1. *Standby capability deficiency*: Presently, there are 8 dewatering centrifuges and 8 dedicated sludge feed pumps. If a pump goes out of service, then the corresponding centrifuge also is put out of service or vice-versa. Centrifuge units #1 and #8, including their paired feed pumps, are designated for standby service only for centrifuge units #3/#5/#7 and #2/ #4/ #6, respectively. Due to this present control strategy, all auxiliary equipment of the centrifuge (sludge feed pump and chemical feed pump included) are routed and controlled via the centrifuge controls. Feed pumps #1 and #8 by themselves cannot provide standby service if a pump in its group is put out of service. As the shutdowns for repair and maintenance of the centrifuges become more frequent, standby pair units #1 and #8 are called to duty more often and for longer periods than intended. On occasions when a standby pair is on duty and an auxiliary equipment of a regular duty centrifuge fails, that whole unit will have to be shutdown as the control strategy dictates, decreasing the dewatering process output.

2. *Inadequately-designed centrate collection pipe system*: Existing undersized and inadequately designed centrate (CN) collection headers result in centrate surcharging at the centrate discharge chutes and causes centrate to overflow into the foul air duct connections. The surcharging is caused by flow interruption at the CN header tees (instead of lateral wyes) and insufficient slope of the centrate collection headers. Centrate in the odor collection ducting eventually gets to and damages the odor fans and scrubbers in Area 60. The presence of centrate in the foul air ducts reduces their exhaust capacities. O&M staff has thus connected drain piping on the odor headers and routed these drains to the area floor drains for centrate removal. The large amount of drained centrate overspills at the floor drains creating a safety hazard for the operators.

   The centrate routed to the area floor drains ends up at the plant's wastewater disposal system instead of the centrate collection system. This overloads the wastewater pump station and also violates discharge regulations for the monitoring of MBC's centrate flows.

   The centrate-loaded foul air duct header in the pipe gallery also runs the risk of collapsing if its hanger supports fail from the extra weight. With a failed foul air duct header, safety of O&M personnel is at risk.

3. *Scaling of centrate pipe headers*: Significant scaling is observed in the centrifuge's centrate (CN) discharge chutes and in the two existing CN collection headers directly under the centrifuges. These CN collection headers must be cleaned with high pressure water every 3 months via flushing ports installed at the header ends. Similar scale build-up due to the centrate's high pH is suspected in the inaccessible 36-inch diameter main centrate collection header in the pipe gallery. With no access means into this 36-inch pipe, its condition has not been verified nor can it be addressed.

In addition, the 36-inch CN header has very minimal slope which limits flow capacity and is conducive to solids settling. There is no provision for flushing/draining this CN main.

4. *Cake hopper level sensor problem*: Centrifuge cake pump operation is controlled by a level sensor mounted on a 5-ft tall cake hopper. With the cake's tendency to "cone up," a requirement for a minimum of 2 feet sensor distance above the cake, and lower water level (LWL) at 6 inches above the hopper bottom, an actual hopper operating range of no more than 2 feet (vs. 3.5 ft design) is only available. The cake spatters in the hopper and also on the level sensor result in erroneous level readings. Worse, this short sensor operating height causes intermittent operation of the centrifuge, bin screws and cake pumps. This causes the bin screw motors to trip out due to high amperage when the bin level exceeds 1 foot (design was for 4 feet). This in turn causes excessive wear on the cake pumps when they ramp up from zero to full speed in short time. This problem also occurs with the cake pumps in the truck loadout area.

5. *Absence of biosolids preheating*: Due to constant plugging of the heat exchangers plant staff has rerouted the biosolids flow to bypass them. Per manufacturer, these heat exchangers are not applicable for the digested biosolids application.

6. *Capacity limitation of centrifuges*: Average flows to the dewatering centrifuges are within the design flows set for the Consumer's Alternatives Phase 1 year 2010 figures. However, due to operational conditions, MBC's experience shows the need for an extra unit available for standby service or the need for larger capacity centrifuge units. Several factors contribute to this need:

    a. Very slow recovery from a shutdown
    b. Undersized capacity of the dewatering transfer pumps including quick wear and poor reliability (about 1,000 hrs actual operation life vs. 2,000 hrs design life)
    c. Inadequate capacity of the centrate collection headers under the centrifuges
    d. Equipment redundancy inadequacy resulting from operational control problems
    e. Low flow peaking factor used in design (1.4 vs. 2.0 needed) resulting in process equipment being undersized to handle significantly larger flows than projected

Recommended Improvements

1. With the lack of space inside the existing centrifuge facility structure, the addition of two more centrifuges (one for each set of 4) to provide standby capability is not feasible. On the other hand, the alternative of enlarging the structure to provide the needed space is economically prohibitive. A solution that provides a more flexible arrangement with true redundancy would be the addition of a 5th sludge feed and 5th polymer feed pumps to each set of centrifuges, independent of the centrifuge controls and dedicated as standby pumps for each centrifuge group. Regardless, the current

overall control strategy of having a single piece of equipment providing standby service to many units as well as dedicated service to a specific centrifuge needs to be reevaluated and revised.

With the MBC mass balance model runs performed by Brown and Caldwell (see Appendix C), it has been determined that the addition of one of two more centrifuge units or replacement with larger units to provide more dewatering capacity (Problem P-10.6) will not be required until 2025. In the interim period, due to increasing wear and tear, the existing centrifuges will be replaced with new same size units. The centrifuge capacity and redundancy problems will be addressed with the implementation of a number of projects (See recommendation #6). Among these, the addition of the 5th sludge and 5th polymer feed pumps for each of the 2 sets of dewatering centrifuges (4 units each set) will alleviate the redundancy problem. This project has been approved for implementation in FY 2007-2010.

2. To address centrate header overflow problems, a project was recently completed in 2005 that installed a U-pipe trap at the CN's 36-inch tee connection to prevent centrate overflows into the odor control exhaust ducting. A phase 2 construction will replace the odor header ducting with ductile iron piping with wye connections and with steeper pipe slope. This will provide a second header for added centrate withdrawal capacity while the header also serves as a foul air conduit. A final third phase is planned to address future larger units or additional centrifuge units. This phase consists of replacing the two existing original centrate headers under the dewatering centrifuges with larger size headers.

3. Install access ports on the 36-inch drain header for needed flushing and cleaning work.

4. Inadequate room height and congested space do not present options for installing taller bins. A water spray system to flush the level sensor periodically, manually or automatically, should be investigated. Additionally, investigate modifying the cake pump operation to reduce to operating level in the cake hoppers.

5. The spiral-type solids heat exchangers have been isolated and bypassed. As these heat exchangers are not suited for the digested biosolids as manufacturer admits, their removal is recommended. The proper type of heat exchanger needs to be looked into.

6. Because of the many factors constraining operating capability of the dewatering centrifuges, increased capacity is needed. This can be accomplished by replacing existing units or adding more units as recommended in Consumer's Alternative Plan Phase 2. However, existing space constraint negates the option of adding more units. Due to this space constraint, replacement of some of the existing units with larger capacity units appears to be the only feasible expansion alternative. This capacity upgrade though has been determined in the Phase 2 Mass Balance Model Runs of this

planning effort to be required not until 2025. It should be noted that mechanical equipment in general is allotted a 20-year life span. For these 24-hour duty heavily used and high speed equipment, a lower life of about 10 to 15 years may be expected. MBC was constructed in 1998 and its frequently repaired/maintained centrifuges will be close to their 15-year life in 2010. Their replacement should be done about that time.

MWWD has decided to implement three projects to address the capacity (including redundancy) problems of MBC's dewatering process namely the following:

1. ***Dewatering Transfer Pumps Upgrade (P-9.3)***
2. ***Standby Centrifuge Sludge Feed and Polymer Feed Pumps Installation (P-10.1)***
3. ***Centrate Collection Piping Upgrades-Phases 2 and 3 (P-10.2)***

These projects are listed in Table 1-3 (also Table 6-1) among other major projects approved for construction capital funding from FY 2007 to FY 2030.

DEWATERED BIOSOLIDS STORAGE AND LOADOUT (P-11)

Design Flows

Minimum 35 dtpd; Average 150 dtpd; Maximum 180 dtpd.
Actual flows (Year 2001-2004): 250-400 wtpd ave.; 100-125 dtpd avg.; 180 dtpd max

Process Description

There are eight storage silos, each at 7,000 cu. ft. capacity (18 ft diameter and 28 ft height). Ten silos were originally planned for installation for Phase I of the Consumer's Alternative. The whole storage system presently provides an average of two days storage for the dewatered biosolids at the design capacity of 180 dry tons per day (dtpd). Currently solids hauled out range from 70 dtpd to a maximum of 180 dtpd. Each storage silo is equipped on top with a pug mill cake chopper and at the bottom with three live-bottom screws. Each set of live-bottom screws feed to a cake hopper assembly then to a silo cake pump. Each silo cake pump (total 8) can also pump the cake at 10 to 150 gpm at 1,200 psi maximum pressure to one of the two loadout bins.

The Biosolids Loadout Facility consists of two trains; each train equipped with lime feed system, cake/lime mixer (90-100 gpm), a weigh bin assembly, a truck load bin assembly and a 60-ton truck scale. A lime bulk storage system was not provided so the lime mixer is not needed. The loadout system can unload 20 wet tons of cake batches in ten minutes. Presently, the load out facility loads 20 trucks per day on the average. After a long weekend storage (when no truck load out is done), 30 trucks each day are required on Mondays and Tuesdays and sometimes Wednesdays to haul out stored cake from all the silos.

DEWATERED BIOSOLIDS STORAGE BINS
AND TRUCK LOADOUT STATIONS

Problems

1. *Inadequate storage capacity for dewatered solids*. The MBC cake load-out facility was designed for a continuous 24 hours per day and 7 days per week operation. However, as landfill operations only allow 9 hours per day for truck delivery, the MBC loadout operation is restricted likewise. Dewatered solids storage silos normally fill up during weekends when no truck hauling is done. Therefore, any repair or maintenance work on the storage silos and loadouts after the weekend will lengthen unloading time for the stored cake. As haul trucks need to be loaded past the regular hours and landfills would have closed by those late hours, loaded trucks would need to park in the facility overnight and wait until next day to travel to the landfills. Parking loaded trucks overnight at MBC results in the emission of fugitive odors and odor complaints. The limited hours for disposal further compound capacity issues when O&M work is required on the cake feed piping system. This work can result in shutting down nearly half of the cake silo system. Thus a half-capacity loadout operation severely limits the dewatering and loadout capacity.

2. *Lime/cake mixer plugging*: The present lime storage and feed system has not been utilized due to the absence of a bulk storage tank. Instead, a small day tank along with a dry feeder and a lime and cake mixer are provided for each load-out system. Except for the lime/cake mixers, MBC has not operated other equipment. Presently, there is no need for lime treatment on the cake product. Frequent plugging of a

lime/cake mixer has reduced loadout capacity and created maintenance (odors and sludge spills) problems.

The following issues need to be addressed:

a. Currently, there is no bypass piping provided around the lime mixers to feed directly into the loadout bins.
b. A lime mixer limits the cake feed into a bin up to 100 gpm (200 gpm for 2 bins).
c. In addition to, if a lime mixer plugs, then cake feed to the 2 loadout bins is cut in half.

3. *Inaccessible frequently failing valve actuators*: Frequent failure of valves is compounded by the lack of access to many of the valve actuators for servicing and position determination. Depending on the valve position at time of failure, several silos and dewatering centrifuges could be forced out of service significantly reducing process capacity.

4. *Potential piping leak damage to electrical equipment*: Chilled water valves and piping for Air Handling Units. 7 and 8 are dangerously located above MCCs and pose risk of damaging electrical equipment in the event of a leak or spill from these assets during repair/maintenance work.

5. *Short landfill operating hours*: This combined with odor control issues related to on-site storage of loaded trucks, have reduced loadout capacity to the point that operating just one of the two loadouts will not meet production demands.

6. Need for Class "A" biosolids in future?: Changing regulations may likely require the production of Class "A" biosolids.

Recommended Improvements

1. Provide 2 additional storage silos and either of the two alternatives described below.

<u>*Alternative 1- Reuse Existing Loadout Facility*</u>

Provide a direct truck loading station to provide load-out capacity in emergencies. Install in the existing loadout facility two additional storage silos or a pair of additional loadout stations so that the biosolids can be pumped directly from the centrifuges or silos. These stations will not be provided with weigh/mix bin assemblies; however, truck scales will be provided.

Alternative 2- Construct New Loadout Facility

Provide a new loadout facility: This alternative will require the construction of a new automated loadout facility to provide a 3rd and 4th loadout stations. This new facility can provide emergency duty service to allow necessary O&M work shutdown on any of the two existing loadout stations in Area 86 without impacting loadout capability. Compared to Alternative 1, this is a very costly alternative.

A comparison of the two Loadout alternatives is presented in Table 3-4. Figure 3-11 shows the concept plan for each alternative.

TABLE 3-4
Biosolids Truck Loadout Alternatives

ALTERNATIVE 1 REUSE EXISTING LOADOUT FACILITY	**ALTERNATIVE 2** CONSTRUCT NEW LOADOUT FACILITY
Advantages	**Advantages**
1. Uses existing facility	1. Significantly increases loadout capacity; independent loadout capability
2. Inexpensive	2. New structure designed to accommodate future Class A biosolids facility requirements.
3. Easier to design	3. New structure designed to provide complete area classifications separation per OSHA safety requirements.
4. Cake pumps need not be upgraded	
5. Assumes continuance of Class B biosolids production	
Disadvantages	**Disadvantages**
1. Does not significantly increase existing loadout capacity	1. Very costly; more/longer cake piping needed
2. Requires operator work booth enclosures for personnel safety	2. Needs new odor control facility
3. Requires the addition of 2 additional silos sooner.	3. Requires upgrade of existing cake pumps to handle higher head or install dedicated higher head pumps for new facility
	4. Enlarges area of work responsibility for operators.

If Class A biosolids will be required in the future, Alternative 2 is recommended. If regulations will not require Class A biosolids production in the future, then Alternative 1 is recommended.

Per Alternative 1 above, MWWD has made a decision to install the emergency loadout stations (including direct feed pipeline) in FY 2007 in conjunction with Recommendations 2 and 5 below. MWWD has also determined that 2 additional silos (units #9 and #10) are critically needed and implementation of this 2-silo addition project is scheduled for 2007- 2014 (See Table 2-8).

2. Install bypass piping around the lime mixer on each cake weigh/mix bin. Bypassing the lime mixers will allow for a 33 percent increase in cake loading capacity (3 cake pumps in operation) of each bin. If MBC decides in the future to provide lime treatment, then the lime storage/ feed system can be recommissioned easily.

   A design project has been initiated to install the bypass piping around the lime mixers. However, it was realized during design that during this piping installation, a weigh/mix bin and loadout station will have to be taken out of operation which will place the entire loadout operation in a stressed condition. It was decided to install the emergency loadout stations in Recommendation 1 above prior to the installation of the lime mixer bypass piping to mitigate the operational interruption. (See also Recommendation No.5 below).

3. Evaluate valve accessibility conditions. Either provide access platforms or catwalks to subject valves or relocate where easily accessible. Overhead valves with motorized operators need to be furnished with chain operators.

4. Relocate valves away from problem area. Piping may have to be rerouted to do this.

5. The installation of two new, totally independent, manually- operated emergency truck loadout stations with direct-feed cake piping from the existing centrifuges or storage silos and built next to the existing loadout bays is recommended to provide capability to increase loadout capacity during peak biosolids production hours,

   Per City decision mentioned in Recommendation No. 1 above, a in-house MWWD project to install these two emergency loadout stations is now under an accelerated design and construction schedule to have it operational for the lime mixer bypass project by the start of Fiscal Year 2007.

6. Provide a new loadout facility with 2 new loadout stations similar to the existing stations and a sludge drying process to generate Class A biosolids.

CHEMICAL STORAGE AND HANDLING SYSTEMS (P-12)

General

The MBC Facility uses various chemicals in liquid form for its solids processes and the odor control systems. These chemicals and their applications are listed below:

TABLE 3-5 Chemical Application at MBC	
Chemical	**Application**
Caustic Soda	Odor control
Sodium Hypochlorite	Odor control
Sulfuric Acid	Odor control
Ferric Chloride	Scale/Sulfides/Odor control; Dewatering Aid
Polymer (emulsion-type)	Thickening (discontinued)
Polymer (mannich-type)	Thickening and Dewatering

All chemical bulk storage tanks, storage transfer pumps, chemical mixing tanks and mixed chemical tank transfer pumps are centrally located in the Chemical Building (Area 60). From the Chemical Building the chemicals are fed to local day tanks in areas where the chemicals are used. Chemical metering pumps feed the chemicals to various points of application in the process. At least one standby pump is provided for each chemical feed system.

CHEMICAL BUILDING

General Problems

The general problems described below and their recommended improvements apply to all chemical feed systems. The Ferric Chloride and Polymer Feed Systems and their unique problems, in addition to these general problems, are discussed in more detail in later sections.

1. *Inaccessible motorized tank valves*: Motorized isolation valves of bulk storage tanks and pumps are located at floor level in the spill containment cells. In the event of chemical or rain flooding, these valves get submerged and damaged in the flooded containment cell. Many of these motorized isolation valves are inaccessible for repair during flooding.

2. *Complex tandem piping and valves*: Dual bulk storage tanks are piped in tandem such that if a valve on one tank fails or leaks and needs service, both tanks would require shutdown. Repair of a single valve requires that the entire chemical feed system be shutdown and drained.

3. *Potential tank spills*: All chemical transfers from the Chemical Building occur via transfer pipes routed through the pipe gallery located below grade. A break or leak in the transfer pipe can empty out the bulk storage tank(s). In addition, a valve failure in the transfer line can overfill a day tank and cause a chemical spill.

4. *Pump suction capacity imbalance*: Different sizes of chemical metering pumps are manifolded to a common suction header. When the larger chemical transfer pumps operate, they starve out the smaller pumps.

5. *Electrical damage from flooding*: Electrical conduits are routed thru the floor of the containment cells and connect to motorized operators of tank valves on the bulk storage tanks. Containment cell flooding has resulted in chemicals entering into the conduits and damaging the wiring and other electrical equipment.

6. *Containment cell flooding*: In the event of heavy rains, the perforated roofing above the bulk storage tanks has resulted in flooding of the containment cells and caused flooding alarms.

7. *Single-walled chemical pipe spills*: Unshielded single-walled chemical piping outside of containment cells or trenches can develop leaks or accidentally rupture and cause an uncontained spill.

8. *Inaccessible tank isolation valves*: Isolation valves for the bulk storage tanks can only be operated from within the chemical containment cells.

Recommended Improvements

The following improvements are recommended to address the problems identified above:

1. Eliminate unnecessary motorized valves. Relocate remaining valves or provide adequate maintenance access.

2. Evaluate existing dual feed piping from bulk storage tanks to allow feed flexibility/ redundancy.

3. Due to hydraulic conditions, a high spot (standpipe with bleed line return to the storage tank) on each chemical transfer piping system must be installed to prevent potential chemical spills.

4. Revise suction header connections to the pumps to prevent uneven flow distribution.

5. Evaluate alternatives to reroute electrical wiring to spill containment cells. Electrical conduits need to be rerouted to ceiling level or to a level above the flood submergence level.

6. Raise the level of the flood sensors in the containment cells to prevent these flooding problems. Evaluate a way to install a solid roofing system without requiring fire protection revisions to this bulk chemical storage area.

7. Secondary containment piping equipped with a leak monitoring system should be installed to prevent a potential hazardous spill event.

8. Provide access/ maintenance catwalks to these isolation manual valve locations or consider installing motor operators on these manual valves for remote operation.

POLYMER STORAGE AND MIXING SYSTEM (P-13)

Process Description

The initial design of the polymer system is shown in Figure 3-12. The design was based on using two different types of polymer for the dewatering and thickening applications. After 5 years of operation and process optimization, this two-polymer operation was modified as discussed herein.

Initial Design:

Emulsion Polymer (PE) System for the Thickening Centrifuge:
The PE system equipment consisted of four 8,500 gallon 10 ft diameter FRP tanks, two recycle/ transfer pumps (50 gpm, 35 psi), two emulsion polymer dispensers, two emulsion polymer dispensers, one 5,300 gal 8 ft diameter mixing tanks with mixers, one transfer pump (90 gpm, 35 psi), two day tanks, and five polymer feed pumps (5-20 gpm @ 50 psi). This system has been revised as discussed in the problems subsection.

POLYMER STORAGE

<u>*Mannich Polymer (PM) System for the Dewatering Centrifuges:*</u>
The PM system equipment consisted of two 12,000 gallon, 14 feet diameter and two 8,500 gal. 10 feet diameter FRP tanks, two storage tank transfer/ recycle pumps (35 gpm, 35 psi), two 5,300 gal 8 ft diameter mixing tanks with mixers, one mixing tank transfer pump (230 gpm, 35 psi), two day tanks, five centrifuge polymer feed pumps (10-40 gpm, 50 psi).
Piped common to these two polymer feed systems is a set of one mixing tank with a mixer and a mix tank transfer pump serving as a standby feed unit.

Problems

The initial polymer system was beset with problems associated with the use of two types of incompatible polymers. This dual-polymer use contributed to the following operational and maintenance difficulties:

1. *Polymer usage problem:* The amount of emulsion polymer usage at the Thickening Centrifuges is very small compared to the usage of the Dewatering Centrifuges. Emulsion polymer storage tanks lay idle for long periods as their volumes are used up very slowly, while the dewatering mannich polymer is consumed inefficiently in short periods. Due to the heavy use of the mannich polymer and its mixing equipment, the feed redundancy needed for the dewatering process has not been provided.

2. *Dual polymer handling difficulties*: Mannich and emulsion-type polymers are not compatible and existing system design could accidentally allow the two polymers to mix. The use of two different polymers, separated or mixed, created handling difficulties for the operators. Among these difficulties are: standby piping, valves, tanks and equipment used for the emulsion polymer need to be drained /cleaned thoroughly prior to switching to mannich use or vice versa. Also, existing piping design can by accident allow the two polymers to mix forming a gel that clogs the piping and is difficult to remove.

Recommended System Improvements

MBC has discontinued the use of emulsion polymer and decided to use the Mannich polymer for both the Thickening and Dewatering Centrifuges. No emulsion polymer is currently used.

With the plant's decision to use only the mannich polymer, the old polymer bulk storage systems were tied together to allow O&M optimal use of all storage tanks for use at both the dewatering and the thickening processes. The suction headers of the transfer pumps for each tank system were connected. The lack of feed/ mixing equipment redundancy for the dewatering process has thus been eliminated.

Likewise, a piping change and valve relocation on the polymer feed header of the common (standby unit) mix/ batch tank, will now allow all four tanks to be utilized for either dewatering or thickening processes, more importantly 4 batch tanks can now adequately cope with polymer mixing demand at the dewatering centrifuges. The use of a single polymer has expanded the feed capacity of the polymer batching for the dewatering use. With only one-type of polymer now used in the plant, the handling difficulties associated with two-polymer use has been eliminated. The polymer system control strategy is being revised for single polymer operation but has not been tested. Present polymer feed operations are still per original design except for use of a single polymer type. This will allow plant staff to switchover to the old strategy of using two polymers in the future if a more compatible emulsion polymer with competitive cost becomes available. It is recommended that testing of the control strategy for the use of single polymer be completed and finalized.

DEWATERING FERRIC CHLORIDE FEED SYSTEM (P-14)

Process Description

Ferric chloride is stored in two 11,000-gallon bulk storage tanks. Two transfer/ recycle pumps (at 20 gpm and 40 ft head, 1 duty and 1 standby unit) send the ferric chloride solution (42%) to two 4,500 gal day tanks in the Centrifuge Building. The day tanks are manifolded to serve eight diaphragm type chemical metering pumps. Each of these metering pumps feed the ferric chloride into the biosolids feed pipe of a dedicated dewatering centrifuge.

FERRIC CHLORIDE FEED AND TRANSFER (RIGHT) PUMPS

Problems

1. *Chemical leakage into centrifuges*: Soon after plant start-up, the plant staff learned that ferric chloride (FC) could leak into the biosolids inlet pipe of a centrifuge unit that was taken out of service. This results in catastrophic corrosion of the centrifuge unit including its associated dewatered biosolids feed pump. The corrosive chemical leaked also into the electrical and instrumentation conduits and panels and, worse, migrated to other electrical conduits/ panels of other centrifuge units resulting in very costly damage.

   To eliminate this major design piping error, operators have disconnected all ferric chloride piping into the centrifuge biosolids inlet pipes and instead piped them into the biosolids suction header of the centrifuge feed pumps. Thus, the corrosive FC is now being fed into a pipe that always has liquid flow in it and this prevents it from doing corrosion damage to the centrifuges.

   For this new feed strategy, four of the original 8 Tuthill metering pumps were retained (3 duty plus 1 stand-by), the other 4 were removed which allowed more access space around the remaining 4 pumps.
   As the original Tuthill pumps were complicated to maintain and repair (with long repair turnaround times), they have been discontinued (replacement parts are no longer available) and not supported by the manufacturer; 3 of the 4 Tuthill pumps were replaced with 2 Micropump units and 1 Seepex unit. For the single Tuthill pump remaining, parts are replenished from the removed units.

The 2 Micropumps work well but require frequent replacement of costly micro filters. The lone Seepex pump is under testing. After testing, the plant will change out all four pumps to a single manufacturer.

2. *Poor equipment access:* The ferric chloride metering pumps are very difficult to maintain due to poor access and very tight working space.

Recommended System Improvements

MBC has reconfigured the FC feed piping by disconnecting each dedicated feed pipe and in lieu connected the main FC feed line to the biosolids feed loop header to the centrifuges. This way, FC is being fed to a live pipe header that always has flow.

1. It is recommended for plant staff to continue its operational testing of the Seepex and Micropumps to determine which pump is best suited for this application.

2. It is recommended that the pump and piping layout be reconfigured when the new pumps are selected.

CENTRATE PUMPING STATION (P-15)

Existing Conditions

The centrate flow from the centrifuges is collected by 16-inch pipe headers which connect to a 36-inch gravity centrate/ plant drain header routed from the pipe gallery to the Centrate Pump Station on the western side of the plant. The flow comes from the following sources:

1. Centrate from the thickening and dewatering centrifuges.
2. Overflow from the digesters.
3. Overflow from the degritting system.
4. Emergency overflows from the blending tanks and the digesters.

The centrate wetwell has a capacity of 4,000 gallons and was designed to be "self-cleaning." Three (3) 100-hp variable-speed non-clog centrifugal pumps, each discharging a flow of 2,500 gpm at 95 feet of head, send the centrate to NCWRP where it flows by gravity via the Rose Canyon Trunk sewer to PLWTP. A magnetic flow-meter on the discharge pipe header measures the total flow from the pump station.

CENTRATE PIPE HEADER
IN THE PIPE GALLERY

Problems

Two old problems related to the centrate system have been addressed by the plant staff recently:

- Undersized air vacuum relief valves on centrate forcemain: During operation of the MBC centrate pumps, air gets trapped in the centrate forcemain to NCWRP due to inadequate venting of the undersized air and vacuum relief valves (one of each). This contributes to reduced centrate flow rate and probable internal pipe corrosion. This was corrected with the installation of the correct valve sizes, dual valves and added manual vent valves for redundancy. The revised air/ vacuum relief valving system on the centrate pipe has been working satisfactorily.

- Start-up priming of centrate pumps: A combination air-vacuum and air-release valve was installed on each pump which eliminated priming problems at pump start-up.

Current problems of the Centrate Pump Station are as follows:

1. *Scaling and reduced pump flow*. Actual discharge flow of each pump ranges from 1,500 to 2,000 gpm which is significantly lower than their 2,500 gpm rating. Scaling was observed on the pump discharge valves and piping. It was highly suspected that the 10- and 36-inch headers in the pipe gallery are severely scaled also. This was confirmed recently when a 36-inch pipe tee and the connecting piping from the

thickening and dewatering centrifuges was discovered to have thick scaling. The extent of scaling of the downstream centrate collection header (36-in. diameter) in the pipe gallery is unknown and cannot be determined due to the absence of provisions for pipe access and inspection including flushing and draining taps on the header.

2. *Non- "self-cleaning" Wetwell:* This problem is due to a poorly designed ogee ramp built to create the required hydraulic jump for flow turbulence, and the inadequate flow during a cleaning cycle to complete an effective "self-cleaning" operation. Plant staff has difficulty running the pumps in "self-cleaning" mode via the faulty DCS control strategy. Plant staff continues its testing to produce a workable automatic "self-cleaning" strategy.

   The wetwell could not be cleaned out by the special Vactor truck because of the absence of a hatch above it. Cleaning of the wetwell can only be done by the operator entering the space and manually hosing down the wetwell trench with high-pressure utility water. Foaming which is inherent of the centrate liquids has been observed in the wetwell which makes visual determination of water level difficult.

3. *Faulty operating valve:* Even at MANUAL mode, the motorized isolation valves for pump #2 close by themselves and shut off the pump. The cause of this problem has not yet been identified by MBC staff.

Recommended Station Improvements

1. Provide inspection ports flushing/ draining connections. Evaluate replacement of pumps with larger capacity units. Evaluate future ultimate flows with the scheduled addition of more thickening and dewatering centrifuge units for the Phase 2 expansion in 2010. The addition of a chemical to prevent scaling should also be looked at.

2. Install a hatch directly above the wetwell to allow easy access for vactor trucks. Plant staff is continuing with testing the DCS control strategy for the "self-cleaning" operation by trying out various liquid levels versus pump start-stop levels. Staff is confident that they will be able to develop a functional revised control strategy.

3. In order to identify root cause of valve malfunction, it is recommended that O&M staff initiate a trial-and-error testing procedure of replacing components. Start with the cheapest items first, replacing the control wiring, then the electrical feed wiring, then the valve master station, etc.