Technical Memorandum

RMC Water and Environment

SMCSD Headworks, Primary and Secondary Treatment Pre-Design

Subject: **TM 5: Primary Treatment**

Prepared For: SMCSD

Prepared by: Mark Takemoto

Reviewed by: Steve Clary, Dennis Gellerman

Date: October 3, 2011

Reference: 0055-003

The purpose of this technical memorandum (TM) is to present the evaluation and preliminary design of the primary treatment process to be implemented at the Sausalito-Marin City Sanitary District (SMCSD) Wastewater Treatment Plant (WWTP). This TM is intended to be included as an appendix to the Recommended Project Summary, which includes a summary of major recommendations. All drawings referenced in this TM are bound together as a separate attachment. The TM is organized in the following sections:

1 Summary Findings and Conclusions

To provide additional redundancy and reliability, SMCSD is currently evaluating alternatives to provide additional primary treatment facilities so that the existing primary clarifier can be removed from service for upgrades and maintenance.

Originally, only compact technologies were considered as part of the evaluation due to the limited amount of space available on the treatment plant site. However, it was later determined that additional land may be available north of the existing treatment plant access road. Relocating the access road to the north would provide sufficient area to locate a new conventional circular primary clarifier on the treatment plant site. A conventional circular primary clarifier is the recommended process based on its proven reliable operation, minimal O&M requirements and performance. The conventional circular primary would be configured to match SMCSD's existing primary clarifier, such that the new and existing primary clarifiers would be interchangeable.

The evaluation of compact primary technologies is included at the end of this TM to document the findings from the compact technology evaluation.

2 Existing Primary Treatment Facilities

The SMCSD WWTP currently has one existing circular primary clarifier with an influent center well built in the 1950's. The existing primary clarifier has a diameter of 55 feet and a side water depth of 9.5 feet. Primary sludge is collected and thickened at the bottom of the clarifier and then sent to digestion.

Currently, waste sludge from the fixed film reactors is also sent to the primary clarifier for co-thickening. Thickened sludge from the primary clarifier is pumped to the primary digester (originally the secondary digester), which is located directly below the primary clarifier in a stacked configuration.

If needed, the plant has the ability to route primary influent around the primary clarifier to one of the two existing secondary clarifiers, which can be used temporarily as primary sedimentation basins. The District has experienced poor treatment performance when the secondary clarifiers have been used this way. Therefore, the existing primary clarifier cannot be taken out of service for maintenance or repairs without adversely impacting plant performance. The current primary treatment process loading is presented in Table 1.

Table 1: Current Process Loading

Process	Units	Average Day	Peak Day Wet Weather	5-Year Event Instantaneous Peak	Typical Peak Flow Design Value
Flow					
Influent Flow	MGD	1.5	6.0	12.3	---
Primary Clarifiers					
Units	--	1	1	1	--
Side Water Depth	ft	9.5	9.5	9.5	14
Surface Area	ft^2	2,376	2,376	2,376	--
Surface Overflow Rate	gal/day-ft^2	631	2,525	5,177	2,000-3,000

Notes:
Typical design criteria taken from Metcalf and Eddy, Inc, *Wastewater Engineering Treatment, Disposal and Reuse*, 3rd edition.

Although the existing primary clarifier can hydraulically pass the peak instantaneous wet weather flow, the surface overflow rate during that condition is higher than the typical peak design value. The clarifier's solids removal capacity is greatly reduced at peak flow rates, especially given the relatively shallow side water depth. Consequently, there is a need to increase primary treatment capacity at peak wet weather flow rates.

3 Compact Primary Treatment Technology Evaluation

Due to the limited amount of space available on the treatment plant site, relocating the access road to the north would be needed to allow siting of a new conventional circular primary clarifier. Therefore, the primary treatment evaluation included consideration of compact primary treatment technologies, which are described below.

3.1 Evaluation

To better accommodate peak wet weather flow, and to provide redundancy at the WWTP facility, the addition of new primary treatment is being evaluated. Primary treatment of wastewater typically follows screening and grit removal. There are three main objectives of primary treatment:

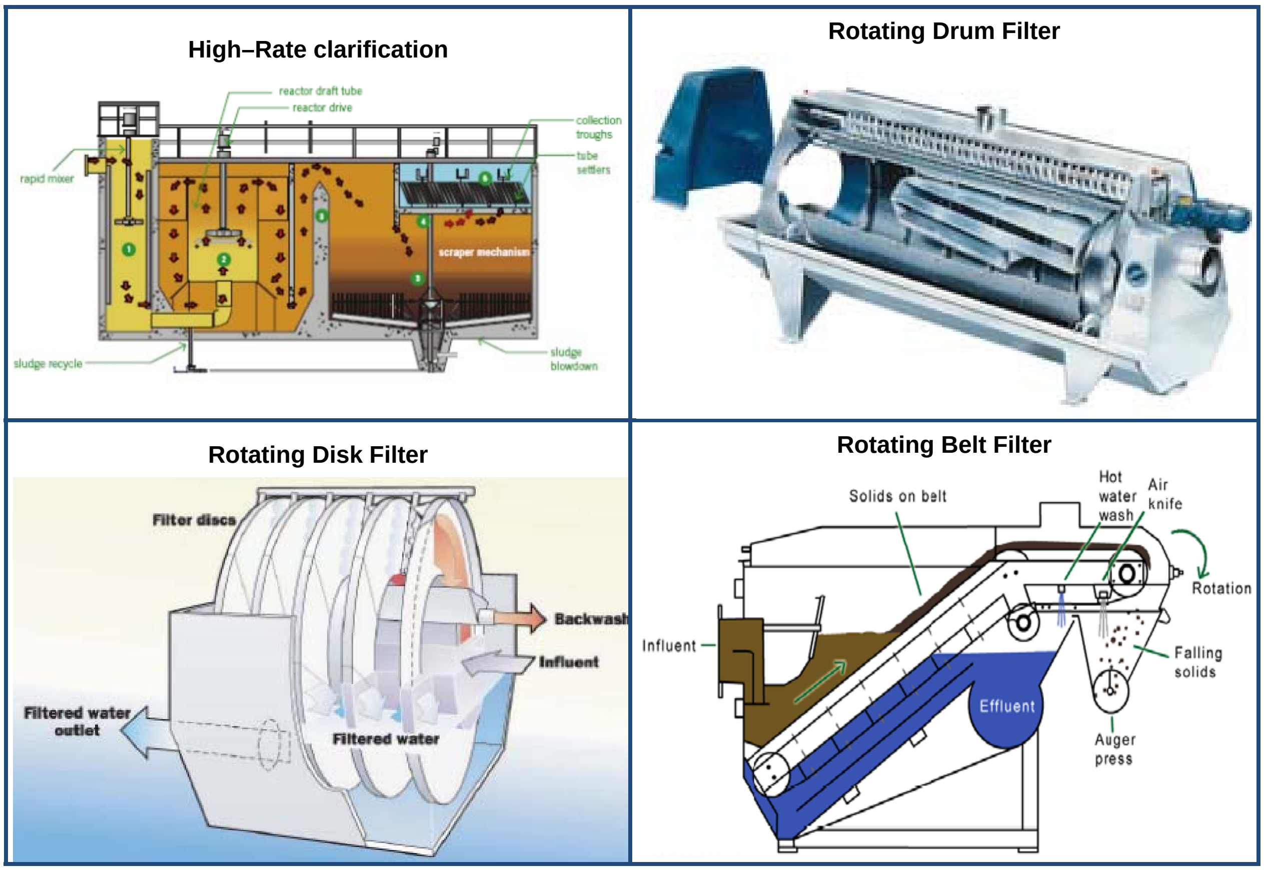
1. Remove solids (sludge) from wastewater, thereby reducing the organic load on the secondary treatment processes
2. Remove scum, grease, and other debris that could foul downstream equipment
3. Thicken removed solids to allow subsequent processing of those solids

Due to the limited amount of space available on the WWTP site, compact technologies were considered as part of the evaluation. A preliminary list of potential compact technologies was developed and included the following:

- High–Rate clarification (e.g. Densadeg or Actiflo)
- Rotating Drum Filter (e.g. Waste Tech Roto-Sieve Drum Screens)
- Rotating Disk Filter (e.g. Kruger/Hydrotech Disk Filter)
- Rotating Belt Filter (e.g. Salsnes)

Illustrations of each of the technologies are presented as . High-rate clarification is a sedimentation process that includes coagulation and flocculation to facilitate solids settling. The remaining three technologies are all physical separation (filtration) technologies that physically screen out solids from the wastewater.

Figure 1: Potential Primary Treatment Technologies



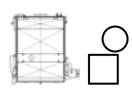
Information on the primary treatment capabilities of the technologies listed was reviewed to confirm whether the equipment would be a viable option for the SMCSD facility. With the exception of the rotating belt filter, the technologies listed were originally developed, and are actively used, as headworks screens (rotating disk and rotating drum) or as a tertiary filtration (high-rate clarification) processes.

Based on communication with a rotating drum filter manufacturer, the rotating drum filter was not recommended (by the manufacturer) as a primary treatment alternative to a traditional primary clarifier.

Based on discussions with SMCSD operation and maintenance staff, it was determined that the high-rate clarifier not be carried forward due to the complexity of the process and the potential for grease and other solids to foul some parts of the process such as the lamella plate settlers. Therefore, only the rotating disk filter and rotating belt filter were carried forward for further evaluation.

The rotating disk filter and rotating belt filter were compared based on several characteristics, including solids and BOD removal performance, which are presented in .

Table 2: Primary Treatment Comparison Summary

Criteria	Rotating Belt Filter (Salsnes)	Rotating Disk Filter
Performance*		
TSS Removal	51%	47%
BOD Removal	30%	27%
Equipment Cost (per unit)	~$275,000	~$350,000
Energy Requirement (per unit)	14 HP	11.5 HP
Number of Installations for Primary Treatment Applications		
United States	2 (plus 2 in construction)	0
Canada	>5	0
Outside North America	>50	4
Upstream Screening Opening Required	≤ 19 mm (0.75 inch)	≤ 5 mm (0.20 inch)
Primary Sludge Solids %	5% (20% with screw option)	0.3%
Additional Primary Sludge Thickening Required	No	Yes
Footprint for one 3 MGD unit (1” = 20’)		
	107” x 102” plus blower 30” x 35” and water heater (30” diameter)	242” x 90”

*Source: “*Capital Regional Pilot Testing of Wastewater Treatment Technologies, Final Report*” prepared by Stantec. February 2005.

Both units have reported similar performance in primary treatment applications with approximately 50% TSS removal and 30% BOD removal efficiencies. These compare with typical expected removal efficiencies of 60% TSS and 35% BOD for conventional primary clarification.

The rotating disk filter manufacturer claims that 80% TSS removal can be achieved with polymer addition and 90% TSS removal can be achieved with polymer and coagulant addition. The rotating disk filter would have a higher capital cost due to the higher bare equipment costs and the larger footprint.

The rotating belt filter has a 20% higher operating energy requirement, mainly due to the need for a blower and hot water heater. The rotating belt filter produces approximately 5% primary sludge solids and can produce over 20% solids with the screw auger option. Salsnes has many installations in Europe, some in Canada and two in the United States. The oldest units have been operating in Europe for approximately 15 years. The installations in the United States have been in operation for two years or less.

There are numerous rotating disk filter installations for tertiary treatment; however there are only four installations where the disk filter has been used for primary treatment. The primary sludge solids percent from the rotating disk filter would be approximately 0.3%, therefore additional primary sludge thickening would be required before it is sent to the digester.

Based on the comparison of features, the rotating belt filter would be the most compatible compact primary treatment alternative for the SMCSD facility due to the rotating belt filter's smaller footprint, more extensive operating history in primary treatment applications, and the fact that it would not need an additional treatment process to thicken primary sludge solids.

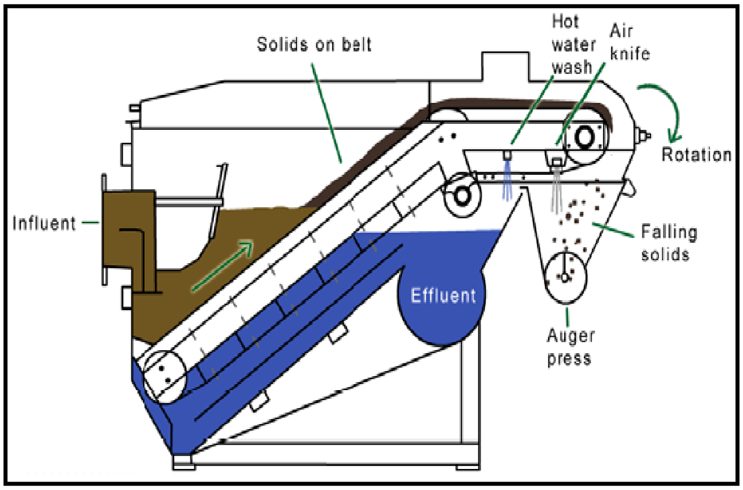
3.2 Rotating Belt Filter (Salsnes) Discussion and Recommendations

Currently, the only manufacturer of a rotating belt filter is Blue Water Technologies, which makes the Salsnes Filter. The Salsnes Filter is a rotating belt primary treatment filter. Wastewater travels through an inclined moving mesh screen and belt sieve, allowing solids to effectively build a mat across the belt. The build-up of this mat allows high solids removal rates.

The belt is continuously rotated to allow cleaned belt to be exposed and allowing the matting process to start over again. Once the matted belt is rotated out of the wastewater, it is cleaned with an air knife, blowing compressed air in the opposite direction as the mat was formed. The belts are washed with hot water normally about 5 minutes every two hours. The water heater for the belt wash must be able to heat the water to a high enough temperature to remove any accumulated grease from the belt (90 degrees to 120 degrees Fahrenheit).

The dislodged solids are collected in an auger and sent for disposal or for solids dewatering with an optional wedge wire extruder screw assembly. Belt openings range from 30 to 840 microns, but a 250 micron (0.01 inch) mesh is most commonly used. Solids augured out of the filter are typically 3-6 % with solid cake of 25% to 40% possible with the optional wedge wire extruder screw assembly. An illustration of the Salsnes filter is shown as .

Figure 2: Salsnes Filter



3.2.1 Design Criteria

The rotating belt filter units are primarily sized based on hydraulic capacity, although the amount of influent total suspended solids can impact the overall capacity of the unit. The largest hydraulic capacity unit currently available is the SF6000, which has a clean water capacity of 3.7 MGD. Influent TSS concentrations also need to be considered to ensure that the treatment unit design provides adequate capacity and process performance. Based on discussions with the Salsnes manufacturer, the SF6000 should be able to provide treatment capacity of 3.0 MGD or more depending on influent TSS concentrations. As discussed in the TM 1: Design Criteria, influent flow to the plant is at or below 6.0 MGD, 99.7% of the time, with 5-year event instantaneous peak wet weather flow of up to 12.3 MGD. Based on the frequency at which flow exceeds 6.0 MGD, it is recommended that two 3.0 MGD units be installed if this technology is used.

Each rotating belt filter would be coupled with a dedicated primary sludge pump. Because of the difficulty associated with pumping high solids sludge (> 8% solids), it is recommended that the screw auger option not be used. Without the screw auger option, the rotating belt filter will produce approximately 5% solids, which can be pumped to digestion using an open throat progressive cavity pump. Based on the estimated TSS removal rate and a 3.0 MGD primary treatment capacity, the primary sludge pumps should be sized to pump 2.0 to 20 gpm. A summary of the recommended design criteria for primary treatment is presented in .

Table 3: Compact Primary Treatment Design Criteria

Criteria	Value	Unit
Primary Clarifier/Filter		
Number	2	
Design Flow (each)	3	MGD
Primary Sludge Pumps		
Type	Progressive Cavity	-
Number	2	-
Capacity	20	gpm
TDH	20	feet
Motor Size	5	HP

3.2.2 Estimated Performance

A comparison of the estimated performance of a typical conventional primary clarifier and the rotating belt filter is presented in . As with conventional primary clarifiers, the removal efficiency of the rotating belt (Salsnes) filter will vary depending on hydraulic and solids loading to the unit.

Table 4: Performance Comparison of Conventional Primary Clarifier versus Rotating Belt Filter

Criteria	Conventional Primary Clarifier	Typical Rotating Belt Filter (Salsnes)	Rotating Belt Filter (Salsnes) Pilot Test at SMCSD
TSS Removal	60%	50%	54%
BOD Removal	35%	30%	45%
Primary Sludge Solids Content	5%	5%	32% (with screw auger option)

The Salsnes filter was pilot tested for one week in May 2008 at the SMCSD WWTP and averaged 54% TSS removal (one week of samples) and 42% BOD removal (one day of samples). There was a large amount of variability in TSS (±10%) and BOD (±7%) removal during the pilot testing. The variability in performance may have been due to the temporary nature of the pilot testing set-up or it may have been the result of changes in the SMCSD influent flow, or some combination of these factors.

The pilot testing at SMCSD included performance testing with secondary sludge to assess the unit's potential to thicken secondary sludge. Removal performance suffered under these conditions, and the normal cleaning cycles for the filter belt could not prevent clogging of the filter belt. Based on these findings, co-thickening of secondary sludge is not recommended. Secondary sludge was also added with the primary influent to determine if co-thickening primary and secondary sludge with Salsnes filter was possible. Based on co-thickening with the pilot unit, it may be possible to co-thicken primary secondary sludge. Although this configuration may work for SMCSD, it is recommended that alternate method of thickening secondary sludge remain available until after the Salsnes unit is installed and it is confirmed that co-thickening can be done reliably. Alternatively, a new process for secondary sludge thickening (e.g. a rotary drum thickener) could be incorporated into the headworks project.

3.2.3 Reliability

The rotating belt filter has a limited operational history with the oldest operating installation being installed in the mid-1990s. A pilot unit was tested at the SMCSD facility, which allowed some opportunity to evaluate the reliability of the Salsnes unit. Although the overall performance during the pilot testing was satisfactory, there were some fluctuations in removal efficiencies.

Four operating facilities in the United States and Canada with the Salsnes filter were contacted to obtain feedback on their operation. Two of these are permanent facilities and two were long-term pilot installations. All of the installations contacted described the mechanical operation of the unit as reliable and relatively trouble free and were using the filter on raw influent sewage. The one facility that had removal performance data indicated that BOD removals were approximately 26% and TSS removals were approximately 50%. Most facilities were looking to use the Salsnes as a new treatment step to reduce BOD loading to their existing secondary process such as an oxidation ditch or sequential batch reactor.

One facility did note that they experience increased operating cleaning due to grease blinding of the belt filter. However, the facility has several fast food restaurants in their service area, which they believe contributed to the problem. In addition, they had a slightly older model, which did not include an automatic hot water cleaning cycle.

It is recommended that SMCSD staff visit an operating facility to obtain reliability feedback directly from plant staff that have operated the Salsnes filter as a duty unit, if this technology is considered for installation at SMCSD.

3.2.4 Operation and Maintenance

The Salsnes filter is a more complex piece of equipment than a traditional primary clarifier. Some operations and maintenance implications involved with the Salsnes filter include:

- Periodic cleaning of the air knife
- Blower maintenance
- Hot water heater maintenance
- Filter belt maintenance and replacement

The frequency at which the filter belt would need to be replaced is typically every 2 to 5 years and will depend on operating conditions, such as the amount of grit sent to the unit and the speed at which the belt rotates.

3.2.5 Odor Control

Handling of raw wastewater has the inherent potential to generate odors. One of the key features of the Salsnes filter is that they are completely enclosed units and therefore only a small volume of air space needs to be odor scrubbed. It is envisioned that the new primary treatment facility will connect to the existing odor control facility, however this will be confirmed after a total volume of space requiring odor control is developed for the new headworks and primary treatment facility.

3.2.6 Integration with Existing Plant Operation

The existing primary clarifier will remain in operation during and after construction is complete as either the primary unit or the back-up unit for wet weather overflow conditions. Flow would be routed in parallel to the existing primary clarifier and to the new Salsnes units. Effluent from the Salsnes units would be conveyed in a dedicated line to the downstream diversion box, where it would join the effluent from the existing primary clarifier. This connection would be a free discharge into the existing diversion box; therefore current issues with air bubbling back into the existing primary effluent pipeline are not anticipated.

3.2.7 Layout

As with the all proposed processes, site constraints will be a key factor in selecting the primary treatment configuration. Due to the limited amount of space available on the WWTP site, compact technologies were considered as part of the evaluation. The new compact treatment units could be located in a new structure where the existing dewatering filter building is located. Compact primary treatment units would be installed at an elevation of approximately 22 feet, which is approximately the same height as the existing second floor of the dewatering filter building. Siting of the new primary treatment units at this elevation will maintain the plant hydraulics required to send primary effluent to the existing diversion structure.

The Siting TM (TM 2) discusses the alternate locations for the primary facilities. The proposed layout and sections for the potential configurations (stacked. extension to the east, and extension to the west) of the Salsnes filter, including the primary sludge pumps and support equipment, are shown in Drawing TM2-1. The layouts do not include space for a third (future) Salsnes unit. The main distinction between the alternatives is a stacked versus unstacked arrangement. For the stacked arrangement, access to the primary treatment area would be through a new causeway access ramp on the east side of the building. The new causeway access ramp would be elevated so that it provides a relatively flat path from the access road, thereby reducing the current operational difficulties associated with backing a truck along a downward sloping access ramp. For the unstacked arrangement, vehicle access to the primary treatment area would be limited due to the offset elevation.

3.2.8 Compact Primary Treatment Cost Estimate

The capital costs for a compact primary treatment facility consist mainly of structural costs for the new primary treatment building along with equipment and mechanical costs. The estimated construction cost for a new compact primary treatment facility is approximately $2.3 million.

There are several items associated with the Salsnes filter that will require operator attention and maintenance. Hot water is used to flush and clean the belt several times per day. Compressed air is used to blow the sludge from the filter mesh. Daily power consumption of the Salsnes filter (from pilot plant study) is estimated at 538 kw-hr (for two units), which includes the motor to turn the filter mesh, the blower to clean the filter and the power consumption for the hot water heater. Additional O&M costs include blower maintenance and replacement of the filter belt cartridge.

The annual O&M cost consists of energy, operation and maintenance labor, parts and equipment. The total energy use for the primary treatment facility will be evaluated based on the major equipment electrical demands. This total energy cost will be determined based on rated motor sizes and the projected operating durations for the equipment. Energy is assumed to cost $0.15/kilowatt-hour (kWh). Operation labor consists of the time required to make operational adjustments on a routine basis, log equipment status, and test process performance. Maintenance labor consists of the time required to perform preventative maintenance and failure repairs to equipment and pumps. Operations labor and maintenance labor cost $45 per hour. Table 5 summarizes the estimated O&M costs for a new compact primary treatment facility.

Table 5: Annual Salsnes Filter O&M Cost Estimate

Element	Cost
Consumables	$8,200
Energy	$32,500
Labor	$33,700
Total Compact Primary Treatment Annual O&M Costs	**$74,400**

4 Conventional Primary Clarifiers

The flow pattern for circular primary clarifiers is radial which is achieved by introducing the wastewater through a circular well located in the center and top of the tank. The circular center well is designed to distribute the flow equally in all directions. Wastewater travels from the center well toward the outer wall and discharges over peripheral overflow weirs into the effluent collection trough (launder).

Solids removal in a circular clarifier is accomplished by a spiral scraping mechanism. Solids are scraped along a sloped bottom to a hopper in the center of the clarifier tank. Primary solids are then collected and pumped to solids processing facilities. A radial skimmer arm also rotates around the basin at the water surface to convey floating material (scum) to a withdrawal trough. Baffles are provided between the scum collection area and the overflow weirs to prevent scum from entering the effluent launder.

4.1 Design

For the WWTP upgrade, a new 55 foot diameter circular primary clarifier would be provided for complete redundancy and additional treatment capacity for peak wet weather flows. The new circular primary clarifier would have similar features to the existing clarifier, including an internal launder and effluent box. However, it would be possible to provide more sidewater depth (e.g. 14 feet) than the existing primary clarifier (9 feet), while still maintaining the existing hydraulic gradeline. The additional sidewater depth would provide better performance, especially during peak flow events. The tank would be constructed of concrete and excavated out of the existing hillside, just inland of the shoreline.

Solids collection from the new primary clarifier would be achieved using a conventional spiral scraper mechanism. Primary solids would be pumped directly to the digesters for processing by progressive cavity pumps located in an open pump gallery adjacent to the new primary clarifier. The pumps would be configured with one progressive cavity pump for solids pumping and one progressive cavity pump for scum pumping. Piping will be configured to allow the primary solids and scum pumps to serve as back-up for each other. Design of the scum pumping piping will allow scum to be pumped to the digesters.

4.2 Covers

Circular primary clarifiers can be covered by either domes or flat covers. Domes can be either standard or low profile. Because of the span of the circular tank, flat covers would require structural support. Capital costs of flat covers with structural support (external truss) are typically 75 to 100% more than traditional dome roofs. However, flat covers minimize the volume of air to be odor scrubbed and allow open air access to the center drive mechanism.

The most common materials for covers are fiberglass reinforced plastic (FRP) and aluminum. FRP covers provide the greatest resistance to corrosion, though they typically require periodic maintenance in the form of a ultra-violet inhibitor coating for durability and longevity if exposed to direct sunlight. FRP is relatively light in weight and generally can be removed by plant staff. Aluminum covers provide the greatest tensile strength with the thinnest cross-sectional area. Some corrosion can be anticipated, but periodic maintenance in the form of an anodized coating should aid in corrosion prevention. The capital costs for FRP and aluminum are similar. The advantages and disadvantages of cover types and materials are presented in Table 6.

In view of the advantages listed in Table 2, and as further discussed in Section 3.4 Odor Control (in this TM), it is recommended that a flat aluminum cover be used on the new primary clarifier. (Covering the existing primary clarifier can be considered at a future date when that clarifier is refurbished.)

Table 6: Advantages and Disadvantages of Cover Types and Materials for Circular Clarifiers

Cover Type	Advantages	Disadvantages	Approximate Capital Cost
Standard Dome	• Lowest capital cost	• Large air space, increases odor control capital and annual costs • Requires confined space entry • Highest elevation of cover alternatives	$2,000 per foot diameter
Low Profile Dome	• Lower elevation than standard dome • Less air space than standard dome, therefore lower odor control costs	• More expensive than standard domes • Requires confined space entry	$2,500 to $3,000 per foot diameter depending on dome height
Flat with Truss Support	• Lowest height of cover alternatives • Lowest air space, therefore lowest odor control costs • No confined space entry	• Truss support can complicate design, negatively affects aesthetics • Adds approximately 8 feet of height to cover	$3,500 per foot diameter
Cover Material	**Advantages**	**Disadvantages**	**Material Costs**
Aluminum	• Not susceptible to UV damage • Widely used and accepted	• Susceptible to corrosion, requires maintenance of anodized coating	Comparable to FRP
Fiberglass Reinforced Plastic (FRP)	• Resistant to corrosion	• Becomes brittle when exposed to UV light for long periods of time	Comparable to Aluminum

5 Recommendations

Overall, the use of a conventional technology is preferred to the use of a compact technology. If additional land can be secured, a new circular primary clarifier is recommended giving SMCSD two primary clarifiers with the exact same capacity and configuration. The one exception would be the potential for adding increased sidewater depth, which will be finalized during design. Flow distribution would be achieved in the primary influent distribution box in the headworks. To improve redundancy and reliability, it is recommended that the effluent from the new primary clarifier be conveyed in a dedicated line to the downstream diversion box, where it will join the effluent from the existing primary clarifier. The connection will be designed to minimize air bubbling back into the primary effluent pipeline, which currently occurs on the existing primary clarifier.

5.1 Design Criteria

A single primary clarifier would be sufficient for nearly all flows to the treatment plant, including moderate peak wet weather events up to 6 MGD. At this flowrate the overflow rate would be 2530 gpd/ft^2, which is within normal design range shown in Table 1 for peak flow conditions.

For flows greater, than 6 MGD both primary clarifiers would be in service, allowing overflow rates to remain within normal design ranges even in extreme wet weather flowrates. The circular primary clarifier will produce approximately 5% solids, which can be pumped to digestion using a progressive cavity pump. Based on the estimated TSS removal rate the primary sludge pumps should be sized to pump for 100 gpm. A summary of the recommended design criteria for primary treatment is presented in Table 7.

Table 7: Primary Treatment Design Criteria

Criteria	Value	Unit
Primary Clarifier		
Number	2 (1 new/1 existing)	-
Type	Circular	-
Maximum Design Flow (each)	6 to 7	MGD
Diameter	55	feet
Side Water Depth	9.5 or 12-14	feet
Surface Area (Each Tank)	2,376	ft^2
Overflow Rates		
1.5 MGD	630 (1 unit)	gpd/ft^2
6.0 MGD	2530 (1 units)	gpd/ft^2
12.3 MGD (5-yr Peak Wet Weather Flowrate)	2590 (2 units)	gpd/ft^2
13 MGD (10-yr Peak Wet Weather Flowrate)	2740 (2 units)	gpd/ft^2
Primary Sludge/Scum Pumps		
Type	Progressive Cavity	-
Number	2	-
Capacity	100	gpm
TDH	20	feet
Motor Size	5	HP

5.2 Estimated Performance

The estimated performance of a typical circular primary clarifier is presented in Table 8. The removal efficiency of the primary clarifier will vary depending on hydraulic and solids loading to the unit. SMCSD also has the ability to add ferric chloride and/or polymer to the primary influent. With chemical addition, primary treatment removal can increase up to 80% for TSS and 45% for BOD. The ability to add ferric chloride and/or polymer will be included with the new primary clarifier.

Table 8: Performance of Circular Primary Clarifier

Criteria	Circular Primary Clarifier	With Chemical Addition
TSS Removal	60%	up to 80%
BOD Removal	35%	up to 45%
Primary Sludge Solids Content	5%	NA

5.3 Layout

Due to the limited amount of space available on the existing WWTP site, additional land would be required to accommodate a new conventional circular primary clarifier. The layout and location for the primary clarifier is discussed in TM 2: Siting, and illustrated on Drawings M-10, M-11 and M-12.

The new primary clarifier would be installed to match the hydraulic gradeline of the existing primary clarifier. Primary sludge and scum pumps would be located underneath the new headworks and adjacent to the new primary clarifier. A preliminary layout of the primary sludge and scum pumps is shown on Drawing M-14.

5.4 Odor Control

Handling of raw wastewater has the inherent potential to generate odors. As discussed previously, it is recommended that a flat aluminum cover be installed on the new primary clarifier. The airspace be connected to the existing odor control facility. The use of a flat clarifier cover will help to minimize odors as well as the total volume of air space requiring odor scrubbing. The total volume of space requiring odor control for the new headworks and primary treatment process will be confirmed during the design phase to make a final assessment of whether the existing odor control facility has sufficient capacity.

5.5 Primary Clarifier Cost Estimate

The capital costs for the primary treatment facility consist mainly of structural costs for the new primary tank along with equipment and mechanical costs. The estimated construction cost for the new primary clarifier is $2.47 million, and are detailed in the overall project cost estimate.

5.6 Operation and Maintenance (O&M)

Because only one primary clarifier will be needed for most flow conditions, the addition of a second primary clarifier will have a minor impact on operation and maintenance labor as well as power consumption to run the equipment. Operation and maintenance associated with the primary treatment process and equipment is presented in the following sections.

5.6.1 O&M Labor

The following discussion represents the typical level of effort for operating a single primary clarifier. Because SMCSD is already operating a primary clarifier, the net increase on O&M labor is effectively zero.

Some annual maintenance will be required for normal servicing and infrequent failures. However the additional labor is expected to be minor because the systems are automated and rugged. The estimated SMCSD labor required for single primary clarifier is presented in Table 9.

Table 9: Estimated Required Process Labor

Labor Type	Process Labor (Hours/week)	Process Labor (Hours/Year)
Operation	2	104
Maintenance	1	52
Total	3	156

5.6.2 O&M Cost Estimate

The annual O&M cost consists of energy, operation and maintenance labor, parts and equipment. The total energy use for the primary treatment facility is based on the major equipment electrical demands. This total energy cost was determined based on rated motor sizes and the projected operating durations for the equipment. Energy is assumed to cost $0.15/kilowatt-hour (kWh). Operation labor consists of the time required to make operational adjustments on a routine basis, log equipment status, and test process performance. Maintenance labor consists of the time required to perform preventative maintenance and failure repairs to equipment and pumps. Operations labor and maintenance labor cost $45 per hour. The estimated O&M cost associated with the primary treatment process are presented in Table 10.

Table 10: Estimated O&M Costs

O&M Items	Quantity	Units	Unit Cost	Total Cost	Notes
Consumables					
Equipment Consumables	$219,600		1.0%	$2,200	% of Equipment Purchase Cost
Mechanical Consumables	$65,209		1.0%	$700	% of Mechanical Purchase Cost
Subtotal Consumables				$2,900	
Power					
Clarifier Mechanism	9772	kwh	$0.15	$1,500	
Primary Sludge Pumps	8144	kwh	$0.15	$1,200	
Subtotal Power				$2,700	
Labor					
Operator	2	hr/week	$45	$4,700	
Maintenance	1	hr/week	$45	$2,300	
Subtotal Labor				$7,000	
Chemicals					
None				-	
Subtotal Chemicals				-	
Total Annual O&M Cost				**$12,600**	

Drawings

Drawing M-10

Drawing M-11

Drawing M-12

Drawing M-14

Drawing TM2-1