CONSULTING ENGINEERS & GEOLOGISTS, INC.
335 S. Main St., Willits, CA 95490-3977• 707-459-4518 • FAX: 707-459-1884 • willitsinfo@shn-engr.com

Technical Memorandum

Reference: 416076
Date: June 14, 2017
To: Mr. Michael Kelley, MCCSD
From: Tom Herman, PLS
Subject: Sludge Drying Beds Alternatives, Mendocino CSD, Mendocino, California

Introduction

The purpose of this technical memorandum is to evaluate alternatives to rehabilitating the existing sludge drying beds at the Mendocino City Community Services District (MCCSD) wastewater treatment facility (WWTF) in the town of Mendocino. A preliminary engineering report (PER) prepared by SHN in March 2017, as a part of the United States Department of Agriculture (USDA) rural communities financial assistance program, evaluated rehabilitating and upgrading the existing sludge drying beds.

The purpose of rehabilitating the existing sludge drying beds would be for an emergency backup for the existing belt press and sludge dryer that handle normal sludge processing at the MCCSD WWTF in the case of equipment failure. The PER proposed lining the beds with concrete, installing a new sludge distribution system, a new central drainage trench, and creating access for a small bobcat type front-end loader to remove dried material. Full designs for the drying beds rehabilitation and upgrade project were completed in 2015, and this project was included in the USDA PER for acquisition of construction funds.

The community and MCCSD board of directors expressed concerns about increased activity in the drying beds, potential odors, and impacts to the local viewshed caused by increased activity in the sludge drying beds. The drying beds and WWTF are located on the scenic headlands of the Mendocino coast and are adjacent to private property with scenic views (Figures 1 and 2). It should be noted that alternatives are considered that will minimize certain impacts with respect to the aforementioned criteria, because no alternative was identified that met all of the criteria. Proper handling of wastewater sludge is regulated by the state for the protection of public health; sanitation and redundancy is essential for compliance, as well as protection of public health. Alternatives to rehabilitating the sludge drying beds are evaluated based on these criteria.

Operational Factors

The existing aerobic digester fills in approximately 1-2 weeks from the clarifier, at which point sludge is processed using the belt press and dryer over 2 days. If the belt press or dryer were to break down, MCCSD would have a maximum of 2 weeks to fix the problem before a transfer from the digester was required.

Although the PER proposed that MCCSD use the sludge drying beds as an energy efficient alternative to the belt press and dryer during the summer, proposed operation of the drying beds has been revised to only include emergency conditions when the belt press or dryer break down or require maintenance.

MCCSD currently disposes of treated biosolids in a landfill in Marin County. The landfill requires that biosolids contain more than 15% solids by weight. MCCSD currently does not have any other alternative to final disposal of biosolids. Raw sludge from the aerobic digester contains approximately 1.5% solids; after passing through the existing belt press, solids content increases to approximately 10% solids; after passing through the dryer, the solids content increases to approximately 90% solids.

Increasing solids content decreases the weight and volume of the processed biosolids, which in turn reduces the cost to haul to a landfill. Using the dryer to achieve 90% solids significantly reduces the volume of biosolids such that MCCSD can store more material and only need to haul periodically (approximately 2-3 times per year). Prior to the installation of the biosolids dryer, MCCSD was shipping approximately 50 loads per year to the landfill (of approximately 10% solids sludge).

Alternatives Considered

The following alternatives are discussed herein:

1. Redundant Dryer with Belt Press or Centrifuge
2. Redundant Solar Dryer
3. Rehabilitate Drying Beds and Replace Belt Press with Centrifuge
4. Rehabilitate Drying Beds and Install Dewatering Tubes
5. Rehabilitate Drying Beds and Install Fence

The concept of reed beds was also considered during the alternatives evaluation. However, this alternative was eliminated from further investigation due to the fact that reed beds require a constant feed of sludge, whereas the sludge drying beds are only being explored as a backup sludge processing system to supplement the belt press and dryer. Reed beds are living natural systems that are designed for continual operation, and are not well suited for short-term temporary sludge handling. Additional disadvantages to reed beds include odors from anaerobic sludge accumulation and possible mosquito vector problems from pooled water in the uneven surfaces of the beds.

Alternative 1: Redundant Dryer with Belt Press or Centrifuge

Budget Cost: $2.0M–Belt Press Option
$2.1M–Centrifuge Option

In order to achieve full redundancy for the sludge handling and disposal system without using the sludge drying beds, another belt press or centrifuge and dryer would be required. A new belt press will cost approximately $540,000, and a new centrifuge will cost approximately $640,000. The

existing dryer and sludge handling building were constructed in 2005 at a total cost of $1M. Accounting for an average inflation rate of 3%, a new dryer and building would cost approximately $1.43M. For a new belt press, dryer, and building to house the additional equipment, the total project cost would be approximately $2.0M. For a new centrifuge, dryer, and building to house the additional equipment, the total project cost would be approximately $2.1M. The location of the new building to house the additional belt press and dryer has not been determined.

The centrifuge costs approximately $100,000 more than the belt press, but would reduce the energy used by the dryer because the centrifuge reduces the moisture content of the sludge more than the belt press. The centrifuge can produce sludge that is 20±2% solids, whereas the belt press can only produce sludge that is 10% solids. This results in approximately half as much water content in the sludge and roughly half the amount of energy will be required for drying sludge from the centrifuge compared to the belt press, resulting in up to $10,000 per year in operational cost savings. The lower moisture content of the centrifuge also means the dewatered sludge can be taken directly to the landfill in case the dryers break down. The centrifuge also requires approximately one third the amount of polymer to dewater sludge, which will further reduce operational costs by approximately $700 per year.

Advantages:

- Provides fully redundant sludge processing system without the need to use drying beds.
- Sludge from centrifuge can be taken to landfill if dryer breaks down.
- Dryer reliably produces Class A biosolids with 90% solids content.
- Reduced operational costs of approximately $10,700 per year.

Disadvantages:

- New building may impact viewshed.
- High cost.

Alternative 2: Redundant Solar Dryer

Budget Cost: $1.0M

A solar dryer would provide a completely redundant sludge processing system that would produce biosolids from sludge capable of disposal to a landfill. The process includes a greenhouse-type structure with circulation and ventilation fans, and a mechanical sludge bed mixer. The structure acts like a greenhouse to increase interior temperatures while the fans circulate the heated air over the sludge beds. A mechanical mixer turns the sludge to increase exposure to heated air, and reduce drying time. The system would require a solar dryer building footprint slightly smaller than the footprint of the three existing drying beds combined at 42 feet wide, 108 feet long, and 23 feet tall. The budget cost of this alternative is approximately $1.0M. A rendering of what the solar dryer might look like from the perspective of a neighboring property is demonstrated in Figure 3.

Advantages:

- Provides fully redundant, year-round sludge processing system.
- Reduces drying time over sludge drying beds alone.
- Requires less energy for drying than existing belt press and dryer.
- Requires low operational management.
- Can take raw liquid sludge, partially dried sludge, or dried biosolids for storage.

Disadvantages:

- Tall structure will obstruct viewshed in vicinity of drying beds.
- Circulation and ventilation fans may generate noise.
- Heated and ventilated sludge may produce odors.
- Drying capacity may vary seasonally.
- High construction cost.

Alternative 3: Rehabilitate Drying Beds and Replace Belt Press with Centrifuge

Budget Cost: $1.0M

This alternative creates emergency sludge storage and dewatering using the drying beds in case the dryer or centrifuge break down, and provides an additional sludge disposal process using the centrifuge by itself to dewater sludge for hauling to a landfill. As previously discussed in Alternative 1, the centrifuge can dewater sludge to 20±2% solids, the minimum requirement for the landfill. A new centrifuge will cost approximately $640,000 and rehabilitation of the existing drying beds will cost approximately $371,250, for a total budget estimate of approximately $1.0M.

Advantages:

- Provides alternative sludge disposal process using the centrifuge by itself.
- Provides emergency sludge storage using the drying beds.
- Reduces energy used by dryer to remove moisture.

Disadvantages:

- Emergency use of drying beds may create odors periodically during use.
- High cost.

Alternative 4: Rehabilitate Drying Beds and Install Dewatering Tubes

Budget Cost: $0.4M

Dewatering tubes are made of porous synthetic fabrics and are used to hold sludge allowing water to exfiltrate from the tubes while retaining the dewatered sludge. Filtrate is returned to the treatment plant, and the fabric tubes are eventually cut open and the material is taken to a landfill. However, if filled too much, the tubes become more cylindrical in shape, and the center of the tubes does not dry as efficiently because it is further from the draining surface. If filled less, the tubes lay flatter, and drying efficiency increases; however, filling the tubes less also means more space will be required.

The existing drying beds would still need to be rehabilitated to collect the exfiltrate from the tubes and to provide a place to contain the material during filling and emptying. The cost to rehabilitate the existing sludge drying beds is approximately $371,250. An example of what these tubes look like inside of concrete drying beds at another facility is shown in Figure 4. The tubes vary in size and can be manufactured to fit the existing drying beds. The tubes could be placed in the westernmost drying bed first to reduce potential odor and visual impacts to neighboring properties.

A dewatering tube of sufficient capacity to hold 6 months of sludge (approximately 30,000 gallons) would measure 22.5 feet wide by 50 feet long, and would fit into the footprint of an existing drying bed with room for handling upon removal. One tube would be used for dewatering and processing. However, the tubes are single-use items, so a second tube would be prepared and ready for additional processing if needed. Tubes should not be filled completely, because sludge in the center of a fully filled tube remains wet, which adds to the processing time and labor.

The budget cost for two tubes of this size is approximately $3,100. The total budget cost for this alternative is estimated to be $374,350.

One of the primary drawbacks to using this technology is the labor required for emptying the tubes. The tube is cut open manually, and then the material must be spread around. If a tractor is used to spread the material, the tube fabric may become entangled in the machinery, complicating handling. It should also be noted that the City of Eureka used this technology with anaerobically digested sludge and eventually abandoned the project because the sludge in the center of the tubes did not dewater properly and when the tubes were split open, the sludge had to be spread out and allowed to air dry before additional handling.

Advantages:

- Provide temporary sludge storage if belt press or dryer break down.
- Can use rehabilitated drying beds as containment and underdrain system.
- Can allow the use of the drying beds in the wet season.
- May reduce odors

Disadvantages:

- Does not reduce moisture content enough for landfill disposal, still requires use of belt press and dryer prior to disposal.
- One time use bags are cut open following use and bag material is disposed of in landfill.
- May impact view shed depending on placement
- Labor-intensive loading and emptying of tubes

Alternative 5: Rehabilitate Drying Beds and Install Fence

Budget Cost: $0.4M

This alternative would rehabilitate the existing drying beds and install a redwood fence along the eastern boundary of each of the three beds to reduce the impacts to the viewshed (Figure 5). The estimated cost to rehabilitate the drying beds is approximately $371,250 and constructing a fence along each of the drying bed boundaries would cost approximately $21,000 for a total budget cost estimate of approximately $392,250.

Advantages:

- Fence obscures view of sludge beds and operating equipment.
- Low cost.
- Low operational management.
- Minimal viewshed impacts.
- No change from current operation.

Disadvantages:

- Does not eliminate potential odor issues.

Alternative Cost Summary

Table 1 summarizes the drying beds alternatives and budget costs.

Table 1
Sludge Drying Beds Alternatives Cost Summary
Mendocino City Community Services District WWTF

Alternative	Budget Cost
1a. Redundant Dryer with Belt Press	$2.0M
1b. Redundant Dryer with Centrifuge	$2.1M
2. Redundant Solar Dryer	$1.0M
3. Rehabilitate Drying Beds and Replace Belt Press with Centrifuge	$1.0M
4. Rehabilitate Drying Beds and Install Dewatering Tubes	$0.4M
5. Rehabilitate Drying Beds and Install Fence	$0.4M

Conclusions and Recommendations

SHN recommends that MCCSD pursue development of Alternative 5, rehabilitation of the sludge drying beds with the addition of a redwood fence along the eastern boundary of each drying bed. This alternative is the lowest cost, lowest operational management, and lowest visual impact. SHN also recommends that MCCSD adopt a standard operating procedure for using the sludge drying beds that stipulates that the beds can only be used by operators in the case of emergencies when the primary sludge processing system fails. This is current operational procedure; however, it is not mandated. Sludge placed into the beds during emergency procedures should be processed using the primary processing equipment once the equipment is back on line.