



210 25<sup>th</sup> Avenue North, Suite 1102  
Nashville, Tennessee 37203  
tel: 615-320-3161  
fax: 615-320-6560

## Technical Memorandum No. 2A

*To: City of Franklin IWRP Team*

*From: CDM*

*Date: April 29, 2011*

*Subject: Integrated Water Resources Plan – Biosolids Technical Analysis  
TM 2A - Evaluation of One versus Two Biosolids Facilities*

### Executive Summary

This Technical Memorandum (TM) was created concurrently with TM No. 2 (Evaluation of Biosolids Alternatives and Technologies). It explores the relative capital and operation and maintenance (O&M) costs associated with the following biosolids management strategies:

- Alternative A: No new wastewater treatment plant (WWTP) is constructed, and all wastewater and resultant biosolids are treated at Franklin WWTP.
- Alternative B: A new WWTP is constructed to accept flows between 2 and 6 mgd. In addition to a new solids process at Franklin WWTP, varying degrees of solids treatment occur at the new WWTP.

Variations on Alternative B (Alternatives B-1 through B-3) were studied in order to develop an understanding of the relative costs. For this analysis, CDM used the Option 3 treatment train (screw thickening, mesophilic anaerobic digestion, centrifuge dewatering, rotary drum drying) as a representative set of processes that achieves the City's goal of producing biosolids that can be beneficially reused. More detailed descriptions of the Option 3 treatment technologies are included in TM No. 2. At the time of this writing, no treatment train option has been either selected or eliminated from further consideration. The costs presented in this TM are preliminary, planning-level costs that are presented solely to illustrate the relative expense of constructing and operating the alternatives discussed herein.



Based on the economic analysis of Alternatives A and B presented in Table ES-1, CDM has concluded that the lowest capital and O&M costs are to be realized if all solids are generated and treated at Franklin WWTP.

**Table ES-1**  
**Summary of Preliminary Economic Analysis for Alternatives A and B**

<b>Alternative</b>	<b>Capital Cost</b>	<b>Annual O&amp;M Cost (2040)</b>	<b>Present Worth</b>	<b>O&amp;M Cost Per DT</b>
<u>Alternative A:</u> All Wastewater and Solids Treatment at Franklin WWTP	\$50.0MM	\$1.03MM	\$65.8MM	\$309
<u>Alternative B-1:</u> Dewatering at New WWTP, Drying at Franklin WWTP	\$66.6MM	\$1.36MM	\$87.6MM	\$408
<u>Alternative B-2:</u> Thickening at New WWTP, Transfer to Franklin WWTP	\$54.6MM	\$1.15MM	\$72.4MM	\$346
<u>Alternative B-3:</u> Pump WAS to Franklin WWTP	\$63.5MM	\$1.08MM	\$80.2MM	\$324
Current O&M Cost	N/A	N/A	N/A	\$547

## 1.0 Introduction

In support of the City of Franklin's Integrated Water Resources Plan (IWRP), CDM has been evaluating the solids handling facilities at the City's wastewater treatment plant (WWTP). CDM has conducted site visits to the WWTP to assess the condition of the existing equipment, as well as reviewing the historical monthly operating reports (MORs), a performing preliminary analysis of the current operation and maintenance (O&M) requirements and costs of solids treatment, and developing an overview of the solids projections based on current conditions and the availability of existing equipment to meet future needs of the WWTP. The results of these activities were presented in Technical Memorandum (TM) No. 1, "Evaluation of Existing Equipment and Sludge Production Forecast."

In TM No. 1, CDM concluded that the existing solids handling facilities were near the end of their useful life; and that if the existing facilities were not replaced and expanded, the anticipated future increases in solids production would exceed the plant's solids treatment capacity between 2020 and 2030. Upgrades to Franklin WWTP's solids handling facilities are needed, regardless of whether a second WWTP is constructed. CDM and the City expect that some kind of solids handling will always be needed at Franklin WWTP, unless the City elects to consolidate solids treatment at another location, such as a second WWTP.

In preparing TM No. 2 ("Evaluation of Biosolids Alternatives and Technologies"), CDM developed preliminary capital, O&M, and present worth costs of the four solids treatment trains discussed during Biosolids Workshop No. 1. Concurrent with this economic analysis, CDM analyzed the



relative capital construction and O&M costs to operate one biosolids treatment facility at Franklin WWTP or two biosolids facilities—one at Franklin WWTP and one at a new WWTP. The purpose of TM 2A is to present and discuss the results of capital construction and O&M costs analysis.

CDM is developing planning level capital costs of the four biosolids treatment train options that were developed at Biosolids Workshop No. 1, held on February 2, 2011. One of the objectives of this part of CDM's work is to evaluate the feasibility and cost of the following biosolids management strategies:

- Alternative A: No new WWTP is constructed, and all wastewater and resultant biosolids are treated at Franklin WWTP.
- Alternative B: A new WWTP is constructed to accept flows between 2 and 6 mgd. In addition to a new solids process at Franklin WWTP, varying degrees of solids treatment occur at the new WWTP.

## **2.0 Discussion of Alternatives**

Variations on Alternative B were studied in order to develop an understanding of the relative costs. For this analysis, CDM used the Option 3 treatment train as a representative example of a complete treatment process that includes all four solids processing steps—thickening, stabilization, dewatering, and drying—and achieves the City's goal of producing biosolids that can be beneficially reused. More detailed descriptions of the Option 3 treatment technologies (screw thickening, anaerobic digestion, centrifuge dewatering, and rotary drum drying) are included in TM No. 2. At the time of this writing, no treatment train option has been either selected or eliminated from further consideration.

The methodologies and assumptions presented in Section 4 of TM No. 2 apply to the development of the costs presented in this memorandum. These costs, summarized in **Table 2-1**, are preliminary, planning-level costs and are presented solely to illustrate the relative expense of constructing and operating the alternatives discussed herein.

### **2.1 Alternative A: No New WWTP; All Wastewater and Solids Treated at Franklin WWTP**

In this alternative, a new WWTP is not constructed, and all wastewater flows to Franklin WWTP for treatment. All waste activated sludge (WAS) produced by the wastewater treatment process is generated and treated on site prior to disposal. A solids handling building would combine all of the new solids handling technologies—three screw thickeners, support equipment for two mesophilic anaerobic digesters, three dewatering centrifuges, and one rotary drum dryer—under one roof.



210 25<sup>th</sup> Avenue North, Suite 1102  
 Nashville, Tennessee 37203  
 tel: 615-320-3161  
 fax: 615-320-6560

**Table 2-1**  
**Summary of Alternatives**

Process	Alternative A: All Solids Treatment at Franklin WWTP			Alternative B-1: Dewatering at New WWTP, Drying at Franklin WWTP						Alternative B-2: Thickening at New WWTP, TWAS to Franklin WWTP						Alternative B-3: WAS Force Main to Franklin WWTP					
				Franklin WWTP			New WWTP			Franklin WWTP			New WWTP			Franklin WWTP			New WWTP		
	No. of Units in 2040 <sup>1</sup>	Unit Capacity <sup>2</sup>	Op. Schedule (hrs/week) <sup>3</sup>	No. of Units in 2040 <sup>1</sup>	Unit Capacity <sup>2</sup>	Op. Schedule (hrs/week) <sup>3</sup>	No. of Units in 2040 <sup>1</sup>	Unit Capacity <sup>2</sup>	Op. Schedule (hrs/week) <sup>3</sup>	No. of Units in 2040 <sup>1</sup>	Unit Capacity <sup>2</sup>	Op. Schedule (hrs/week) <sup>3</sup>	No. of Units in 2040 <sup>1</sup>	Unit Capacity <sup>2</sup>	Op. Schedule (hrs/week) <sup>3</sup>	No. of Units in 2040 <sup>1</sup>	Unit Capacity <sup>2</sup>	Op. Schedule (hrs/week) <sup>3</sup>	No. of Units in 2040 <sup>1</sup>	Unit Capacity <sup>2</sup>	Op. Schedule (hrs/week) <sup>3</sup>
WAS Storage	1	1.2 MG	n/a	1	0.9 MG	n/a	1	0.3 MG	n/a	1	0.85 MG	n/a	1	0.3 MG	n/a	1	1.2 MG	n/a	1	0.3 MG	n/a
Thickening (Screw Thickener)	3	1,100 lbs/hour	75	2	1,100 lbs/hour	109	2	1,100 lbs/hour	40	3	1,100 lbs/hour	55	2	1,100 lbs/hour	40	3	1,100 lbs/hour	75	n/a	n/a	n/a
TWAS Storage	1	160,000 gal	n/a	1	120,000 gal	n/a	1	50,000 gal	n/a	1	120,000 gal	n/a	1	50,000 gal	n/a	1	160,000 gal	n/a	n/a	n/a	n/a
Stabilization (Anaerobic Digestion)	2	0.6 MG	n/a	2	0.4 MG	n/a	1	0.4 MG	n/a	2	0.6 MG	n/a	n/a	n/a	n/a	2	0.6 MG	n/a	n/a	n/a	n/a
Dewatering (Centrifuge)	3	1,280 lbs/hour	43	2	1,280 lbs/hour	62	2	1,280 lbs/hour	23	3	1,280 lbs/hour	43	n/a	n/a	n/a	3	1,280 lbs/hour	43	n/a	n/a	n/a
Drying (Rotary Drum Dryer)	1	825 lbs/hour	132	1	825 lbs/hour	132	0	825 lbs/hour	n/a	1	825 lbs/hour	132	n/a	n/a	n/a	1	825 lbs/hour	132	n/a	n/a	n/a
<b>Planning Level Construction Cost</b>	\$49,976,000			\$66,616,000						\$54,639,000						\$63,546,000					
<b>Annual O&amp;M Cost</b>	\$1,027,000			\$1,356,000						\$1,149,000						\$1,077,000					
<b>Present Worth</b>	\$65,800,000			\$87,600,000						\$72,400,000						\$80,200,000					
<b>O&amp;M Cost per DT</b>	\$309			\$408						\$346						\$324					

<sup>1</sup> Includes standby unit where applicable.

<sup>2</sup> Capacities expressed as pounds per hour or pounds per day are dry solids

<sup>3</sup> In the maximum month.

<sup>4</sup> O&M costs are presented for the design year of 2040



210 25<sup>th</sup> Avenue North, Suite 1102  
Nashville, Tennessee 37203  
tel: 615-320-3161  
fax: 615-320-6560

The planning-level Opinions of Probable Construction costs (OPCC) for Alternative A is \$50.0 million. The annual O&M cost in 2040 is estimated to be \$1.03 million, or \$309 per dry ton (DT) of solids treated. The 30-year present worth of Alternative A is \$65.8 million.

## **2.2 Alternative B: Construct New WWTP and Treat Solids at Both WWTPs**

The possibility of constructing a second WWTP is currently being investigated. For the purposes of this analysis, the capacity of this new WWTP was assumed to be 2 mgd at startup, with an ultimate capacity of 6 mgd in 2040.

One approach to solids treatment would be to construct a completely separate, independent solids treatment train at the new WWTP. A more practical approach, however, would be to transfer solids from the new WWTP to Franklin WWTP for treatment. Many solids treatment technologies benefit from continuous running, and consolidating solids treatment at one plant lengthens process run times, while minimizing the amount of redundant equipment, O&M, and staffing requirements. Furthermore, the proximity of this potential new WWTP to Franklin WWTP makes transfers of sludge feasible. Three alternatives, each involving different degrees of solids treatment at the new WWTP, are discussed below.

### **2.2.1 Alternative B-1: Dewatering at New WWTP, Drying at Franklin WWTP**

In this alternative, a solids handling building at Franklin WWTP would house two screw thickeners, support equipment for two anaerobic digesters, two dewatering centrifuges, and a rotary drum dryer. A smaller solids handling building at the new WWTP would contain two screw thickeners, support equipment for one anaerobic digester, and two dewatering centrifuges. Because even the smallest drum dryer would be oversized for a 2 to 6 mgd WWTP, CDM did not include a dryer at the new WWTP. Instead, it was assumed that the dewatered biosolids from the new WWTP would be hauled via truck to Franklin WWTP for drying and subsequent disposal.

All of this redundant equipment and facilities results in a planning level OPCC of \$66.6 million for Alternative B-1. The annual O&M cost in 2040 is estimated to be \$1.36 million, or \$408/DT of solids treated, due to the additional staffing and maintenance needed for the new WWTP. The 30-year present worth of Alternative A is \$87.6 million.

### **2.2.2 Alternative B-2: Partial Solids Treatment at New WWTP; Transfer of TWAS to Franklin WWTP**

This alternative assumes that WAS from the new WWTP is transported to Franklin WWTP via tanker truck. The WAS could be hauled, untreated at 0.5-percent solids, or be thickened by mechanical means to approximately 5-percent solids prior to transport. As **Table 2-2** demonstrates, because thickened WAS (TWAS) occupies 1/10 the volume of unthickened WAS, it is more economical to transport than unthickened WAS.



**Table 2-2  
 Comparison of Costs for Hauling WAS and TWAS from a New WWTP**

Waste-Water Flow (mgd)	Unthickened WAS				Thickened WAS			
	Solids (%)	Volume Produced (gal/day)	Truckloads per Year <sup>1</sup>	Annual Hauling Cost <sup>2</sup>	Solids (%)	Volume Produced (gal/day) <sup>3</sup>	Truckloads per Year <sup>1</sup>	Annual Hauling Cost <sup>2</sup>
2	0.5	39,400	2,400	\$278,000	5.0	3,800	240	\$33,000
6		118,000	7,180	\$818,000		11,300	690	\$84,000

<sup>1</sup> Each tanker truckload is 6,000 gallons.  
<sup>2</sup> Includes insurance, maintenance, fuel, and labor costs.  
<sup>3</sup> Assumes 90-percent solids capture in the thickeners.

For Alternative B-2, CDM assumed that WAS produced at the new WWTP would be thickened from 0.5- to 5-percent solids using a screw thickener. TWAS would be pumped into a tanker truck and hauled to Franklin WWTP for further treatment and ultimate disposal. The hauling distance used for this analysis was assumed to be 6.8 miles, which is approximately equal to the length of a theoretical sludge transfer pipeline discussed in Alternative B-3, Section 2.2.3.

When compared to Alternative A, it is evident that Alternative B-2 will have a higher construction cost due to the need to construct separate thickening facilities at each WWTP. Alternative B-2 requires the procurement of two more screw thickeners, construction of a thickening building at the new WWTP, and WAS and TWAS storage tanks with mixing systems. The City does not currently own any sludge tanker trucks, so the City would have to purchase at least two tanker trucks. A tanker truck unloading facility would also have to be constructed at the Franklin WWTP to receive the thickened sludge.

The planning level OPCC for Alternative B-2 is \$54.6 million. The annual O&M cost in 2040 is estimated to be \$1.15 million, or \$346/DT of solids treated. The 30-year present worth of Alternative A is \$72.4 million.

**2.2.3 Alternative B-3: WAS Force Main from New WWTP to Franklin WWTP**

Pumping of WAS from the new WWTP to Franklin WWTP was examined in Smith Seckman & Reid, Inc.'s (SSR) January 2011 technical memorandum. A 36,000-foot-long force main would be required to transmit raw WAS at 0.5-percent solids to Franklin WWTP. The conceptual cost estimate presented in SSR's memo is \$2.7 million to \$3 million, which does not include acquisition of rights-of-way. The use of a force main between the plants eliminates the expense of hauling liquid sludges via tanker truck, and it also eliminates the need to construct solids handling facilities at the new WWTP.

In developing preliminary costs for this alternative, CDM assumed that a 6-inch, 36,000-foot-long force main would be constructed from the new WWTP to Franklin WWTP, along with WAS storage and pumping facilities at the new WWTP. The planning level OPCC for Alternative B-3 is



City of Franklin IWRP Team  
TM 2A - Evaluation of One Versus Two Biosolids Facilities  
May 3, 2011  
Page 7

\$63.5 million. The annual O&M cost in 2040 is estimated to be \$1.08 million, or \$324/DT of solids treated. The 30-year present worth of Alternative B-3 is \$80.2 million. These costs are likely to increase after the cost of right-of-way acquisition is calculated.

### **3.0 Conclusions and Recommendations**

Alternative A, where all solids are generated and treated at Franklin WWTP, carries the lowest construction and O&M costs of the four alternatives presented in this memorandum. Alternative B-2, in which two separate solids handling treatment trains are constructed, is the most expensive. CDM recommends that, in order to minimize capital and O&M costs, the focus of the IWRP should be on consolidation of solids handling facilities at Franklin WWTP.