Technical Memorandum

RMC Water and Environment

SMCSD Headworks, Primary and Secondary Treatment Pre-Design

Subject:	**TM 6: Materials Handling, Storage and Disposal**
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The purpose of this technical memorandum (TM) is to present the evaluation and preliminary design of the materials handling for screenings, grit and dewatered sludge handling facilities to be implemented at the Sausalito-Marin City Sanitary District (SMCSD) Wastewater Treatment Plant (WWTP). Each of these materials need to be loaded on a truck, removed from the site, and disposed of at a landfill. Due to the extreme site limitations regarding truck access, special design requirements need to be used to improve safety and efficiency of plant operations. 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. This TM is organized in the following sections:

Section Page

1 Summary and Conclusions

This TM includes an evaluation of alternatives for storage, handling, and disposal for screenings, grit and dewatered sludge. The goal of the evaluation is to develop a materials handling alternative that provides a simple and safe method for handling waste material from the new headworks facility, while also:

1. Minimizing plant staff time required to operate the materials handling system
2. Minimizing odors
3. Improving disposal truck access and reducing disposal costs
4. Minimizing impacts to the existing WWTP operation

A summary of the recommended materials handling alternative is presented in Table 1.

Table 1: Material Handling Recommended Alternative

Material	On-Site Conveyance	On-Site Storage	Method for Transferring Material to Off-Site Hauler	Hauling Method	Hauling Frequency	Disposal
Screenings	Conveyor	Empty Into Grit Bin	With Grit	With Grit	With Grit	With Grit
Grit	Directly to dumpster	6 CY Dumpster (material plastic bag encased)	Backlift type dumpster	Backlift type Retriever Truck	2 times per week	Redwood Landfill
Dewatered Digested Sludge	Front loading vehicle	Two 14 CY Roll-Off Bins	Transfer on-site roll-off bin to truck	Roll-Off Bin Truck	2 times per week (unless permit is modified)	Redwood Landfill (Daily Cover)

In order to facilitate waste hauler access and maneuverability, it is also recommended that a truck turntable be installed. The turntable will minimize the amount of space required for truck access. In addition to material handling, the truck turntable could be used to help other plant functions such as chemical and other supply deliveries.

The District will continue to manually perform in-plant transfer of dewatered sludge to an on-site storage bin. A new front loading vehicle has been purchased by the District to facilitate the in-plant transfer. The District has also purchased two 14 CY roll-off dumpsters for dewatered sludge, which will be picked up twice per week by a contract hauler for disposal.

2 Existing Materials Handling, Storage and Disposal Operation

Currently, approximately 0.75 cubic yards (CY) per week of screenings and other small volumes of waste material (excluding dewatered cake) are collected in small dumpsters. The small dumpsters are then picked up within the plant site and emptied into garbage trucks by the local waste management agency (Bay Cities Refuse) and hauled to the landfill. The existing trucks used by Bay Cities Refuse are between 25 feet and 31 feet in length.

SMCSD recently completed a dewatering process upgrade which involved the installation of a single new dewatering screw press on an elevated platform in the middle of the main process area of the plant. The District currently operates the screw press three times per week. Dewatered cake is currently collected in small 2 CY dumpsters under the screw press and then transferred to the District's dump truck for transport to Redwood Landfill for use as alternative daily cover. Hauling sludge to the landfill typically takes 2 hours of District staff time. The District's current permit requires that all dewatered sludge be hauled away for disposal within 24 hours.

Truck access to the SMCSD facility, specifically to the main process area of the plant, is difficult and requires the driver to make multiple-point turns to turn the truck around. Also truck access on the treatment plant causeway is prohibited (when trucks are full) due to the limited weight bearing capacity of the causeway.

3 Materials Handling Design Criteria

SMCSD does not plan on additional growth or infill in its service area. Therefore, it is anticipated that the influent load of material to be handled by the new headworks and existing dewatering facility will not increase in the future. A summary of the estimated production, required storage and hauling frequency of waste materials is presented in Table 2.

Table 2: Material Disposal Design Volumes and Frequency

Material	Production (CY/Day)	Storage Volume (CY)	Hauling Frequency (trips per week)
Screenings	0.1	With grit	With grit
Grit	0.5	6	2
Dewatered Digested Sludge	4 to 5*	8	2 to 3

*Only when the dewatering equipment is operated, which is currently 2 to 3 times per week.

Screenings and Grit

The material handling frequency and volume for screenings and grit were estimated based on typical industry values. Screenings and grit will be generated from the new headworks screens and grit removal processes. The handling of these items prior to their placement in on-site waste bins is presented in the TM 3: Screening and TM 4: Grit Removal.

Both grit and screenings will be produced in relatively small volumes on a continuous basis at 0.5 CY/day and 0.1 CY/day, respectively. The volume of grit produced is estimated to be five times greater than the volume of screenings produced. Therefore grit production will dictate the frequency at which screenings and grit will be hauled off for disposal. A 6 CY bin is recommended for grit because it is small enough that it can be maneuvered within the headworks building and it is large enough to allow more than a week's worth of grit storage, if needed. Due to the small volume of screenings produced, it is recommended that screenings be stored in the same bin as the grit. In order to minimize odors, it is recommended that the grit and screenings be contained within plastic bags as they are discharge and that they be hauled off-site at least twice a week.

Dewatered Digested Sludge

SMCSD recently completed a dewatering process upgrade which involved the installation of a single new dewatering screw press on an elevated platform in the middle of the main process area of the plant. The current dewatering operation was previously described in Section 2. Based on recent operation, SMCSD produces about 12 CY of dewatered sludge per week in dry weather and up to 15 CY per week in wet weather. The dewatering process is typically operated two to three times per week and produces dewatered sludge at a rate of approximately 1 CY per hour. SMCSD staff indicate they typically achieve between 20% and 24% solids with a sludge density of 1,890 lbs/CY.

In the future, SMCSD staff plan on optimizing the performance of the screw press which would increase the solids content and lower the production volume of dewatered sludge. Because the operation of the dewatering process is not expected to change significantly in the future, it is recommended that the dewatered sludge storage, handling and disposal operation be designed based on current production rates. It is also recommended that a minimum of 8 CY of on-site dewatered sludge storage be provided, which would accommodate normal operation of the screw press and also provide sufficient capacity to allow the screw press to operate for 8 hours a day, if needed. SMCSD staff have a preference for a 14 CY storage bin to prevent spilling of material when the bin is near full capacity. The 14 CY on-site storage bin would be picked-up and hauled away as needed, which would be two to three times per week under the current operating scenario at the plant. Because of the weight and space restrictions on the existing plant area and access causeway, the 14 CY bin would need to be located at a separate location from the dewatering screw press.

Another potential configuration would be to provide two 7 CY bins for dewatered sludge. However, due to the District's current requirement to off-haul dewatered sludge on a daily basis, multiple hauling trips would be created if more than 6 CY of dewatered sludge were produced in a single day. Therefore, use of 7 CY bins is not recommended.

4 Material Handling, Storage and Disposal Options

As indicated in Section 3, the new headworks facility will increase the volume of screenings and grit that will need to be regularly stored on-site and prior to being hauled away for disposal. Due to the difficulties and labor requirements associated with the current dewatered digested sludge hauling operation, alternatives for improving dewatered sludge material handling were also evaluated as part of this project to assess an improved materials handling operation for the entire plant. Discussions on material storage bin types, siting and hauling/transfer are presented in the following sections.

4.1 Storage/Disposal Bin Type and Handling Options

There are a wide range of storage and disposal bin options available to facilitate material handling at the SMCSD site. The selection of the appropriate bin for each waste stream will be a function of the required storage volume as well as the method that will be used to transfer the material off-site. The required storage volume for screenings, grit and dewatered sludge were presented in Section 3. A summary of material storage and disposal bin options, including offsite hauling vehicles, is presented in Figure 1.

In order to maximize vehicle access and maneuver ability, the material bin selected should be compatible with the shortest truck length possible. A retriever-type truck coupled with a compatible 6 CY bin would be the recommended configuration for screenings and grit. A retriever type truck could be driven down to existing dewatering building loading area, but maneuverability in the lower part of the access road (below the administrative level) would be difficult.

For dewatered sludge, a roll-off bin could be used to provide 14 CY of storage. The roll-off bin would be picked-up by a straight body truck with the shortest wheel base needed to pick-up a 14 CY roll-off container. It is unlikely that a truck of this size would be able to maneuver down to the existing dewatering building location as the access road is currently configured. An alternative would be to use a shorter retriever type truck and container that can provide up to 8 CY of dewatered sludge storage/hauling capacity. There are a limited number of vendors that use retriever type lifts of this size with the lifting capacity required. The estimated cost for a retriever type truck of this size is $180,000. For the purpose of this evaluation, space was provided for a 14 CY bin roll-off bin because it would be the most conservative approach in terms of space required. Consideration should also be given to providing space a second 14 CY bin, which will allow the waste hauler to drop-off a clean bin at the site before the full bin is loaded onto the truck. If space for a second bin is not provided, then the waste hauler would need to make a second trip to provide an empty bin. The final selection of the waste bin type and configuration will need to be coordinated with the contract waste hauler during the design phase.

Figure 1: Summary of Material Handling Storage/Disposal Bin Options

Option		Dumpster Sizes	# of Trips Per Week	
			Screenings & Grit	Dewatered Sludge
Self-Dumping Hopper (Intra-Plant Materials Handling)	 	1 CY	5 - 6	12 - 15
		3 CY	2 - 3	4 - 6
Roll-off Bin & Truck (Hauling Materials Off-site)	  **Truck Dimensions: 18'L x 8'W x 15'H** **Truck Turning Radius = 46 feet** **10-wheel base**	5 CY	1 - 2	3 - 4
		8 -14 CY	1 - 2	2 - 3
"Retriever" Truck & Dumpster (Hauling Materials Off-site)	  **Truck Dimensions: 16'L x 8'W x 15'H** **Truck Turning Radius = 38 feet**	6 - 8 CY	1 - 2	2 - 3
Front End Loading Bin & Truck (Hauling Material Off-site)	  **Truck Dimensions: 19.5'L x 8'W x 18.5'H** **Truck Turning Radius = 46 feet**	2 CY/ 4 CY/ 6 CY	2 - 5	5 - 15
		Note: Weight Limit is 1,000 lbs which limits effective dumpster to ½ CY		

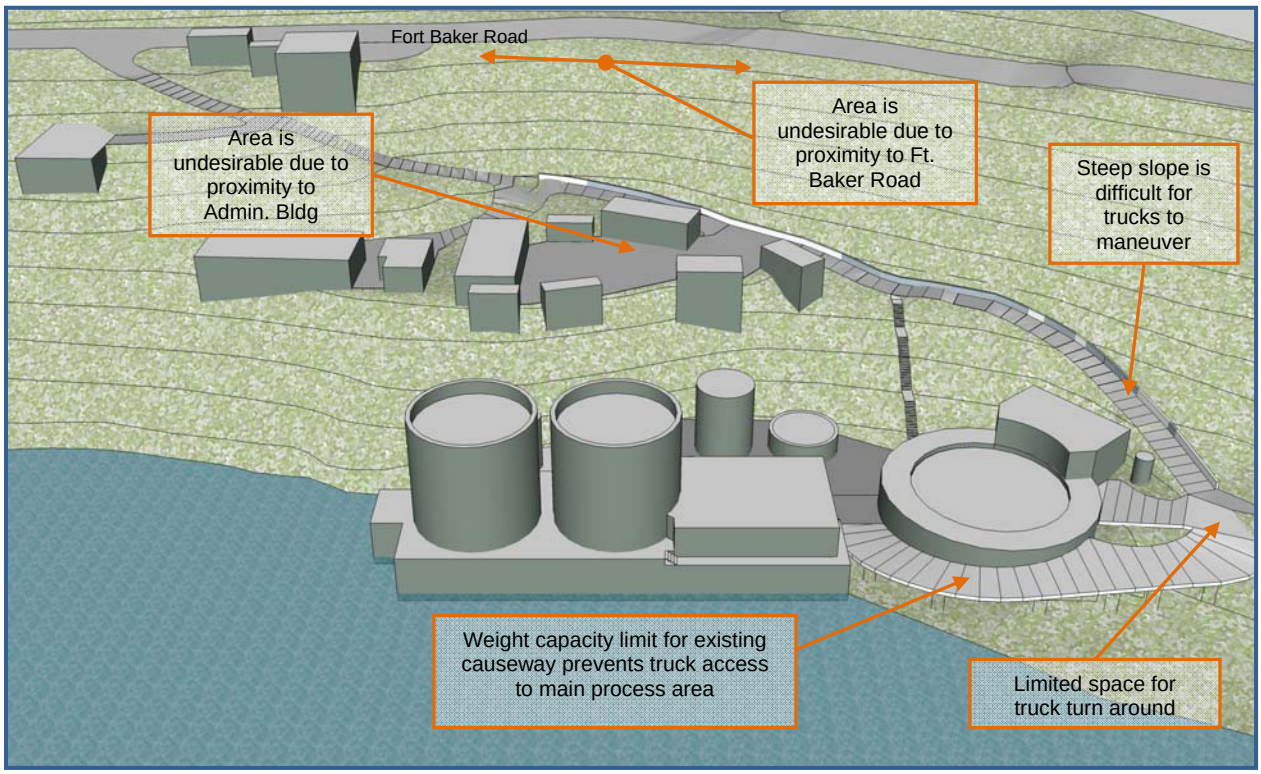
4.2 Material Storage/Handling Siting

There are several potential locations within the SMCSD plant site that could be used to store waste materials. However, the location needs to meet the following objectives:

- Simplify material handling to the greatest extent practicable
- Provide easy access for waste hauler and SMCSD vehicles
- Minimize visual and odor impacts
- Minimize SMCSD labor requirements

Based on these objectives, the number of viable sites at the SMCSD facility are limited. A summary of the issues related to vehicle access and material storage are presented in Figure 2.

Figure 2: Summary of SMCSD Truck Access and Material Storage Site Issues



The waste material storage area cannot be located at or near Ft. Baker Road or at the Administration Building level due to potential visual and odor impacts. A material storage site at the main plant process level would be difficult to access by waste haulers because of the difficulty in maneuvering a steep slope and small turn around area. In addition, hauler truck access is restricted by the limited weight capacity of the plant access causeway.

Based on the above restrictions, it is recommended that the waste material handling facilities be located below the Administration Building level, but above the main process level. In order to achieve the objectives outlined above, it is recommended that the material handling facilities for screenings, grit and dewatered sludge be centralized and located adjacent to, or as a component of, the new headworks facility. Screenings and grit stored within the new headworks facility would minimize additional conveyance equipment which would be needed if these items were stored outside of the headworks building or elsewhere on site. Depending on the final configuration of the new headworks building, the

dewatered sludge hauling bin could be stored inside the headworks building or in a separate storage shed/ garage next to the new headworks facility.

4.3 Off-Site Materials Hauling

To reduce the labor requirements on SMCSD staff, the District would like to contract with a materials hauling vendor for off-site material disposal. The off-site material contractor will need adequate access to the material storage bins. There is limited space available and a steep and narrow access road, making it difficult to maneuver a large hauling truck at the existing site.

One alternative to improve vehicle access would be to develop a large, flat area which would allow a hauling truck to turn around. A typical roll-off truck with a 33-foot body length would have a turning radius of 45 feet and would need a clear area of approximately 50 feet in radius to turn around. It would be difficult to provide this amount of open flat area at the existing site. The area required could be reduced by providing a turn-in or nook in the hillside so that the truck could make a three-point turn to turn around. However, the three-point turn configuration would add an additional level of difficulty for the truck driver and it would also be difficult to accommodate the turning area required on the existing site.

Another option to improve vehicle maneuverability would be to install a truck turntable. An example of truck turntable is shown in Figure 3. The inside of a partially assembled turntable is shown in Figure 4.

Figure 3: Truck Turntable

Figure 4: Partially Assembled Turntable

Truck turntables are commonly used in tight spaces such as loading docks under large buildings. There are two known truck turntable installations in San Francisco. One at the Jessie Square/Westin Hotel and one at the Marriott near the Moscone Center. A turntable would allow a truck to turn in any direction, including 180 degrees. The main advantage of the truck turntable is the small footprint required. A 25-foot diameter turntable would allow a 33-foot roll-off truck to turn around at the SMCSD site and would allow for the use of a 14 CY roll-off bin for dewatered sludge disposal. The turntable would be provided with a motor, gear reducer and controls, which would allow the operator or truck driver to rotate the table using a local control station. The motor and gear reducer would be installed in a small pit next to the turntable. Normal maintenance for the turntable would involve greasing the gear reducer.

Turntables are also commonly used at rail facilities such as BART and MUNI. BART has several turntables, including one in Daly City, which is installed outdoors. RMC and SMCSD staff attended a site visit to the BART facility in Daly City to get direct feedback from operations and maintenance staff. A photograph of the BART facility is shown as Figure 5. The overall feedback from the site visit was positive. The turntable functions as intended and does not require excessive maintenance. Routine maintenance is performed once every six months and consists primarily of lubrication of bearings and moving elements.

The BART turntable is also used in a similar environment to SMCSD, is installed outdoors and is exposed to moisture from the bay/ocean. The deck plate for the BART facility is painted carbon steel, which is showing signs of corrosion after nine years of service. If used at SMCSD, it is recommended that the deck be manufactured out of a galvanized steel and fusion bonded epoxy coated as a cost effective means of providing protection against the elements.

Figure 5: BART Rail Turntable

Because open space is difficult to obtain at the SMCSD site, it is recommended that a truck turntable be installed to facilitate waste hauler access. In addition, the access road and loading areas should be modified or configured to provide manageable slopes and grade transition for waste hauler vehicles and SMCSD maintenance staff.

4.4 On-Site Material Transfer

Ideally, each process equipment package for screenings, grit, and dewatered biosolids would load directly into the disposal bin. However, the existing site limitations do not allow this configuration in all cases. A number of options for onsite conveyance of screenings, grit and dewatered biosolids are discussed below.

4.4.1 Screenings and Grit

It is most economical to dispose of screenings and grit in a common disposal bin. For screenings and grit to be disposed in a common bin, either manual dumping or some form of conveyor is necessary. Based on the site limitations, several conveyance options were developed. These options are described below:

- Manual dumping of screenings
- Single conveyor of screenings to grit
- Double conveyor of screenings to grit

These layout options are shown on Drawing TM6-1. Screenings and grit will be stored in waste bins in the new headworks facility. When needed, the grit bin will be moved using a forklift to just outside the headworks building where the bin would be picked up by the waste hauler. The waste hauler would utilize the turntable to turn around before loading the grit bin. The new headworks building will need to be designed to accommodate the movement of these bins in and out of the building.

4.4.2 Dewatered Biosolids

For dewatered biosolids, the District could continue their current method of operation which would involve using a front loader to dump dewatered sludge into a larger bin at the new headworks area. Another option for transferring dewatered sludge would be to use a cake pump to pump high solids sludge to the 14 CY roll-off bin at the headworks facility. Cake pumps are piston-type positive displacement pumps and have been used at other wastewater treatment facilities to move dewatered cake with 20 percent solids and above. Specifically, East Bay Municipal Utilities District (EBMUD) and Central Contra Costa Sanitary District (CCCSD) use cake pumps for this purpose. A picture of a package cake pump system is shown in Figure 6.

For transfer of dewatered sludge at SMCSD, the cake pump would have a 7.5 HP screw feeder and a 10 HP hydraulic unit for powering the pump and would transfer sludge at a rate of approximately 3.5 gpm. The cake pump would be located directly beneath the discharge chute for the existing screw press and would pump cake to the new materials handling area. The estimated capital cost for adding a cake pump is approximately $500,000. There would also be additional on-going costs associated with running the cake pump as well as maintaining it. With a cost of $500,000, it is estimated that adding the cake pump would have a payback of approximately 35 years, due to the slightly lower labor and operating cost requirements of the cake pump option compared to the District's current material transfer procedure (see Table3).

Figure 6: Package Cake Pump

Another potential alternative would be to relocate the existing screw press to the new materials handling area. The screw press could be installed on an elevated platform above, and discharge directly into, the new dewatered sludge roll-off bin. All the piping and electrical connections to the screw press would

need to be re-routed. However, the existing equipment would be reused. By relocating the screw press, the need for on-site transfer of digested sludge would be eliminated. The estimated capital cost for relocating the existing screw press is approximately $500,000. With a cost of $500,000, it is estimated that relocating the screw press would have a payback of approximately 20 years (see Table 3). Although the screw press was only installed in its current location a few years ago, the relocation of the dewatering process was necessary to free-up the space where the existing dewatering building is located. By making the dewatering building available, SMCSD is now able to move forward with the headworks and primary treatment improvements.

A summary of the on-site dewatered sludge material handling options are presented as Table 3.

Table 3: On-Site Dewatered Sludge Material Transfer Options

Option	Relative Capital Cost	Labor and Operating Cost Requirement	Difficulty of Implementation
Use Front Loader and Dump into Larger Roll-Off Bin	None	~$25K/Year	None
Cake Pump	+$500K	~$10K/Year	Fair
Relocate Screw Press	+$500K	~$2K/Year	Moderate

5 Recommendations

The recommended materials handling and storage configuration is presented in Table 4.

Table 4: Materials Handling Recommended Alternative

Material	On-Site Conveyance	On-Site Storage	Method for Transferring Material to Off-Site Hauler	Hauling Method	Hauling Frequency	Disposal
Screenings	Conveyor	Empty Into Grit Bin	With Grit	With Grit	With Grit	With Grit
Grit	Directly to dumpster	6 CY Dumpster (material plastic bag encased)	Backlift type dumpster	Backlift type Retriever Truck	2 times per week	Redwood Landfill
Dewatered Digested Sludge	Front loading vehicle	Two 14 CY Roll-Off Bins	Transfer on-site roll-off bin to truck	Roll-Off Bin Truck	2 times per week (unless permit is modified)	Redwood Landfill (Daily Cover)

Based on the dewatered sludge transfer options listed, SMCSD would prefer to manually transfer dewatered sludge into the larger roll-off bin using the front loader which will not require additional capital investment. A 25 foot diameter truck turntable and dewatered sludge roll-off bin storage area will be located next to the new headworks process to facilitate hauler access. The roll-off bins will either be covered or housed within a storage garage to minimize odors. Grit and screenings would be housed within the headworks building.

The truck turntable will be motorized with simple controls (e.g. two speeds and forward and reverse). The turntable will be capable of rotating a full 360 degrees. The turntable drive and gears will be accessible from a box outside of the turntable or through an access hatch on the deck plate. A drain will be located in the bottom of the turntable pit to allow accumulated water to drain.

5.1 Layout and Arrangement Options

There are various options for the layout and arrangement of material handling and storage. Each option is discussed in the TM 2: Siting. The recommend layout and arrangement is shown in Drawings M-10, M-11 and M-12.

5.2 Material Handling Facility Cost

Capital cost for the material handling improvements include any on-site storage areas, storage bins and other intra-plant transfer equipment. It assumed that the costs associated with off-site hauling of waste material will be covered in an on-going contract with a waste hauling vendor. The associated hauling fees for the third party vendor will be covered under operation and maintenance costs. The cost estimate does not include costs for the front end loader and dewatered cake haul off bins which have already been purchased by SMCSD. The estimated construction cost for the turntable facilities is approximately $0.62 million depending on the siting and equipment selections. See the project cost estimate for more details. The additional details estimated cost for material handling and storage facilities are included with the overall cost estimate for the recommended project.

5.3 Operation and Maintenance (O&M)

SMCSD is already using a front loader to manually transfer dewatered sludge, therefore the O&M labor and costs are not included in this summary. The addition of a truck turntable will require a minor amount of operation and maintenance labor as well as power consumption to run the equipment. Operation and maintenance associated with material handling and equipment is presented in the following sections.

5.3.1 O&M Labor

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 rugged and have few moving parts. The estimated impact on SMCSD labor associated with the truck turntable and screenings conveyor is presented in Table 5.

Table 5: Estimated Required Process Labor

Labor Type	Process Labor (Hours/week)	Process Labor (Hours/Year)
Operation	1	52
Maintenance	0.4	20
Total	1.4	72

5.3.2 O&M Cost Estimate

Adding materials handling facilities to the SMCSD plant will have a small impact on the O&M costs relating to the following items:

- Operation and maintenance labor
- Energy
- Repair parts and service

The estimated O&M cost associated with the material handling facilities, including the truck turntable and screenings conveyor, are presented in Table 6. The costs associated with SMCSD's current practice of manually transferring dewatered sludge to the disposal bin on-site are not included. Hauling and disposal fees are also not included since they will be handled separately by SMCSD.

Table 6: Estimated O&M Costs

O&M Items	Quantity	Units	Unit Cost	Total Cost	Notes
Consumables					
Equipment Consumables	$200,000		1.0%	$2,000	% of Equipment Purchase Cost
Subtotal Consumables				$2,000	
Power					
Turntable Drive	290	kwh	$0.15	$40	
Screenings Conveyor	814	kwh	$0.15	$120	
Subtotal Power				$160	
Labor					
Operator	1.0	hr/week	$45	$2,300	
Maintenance	0.4	hr/week	$45	$900	
Subtotal Labor				$3,200	
Chemicals					
None				$-	
Subtotal Chemicals				$-	
Total Annual O&M Cost				**$5,360**	

Drawings

Drawing TM6-1

Drawing M-10

Drawing M-11

Drawing M-12