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BIOSOLIDS REUSE ACTION PLAN

DRAFT REPORT For Review

May 2024

TOWN OF MONTAGUE, MASSACHUSETTS

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LIST OF ABBREVIATIONS

BA – Bulking Agent
CWF – Clean Water Facility
FCSWMD – Franklin County Solid Waste Management District
FRCOG – Franklin Regional Council Of Governments
TSS – Total Suspended Solids

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1.0 BACKGROUND & EXISTING STUDY

Weston & Sampson was hired to conduct an evaluation for the Montague Clean Water Facility (CWF) to determine whether composting or drying their biosolids would be desirable for the Town to pursue and implement. Originally, the evaluation scope was only for composting systems. During the process, the Town added the evaluation of a mechanical dryer system. As a result, to stay within the original contracted budget, Weston & Sampson removed the qualitative evaluation of odor impacts from the scope, as the previous engineering report covers this quite extensively. This evaluation was conducted after a prior study was provided to the Town by a separate engineering firm. Weston & Sampson was tasked with assessing the existing study and confirming or revising the conceptual designs, filling any gaps remaining, and providing preliminary calculations for bringing the project to the next stage – design.

1.1 Background

The Town of Montague CWF is currently designed to treat an average daily flow of 1.0 MGD. The facility treats an average daily flow of 0.66 MGD. The facility currently processes biosolids using a gravity thickener tank and a volute screw press for dewatering. The dewatered biosolids (cake) are hauled off site by third party companies to dispose of using incineration or other methods. The Town is currently in a contract with these companies to haul their cake at a billing rate per wet ton. This disposal rate has increased over recent years and the Town would like to be self-reliant on their disposal methods. The Town prioritizes sustainable wastewater treatment and disposal methods, with an emphasis on beneficial reuse of their biosolids.

The Town originally intended to evaluate a composting option of biosolids treatment in order to provide class A biosolids for beneficial reuse on site or elsewhere in the region. During the study, it was decided by the Town to also evaluate the use of a mechanical dryer to process biosolids to provide class A dried biosolids for beneficial reuse. Weston & Sampson conducted analyses on both of these options and provide conclusions and recommendations within this report.

1.2 Study Conclusion and Gap Analysis

As part of this evaluation, Weston & Sampson analyzed the existing composting study in an effort to validate or revise the findings in the previous report. The report was also used as a starting point for the composting evaluation, so as not to duplicate previous efforts. After analyzing the report, some of the gaps identified include the following:

1.2.1 Biosolids Throughput

The previous report included two scenarios of biosolids processing in order to provide conceptual sizing of composting systems required. The two scenarios were 4 and 10 dry tons per week. The first being the scenario of only processing biosolids produced from the Town of Montague. The second scenario (10 dry tons per week) included the acceptance of 6 dry tons per week from regional facilities.

After Weston & Sampson evaluated the current flows and loadings to the CWF, it was determined that the previous estimate of 4 dry tons per week is not adequate to support the CWF. At the current average daily flow of 0.66 MGD and average influent Total Suspended Solids (TSS) concentration of 300 mg/L, the projected average weekly solids throughput is 5.7 dry tons/week. It should be noted that these values are based on the assumption that all solids entering the facility are transferred through the dewatering process. There may be slight reduction in solids volume throughout the biological treatment process. It should be noted that the influent sample point for the facility is at a location downstream of where regional communities discharge their sludge hauled by trucks. A breakdown of the solids data for the CWF and its regional partners is shown in Table 1.

Table 1 – Total Solids Throughput Data

Parameter	Value
Average TSS Concentration*	300 mg/L
Average Plant Flow	0.66 MGD
Average Total Solids Loading, Dry Tons/Week	5.7
Average Regional Weekly Solids Received, Dry Tons/Week	2.0
Average Montague Solids Calculated, Dry Tons/Week	3.7

**The sample point for TSS is downstream of where the regional sludge and sewage trucks are accepted, so the data reflects all solids loading currently received at the facility.*

The values presented were calculated using the average total suspended solids (TSS) concentration and average plant flow. The regional sludge value was calculated using the last 8 months of data from receiving truck loads of sludge from other facilities throughout the region, based on each community's general average solids concentration of their sludge. The amount that comes directly from the local Town of Montague collection system was calculated by subtracting the regional volume from the total. This is a conservative number, because the facility's annual EPA residuals report for 2023 indicated that an average of 3.8 dry tons/week are hauled from the facility in the form of dewatered cake. In order to provide adequate sizing of a biosolids drying system, we decided to use the higher value of 5.7 total dry tons/week for the current scenario.

In addition, the solids drying system or composting system needs to be sized to accommodate potential future flows and loads from both the Town and any expansion on the regional acceptance program. The Montague CWF is designed to treat 1 MGD from the Town's collection system. At 250 mg/L TSS (the calculated amount that comes from the Town only), and at a flow of 0.8 MGD (80% of the design capacity), the Town could produce 5.8 dry tons/week from its local community.

As a result, we determined that it would be necessary to reserve a minimum of 5.8 dry tons per week for the Town of Montague. For purposes of our evaluation, we used values of 6 and 12 dry tons per week for the two options considered. These include evaluating the processing of biosolids from the Montague CWF only (6 dry tons/week – Option 1) in addition to the receiving of 6 additional dry tons per week from regional partners (12 dry tons/week total – Option 2). These options are further broken down in Section 2.2.

1.2.2 Economic Analysis

There are a couple of items of note in the economic analysis provided in the previous report that we want to bring attention to. We noticed the use of an electrical rate of $0.10/kWh in the previous report. Based on electric bills to the CWF, it was observed that the flat rate charged by Eversource is $0.165/kWh. With the additional miscellaneous charges, Weston & Sampson has calculated an aggregate rate of electricity use as $0.22/kWh. This is more than double the value used in the previous report, which is very important when evaluating the mechanical dryer option for this project.

Another item that needs to be adjusted is the regional solids disposal/acceptance rate. The previous report used a value of $750/dry ton to accept or dispose of 20% cake. Montague's current rate of disposal is increasing to $208/wet ton, which equates to $1,094 per dry ton. This discrepancy could be due to the volatile market of biosolids disposal, which has increased drastically over the last few years. For purposes of this evaluation, Weston & Sampson will be using the most recent values for calculating both the disposal and acceptance of biosolids.

Finally, the previous report did not compare the final annualized costs with the annual savings that Montague would experience by not hauling away cake if a composting or drying system was installed. Weston & Sampson portrays the overall cost and revenue structure to delineate the total financial impact to the Town if they were to implement a project of this nature. Essentially, we compare negative balances (capital, utility, O&M costs) to positive balances (revenue from regional partners, savings from current disposal method) to achieve a break even quantity of regional acceptance AND a break even point of how much is needed to charge the regional partners.

The study included an extensive odor study for the Sandy Lane location for the composting system. Weston & Sampson reviewed this portion and found that it is valid. Additionally, the Town reached out to Weston & Sampson during the evaluation process and initiated an additional phase of the study to evaluate a mechanical dryer. In order to provide these services within the existing contract amount, Weston & Sampson has removed the portion under scope item 5 – Update Siting Alternatives in regard to the qualitative evaluation of odor impact.

2.0 ADDITIONAL ALTERNATIVE ANALYSIS

Weston & Sampson wanted to provide the Town with additional alternatives to the static aeration composting method. During this phase, as previously mentioned, the Town informed Weston & Sampson that they would like to evaluate a mechanical drying system in lieu of other composting technologies. As a result, Weston & Sampson conducted an analysis of multiple biosolids drying technologies in addition to an aerated static pile composting system. Furthermore, the most beneficial physical location of these systems was evaluated as well.

2.1 Site Options Identification for Composting System

The previously identified site by both the engineering report and the Town personnel is Sandy Lane, where the Town owns a parcel of vacant land that is secluded and not near any major residential or commercial areas. It is surrounded by a solar panel field on one side and wooded vegetation on the other. It is only a 1.5 mile drive from the CWF. Although Weston & Sampson agrees that this is a promising site for locating a composting system, we provided a few other options as a due diligence effort. These locations are shown below in These options are all owned by the Town and fit the criteria used for the Sandy Lane site identification. It should be noted that this is a cursory desktop review and that these locations were not individually vetted with Town personnel, since the Sandy Lane site was deemed the optimal location by staff.

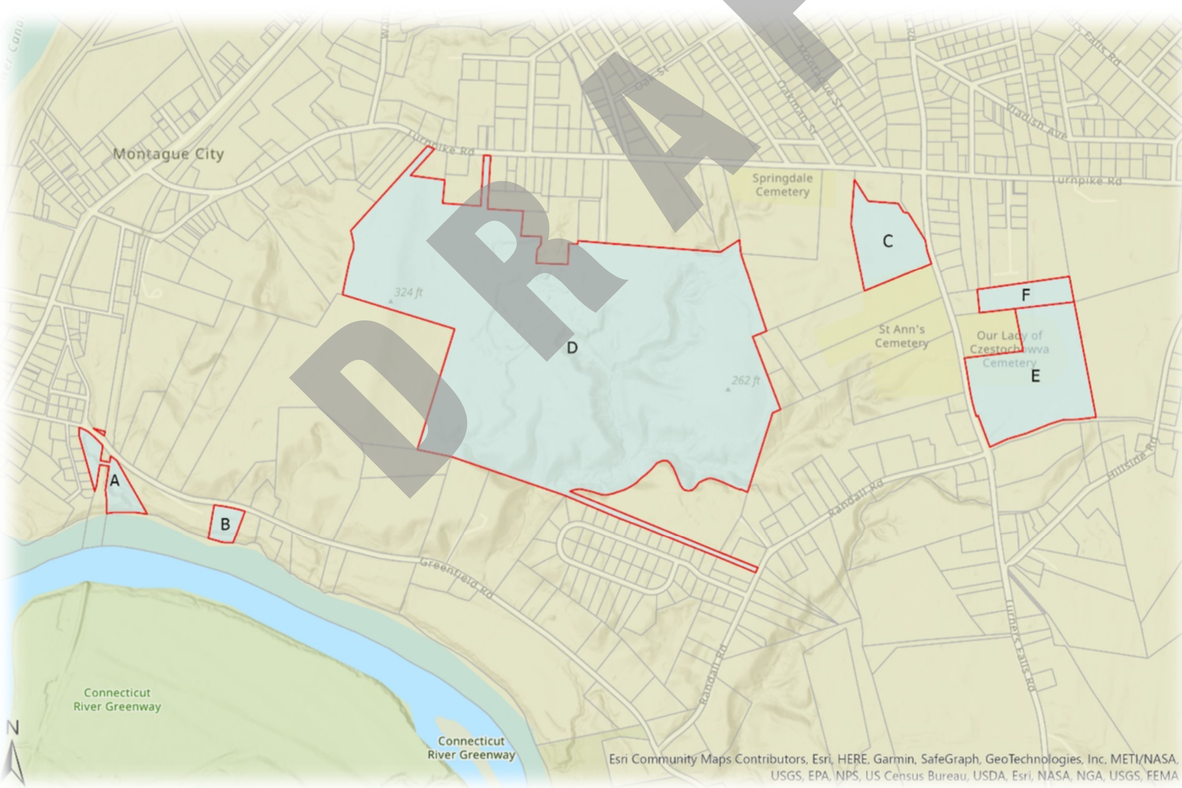

Figure 1 – Site Alternatives Location Map

A – 0 Greenfield Rd (Inhabitants of Montague)
B – 46 Greenfield Rd (Inhabitants of Montague)
C – 128 Turners Falls Rd (Inhabitants of Montague)
D – 10 Sandy Ln (Inhabitants of Montague)
E & F – 0 Turners Falls Rd (Gill Montague Regional)

Location A
- Pros: proximity to CWF
- Cons: size and proximity to residential areas

Location B
- Pros: proximity to CWF
- Cons: size and proximity to residential areas

Location C
- Pros: Size
- Cons: Heavily wooded, proximity to CWF, proximity to residential areas

Location D
- Pros: size, ready for construction, secluded
- Cons: proximity to CWF

Locations E & F
- Pros: Size
- Cons: Cons: Heavily wooded, proximity to CWF, proximity to residential areas

Other than Location D (Sandy Lane), the only other viable option that should be considered is Location B, located adjacent to the existing CWF administrative building. Although, if a building expansion is desired, this option would not be advisable. For purposes of this evaluation, Weston & Sampson has decided to move forward with the off-site location option of Location D at 10 Sandy Lane. The off-site location evaluation only applies to the composting portion of the project, as the mechanical drying equipment can be located on site at the CWF.

2.2 Advanced Technology Options

This section describes the different technologies evaluated for this regional facility. This included an Aerated Static Pile composting system, and various mechanical drying systems. When evaluating the composting and drying options, the following assumptions were used for all life-cycle cost analyses:

- Electric Rate (Total Monthly): $0.228 per kWh
- Propane Rate: $3.50 per gallon
- Capital Loan Annual Interest Rate: 2%
- Annual Utility Inflation: 3% (equal to present worth rate)
- Regional Rate for 9,000-gallon truck: Varies, $950-$1,200
- Annual Revenue Charges Inflation: 3%
- Current Cake Disposal Rate: $208 per wet ton (Implemented this year)
- Annual Cake Disposal Inflation: 7% (matches latest increase)

The total life cycle costs for 20- and 30-year analyses are given in projected future values based on the assumptions presented. A present worth summary is given at the end of the report in Table 17.

2.2.1 Composting Technologies

The Aerated Static Pile (ASP) composting method, as described in the previous engineering report, is a relatively low-cost method of composting biosolids if adequate space is available. The Sandy Lane location would be the preferred location for this option of composting, especially considering the implementation of Option 2 (12 dry tons per week).

Because the Town introduced an additional component of evaluating a dryer technology for the project, the efforts of advanced technology analyses were focused on the mechanical biosolids drying equipment, rather than composting. Upon the review of the conceptual design given in the previous engineering report, we agree that the general concept provided is adequate for inclusion within our final report. The static aerated pile method is a relatively low energy technology that has been proven successful with this type of application. It does tend to result in higher capital costs, but it provides an easily expandable system if the regional market demands.

In order to meet the Class A pathogen and vector attraction reduction requirements as laid out in 40 CFR 503, the dewatered biosolids should be blended with a fibrous bulking agent (BA), such as wood chips or similar, to meet these requirements in a shorter time. The bulking agent can be provided as yard waste from residents or other “waste” sources of organic fibrous materials (wood). This bulking agent acts as a source of carbon, increases porosity, and decreases the overall moisture content in the material. The composting process consists of raw product storage, mixing stage, active phase, screening/curing phase, and final product storage.

In order to be consistent between the composting and drying analyses, the process should be designed around one week of biosolids production and be composted in batches. The process is described below based on a maximum 12 dry tons/week at 19% solids (average concentration at the discharge of the existing volute press at the Montague CWF).

One week’s worth of raw dewatered biosolids would be stored adjacent to the composting process in a dedicated enclosed building with containment and drainage. The drainage system would discharge to a local lift station that will transport water to the collection system. The raw biosolids storage building will have an odor control exhaust system that will pull foul air from the space and move it through a biofilter to minimize foul odors on site.

On a given day each week, the previous week’s raw biosolids would be moved into the mixing stage. In the mixing stage, the biosolids are blended with the bulking agent using a trailer-mounted mixer and front-end loader. The ideal solids content of the blended mix is 40%. After the material is homogenized, the loader will move the material into an active composting bay. The mixing and construction of the active composting pile shall occur in the same day.

In the active phase, dewatered biosolids are aerated continuously to allow for aerobic conditions while the mixed pile is achieving a temperature over $60^{\circ C}$. Each batch should be kept in the active phase for 21 days. The temperature must be measured and recorded each day for each batch in the active composting phase.

After the 21-day active phase, the batch shall be transferred to the screening and curing phase, where the material is separated with a mechanical screen to recover the larger bulking agent components.

The screened compost material is then transferred to the curing bays, where the biosolids compost will be aerated at a lower rate for a total period of 28 days.

Finally, the cured compost material shall be transferred to the final storage area, where it can be loaded into trucks or other vehicles for reuse.

Each active and curing bay shall be thoroughly cleaned after the material is removed, to allow for reliable aeration transfer from the trenches. In addition, the front end loader shall use two separate buckets so cross-contamination does not occur between the raw and treated materials.

Because the process needs to occur in weekly loads/batches and the longest detention time is 28 days, each of the active and curing stages needs to have at least four separate bays. The active stage, being 21 days, is more flexible with four bays than the curing process. Therefore, we recommend that the active composting stage has four bays, and the curing process has five bays, similar to the previous engineering report. This will allow the process to continue with one active bay and one curing bay out of service, if necessary.

The technologies involved in the Aerated Static Pile composting process include:

- Blowers for Active Bays (Positive Displacement with VFDs)
- Blowers for Curing Bays (Positive Displacement with VFDs)
- Mechanical Mixer (trailer mounted)
- Mechanical Screen (½ or ¼" mesh size)
- Front-End Loader
    - Spare front-end loader bucket
- Dump Truck for Transport from CWF to Composting Site
- Submersible Sewage Pump Station

The conceptual opinion of probable costs and life-cycle analyses for various sized facilities are shown in Table 2. Full breakdowns of the conceptual opinion of costs can be found in Appendix A.

Table 2 – Aerated Static Pile Composting Conceptual Opinion of Cost

Parameter	*Current Operation	6 Dry Tons/Wk	8 Dry Tons/Wk	12 Dry Tons/Wk
Construction Sub-Total	$0	$4,607,000	$5,640,000	$5,640,000
Contractor OH&P, 20%	$0	$921,000	$1,128,000	$1,128,000
Contingency, 25%	$0	$1,152,000	$1,410,000	$1,410,000
Design & Construction Engineering/Inspection, 15%	$0	$692,000	$846,000	$846,000
Construction Total	$0	$7,372,000	$9,024,000	$9,024,000
Annual O&M Costs	$325,000	$330,000	$480,000	$530,000
Regional Rate, per 9,000-gallon Truck	$725	$950	$950	$950
Annual Revenue	$91,000	$120,000	$257,200	$448,000
Estimated 20-Year Cost	$11,940,000	$13,360,000	$15,133,000	$11,075,000

**Current Operation is based on accepting ~2 dry tons/week from the regional facilities and disposing of all dewatered cake in a landfill. This estimated 20-year cost is also used for comparing mechanical drying options.*

The Annual O&M costs include additional staff member(s) and their salaries, in addition to performed maintenance on the composting components and equipment. The middle scenario, 8 dry tons/week, is based on the same size facility as the 12 dry tons/week but provides a conservative estimate if the regional facility does not maximize its users. It should be mentioned that the regional rate per truck in this analysis is $950. Since the composting options total life-cycle costs are greater the current operating scenario in this estimate, the next analysis evaluates different regional rate charges and their impact on the life-cycle cost. For consistency, the 12 dry ton/week scenario was used for this exercise. The 6 and 8-dry ton/week scenarios did not prove to be lower than the current operations 20-year scenario even if the regional acceptance rate were $1,400. The results of varying rates are shown in Table 3.

Table 3 – Composting System at Different Regional Rates, 12 DT/Wk			
Parameter	Rate 1	Rate 2	Rate 3
Regional Acceptance Rate, per 9,000-gal Truck	$950.00	$1,100.00	$1,300.00
Construction Total	$9,024,000.00	$9,024,000.00	$9,024,000.00
Annual O&M Costs	$530,000	$530,000	$530,000
Annual Revenue	$448,731	$519,584	$614,054
Estimated 20-Year Cost	$11,075,000	$9,043,000	$6,334,000

It is estimated that a regional rate of $1,100 per truck would be the approximate "break-even" point if the facility were operated at full capacity of 12 dry tons per week, with 7.5 dry tons/week coming from regional facilities. The average regional rate to bring liquid sludge elsewhere is approximately $1,400, so the goal is to find a solution that allows for a discount compared to these other options for the existing facilities in the region.

Another factor in this analysis is that the composting system has a greater life expectancy than 20 years for the majority of its components. If we took the analysis from Table 2 and extended it to 30 years (including the capital loan), it would have the following results, shown in Table 4.

Table 4 – Composting 30-Yr Life-Cycle Analysis				
Parameter	*Current Operation	6 Dry Tons/Wk	8 Dry Tons/Wk	12 Dry Tons/Wk
Construction Total	$0	$7,372,000	$9,024,000	$9,024,000
Annual O&M Costs	$325,000	$330,000	$480,000	$530,000
Regional Rate, per 9,000-gallon Truck	$725	$950	$950	$950
Annual Revenue	$91,000	$120,000	$257,200	$448,000
20-Year Overhaul	$0	$1,000,000	$1,000,000	$1,000,000
30-Year Life-Cycle Cost	**$28,600,000**	**$21,900,000**	**$24,850,000**	**$17,800,000**
Years to "Break Even"	N/A	23	26	15

The results from Table 4 are also shown graphically in *Figure 2.*

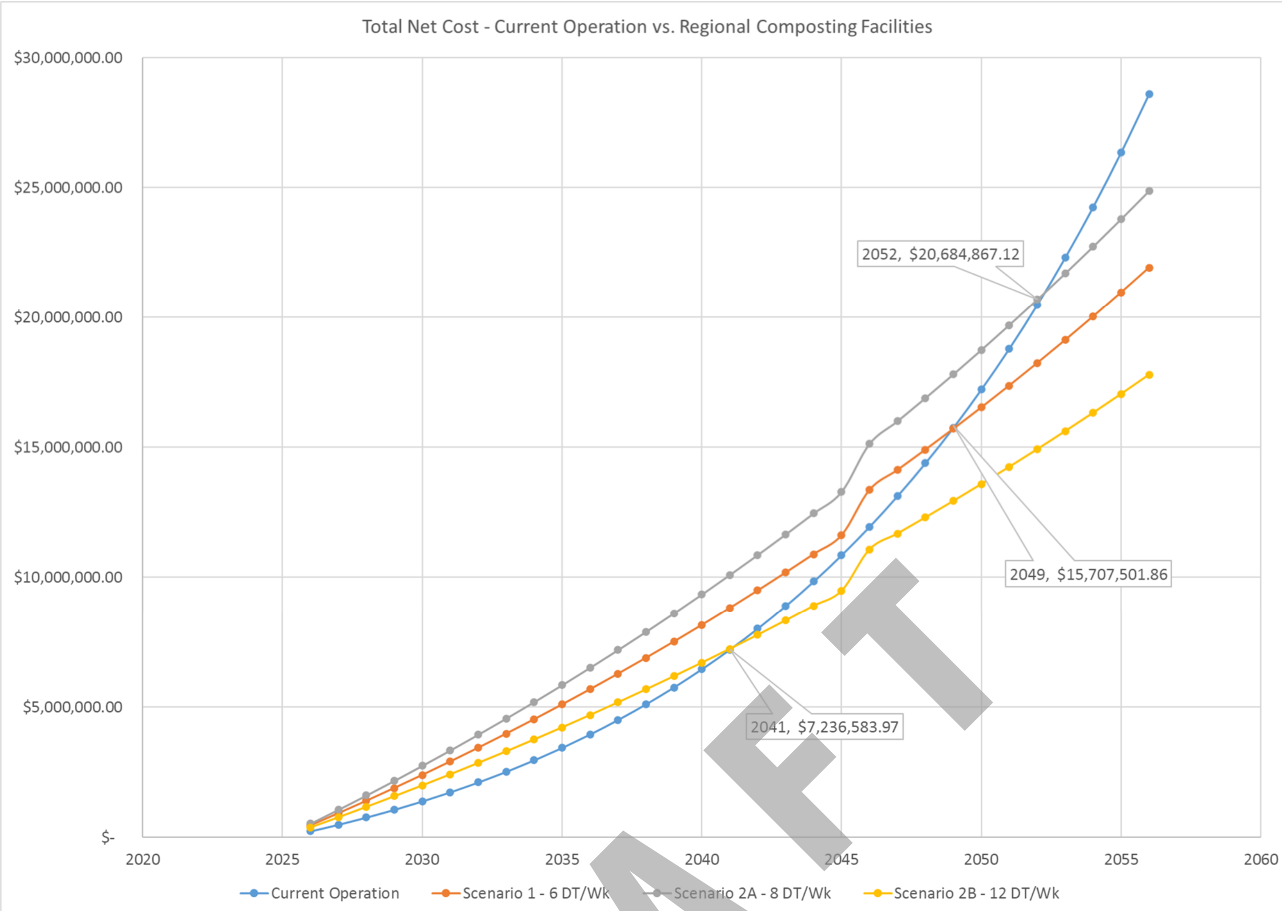

Figure 2 – 30-Year Net Cost of Regional Composting Facility Scenarios

As a result, the composting option does prove to be financially viable when we factor in the longevity of most of the capital costs included in the project. Most of the costs are concrete structures, steel structures, and piping, which have expected useful lives of 60 years. There are some mechanical and electrical components that will requirement replacement within 20 years, but an overhaul value of $1,000,000 was used at year 20 for this analysis, which would cover these components and potentially the front-end loader or similar.

In summary, the composting facility would prove to be a sustainable method of implementing a regional biosolids reuse program in the Town of Montague, which would benefit its neighboring communities.

2.2.2 Mechanical Dryer Technologies

Multiple dryer technologies were evaluated throughout the duration of this project. Our team is familiar with a handful of these companies and have developed good relationships with them over the years. These technologies were compared on a number of factors, including capital cost, energy consumption, footprint, annual maintenance requirements, solids throughput, support, and reliability. The team visited the CWF to determine the available space on site for the installation of one of these machines. Field measurements were translated into AutoCAD format and the dimensions of the available space were shared with all equipment vendors. In addition, relevant design criteria shown in Table 5 was provided to each equipment vendor.

Table 5 – Mechanical Dryer Design Criteria		
Parameter	Option 1	Option 2
Total Biosolids Throughput, dry tons per week	6	12
Feed Solids Concentration, %	19%	19%
Operating Days per Week	4	4
Operating Hours per Day	24	24
Total Operating Hours per Year	5,000	5,000
Target Dried Solids Concentration, %	90	90

Our team received budgetary proposals for both options from multiple equipment vendors. The results of these proposals, including the soft evaluation criteria mentioned above, are displayed in Table 6 and Table 7.

Table 6 – Mechanical Dryer Technology Comparison for Option 1 (up to 6 dry tons/wk)					
Parameter	BioForceTech	BCR	PWTech	Huber	Komline-Sanderson
Model Number	BioDryer	BIO-SCRU IC-800	MBD – 12/2D	BT6	8W-580
Number of Units	2	1	1	1	1
Solids Capacity, wet lb/hr	614	716	639	1053	635
Operating Hours per Week	103	88	99	60	99
Electricity Usage, kWh per year	650,000	100,222	128,490	77,973	253,427
Propane Usage, gal per year	0	56,232	55,000	44,240	42,643
Capital Cost, $	$2,390,000	$2,945,000	$1,200,000	$4,230,000	$2,500,000
Annual Energy Cost, $	$148,200	$219,662	$221,796	$172,617	$207,033
Annual Maintenance Costs, $	$25,000	$20,000.00	$25,000.00	$30,000.00	$40,000
*Total Annualized Cost, $	$292,700	$386,912	$306,796	$414,117	$372,033
Fits within Existing Footprint?	NO	YES	YES	NO	MAYBE

Based on a 20-year project life cycle

Table 7 – Mechanical Dryer Technology Comparison for Option 2 (up to 12 dry tons/wk)					
Parameter	BioForceTech	BCR	PWTech	Huber	Komline-Sanderson
Model Number	BioDryer	BIO-SCRU IC-1800	MBD – 9/2D	BT6	8W-580
Number of Units	3	1	1	1	1
Solids Capacity, wet lb/hr	925	1423	1256	1053	1271
Operating Hours per Week	137	89	101	120	99
Electricity Usage, kWh per year	1,100,000	175,389	261,482	311,891	263,515
Propane Usage, gal per year	0	112,500	119,200	89,300	88,300
Capital Cost, $	$3,290,000	$3,942,000	$1,300,000	$4,230,000	$2,750,000
Annual Energy Cost, $	$250,800	$433,566	$486,000	$383,657	$369,043
Annual Maintenance Costs, $	$40,000	$25,000	$35,000	$40,000	$50,000
***Total Annualized Cost, $**	**$455,300**	**$655,666**	**$586,000**	**$635,157**	**$556,543**
Fits within Existing Footprint?	NO	YES	YES	NO	MAYBE

**Based on a 20-year project life cycle*

Of the five equipment manufacturers explored, two of them will fit in the existing space of the dewatering room and dumpster bay, with the primary drying system being located in the dumpster bay and ancillary components located in the dewatering room at the CWF. Even though the BioForceTech BioDryer proved to show the lowest annualized cost, it requires 2 or 3 units, depending on capacity, and would require a significant building expansion at the CWF, which would force the total project costs to exceed that of the equipment options that would fit in the available space.

Vendors were approached with inquiries for both fully electrical heating systems and propane heating systems. On average, the propane heating systems provide a lower annual energy cost based on current market rates. The comparison of electricity vs. propane is described in Table 8. Since PWTech's equipment proved to be the lowest annualized cost of the two vendors that fit in the space, this manufacturer was used in the electric vs. propane comparison.

Table 8 – Propane vs. Electric Dryer Comparison (12 DT/wk)		
Parameter	PWTech Propane	PWTech Electric
Model Number	MBD – 9/2D	MBD – 9/2D
Number of Units	1	1
Solids Capacity, wet lb/hr	1256	1256
Operating Hours per Week	101	101
Electricity Usage, kWh per year	261,482	2,316,728
Propane Usage, gal per year	119,200	0
Capital Cost, $	$1,300,000	$1,300,000
*Annual Energy Cost, $	$486,000	$528,214
Annual Maintenance Costs, $	$35,000	$35,000
Total Annualized Cost, $	**$586,000**	**$628,214**
Fits within Existing Footprint?	YES	YES

**Based on the current total average electrical rate of $0.228/kWh taken from Montague's latest electric bills, and $3.50 per gallon of propane, which is a conservative rate in the region.*

The electric system costs approximately 25% more per year than the propane system. Although using a propane system will require additional capital for installing underground propane tanks, this cost would be recovered in the first few years of annual savings compared to an electric system.

As a result of the vendor comparison and electric vs. propane comparison, it was decided to pursue the feasibility of running the life-cycle analysis with the PWTech propane fueled dryer systems. The team evaluated multiple solids throughput values to determine the life-cycle cost of a dryer that can process up to 6 or 12 dry tons per day. The goal of this evaluation was to determine a "break even" point for the project, whether it be quantity of regional solids accepted and/or rate that Montague needs to charge the regional facilities to accept sludge at Montague. The various scenarios analyzed are described in Table 9.

Table 9 – Dryer Sizing Scenarios

Parameter	Scenario 0	Scenario 1	Scenario 2A	Scenario 2B
PWTech Model Number	N/A	MBD – 12/2D	MBD –9/2D	MBD – 9/2D
Number of Units	0	1	1	1
Solids Capacity, wet lb/hr	N/A	639	1256	1256
*Regional Solids Throughput, dry ton/week	2	2	4.3	7
Montague Solids Throughput, dry ton/week	3.7	3.7	3.7	5*
Total Solids Throughput, dry ton/week	5.7	5.7	8	12

***Scenario 2B includes processing the full capacity of the dryer. It is assumed that a portion of the capacity will be reserved for Montague as flows increase in future years. As a result, we have reserved an additional 1.3 dry ton/wk.*
**The regional solids volumes were based on data given by FCSWMD. Scenarios 2A and 2B regional volumes are based on an assumption that these could increase if a regional facility was implemented. Refer to paragraph 3.1.2*

In order to evaluate the scenarios over an expected 20-year life-cycle period, a conceptual capital cost estimate was created, in addition to an annual estimate of energy costs, maintenance costs, and regional sludge acceptance revenue. Scenario 0 is used as a base line of current operating conditions to compare the proposed dryer scenarios to. The results of the financial analysis are shown in Table 10.

Table 10 – Life Cycle Costs of Dryer Scenarios				
Parameter	Scenario 0	Scenario 1	Scenario 2A	Scenario 2B
Regional Solids Throughput, dry ton/week	2	2	4.3	7
Montague Solids Throughput, dry ton/week	3.7	3.7	3.7	5
Total Solids Throughput, dry ton/week	5.7	5.7	8	12
Regional Acceptance Rate, per 9,000-gal Truck	$800	$950	$950	$950
*Capital Cost	$0	$4,956,000	$5,166,000	$5,166,000
*Annual O&M Costs (Compared to Current)	$0	$245,700	$318,800	$458,100
*Annual Disposal Costs	$324,400	$0	$0	$0
*Annual Revenue from Regional Facilities	$117,700	$117,700	$253,200	$412,200
Total 20-Year Cost	**$11,940,000**	**$10,010.000**	**$9,740,000**	**$8,900,000**

**All capital and annual costs are shown in 2024 dollars. These values increase over the 20-year period per the assumptions above. The Total 20-year cost portrayed includes all these projected increases.*

This analysis used the average current regional acceptance rate of $725 per 9,000-gallon truck. The proposed dryer scenarios assume a regional acceptance rate of $950 per 9,000-gallon truck. This is to provide additional protection to the Town of Montague and reduce the amount of risk they would assume to implement this project. This rate is still significantly less than the alternative options for the regional communities. For example, Lowell charges an average of $1,400-1,500 per truck.

The results in Table 10 are also shown graphically in *Figure 3*.

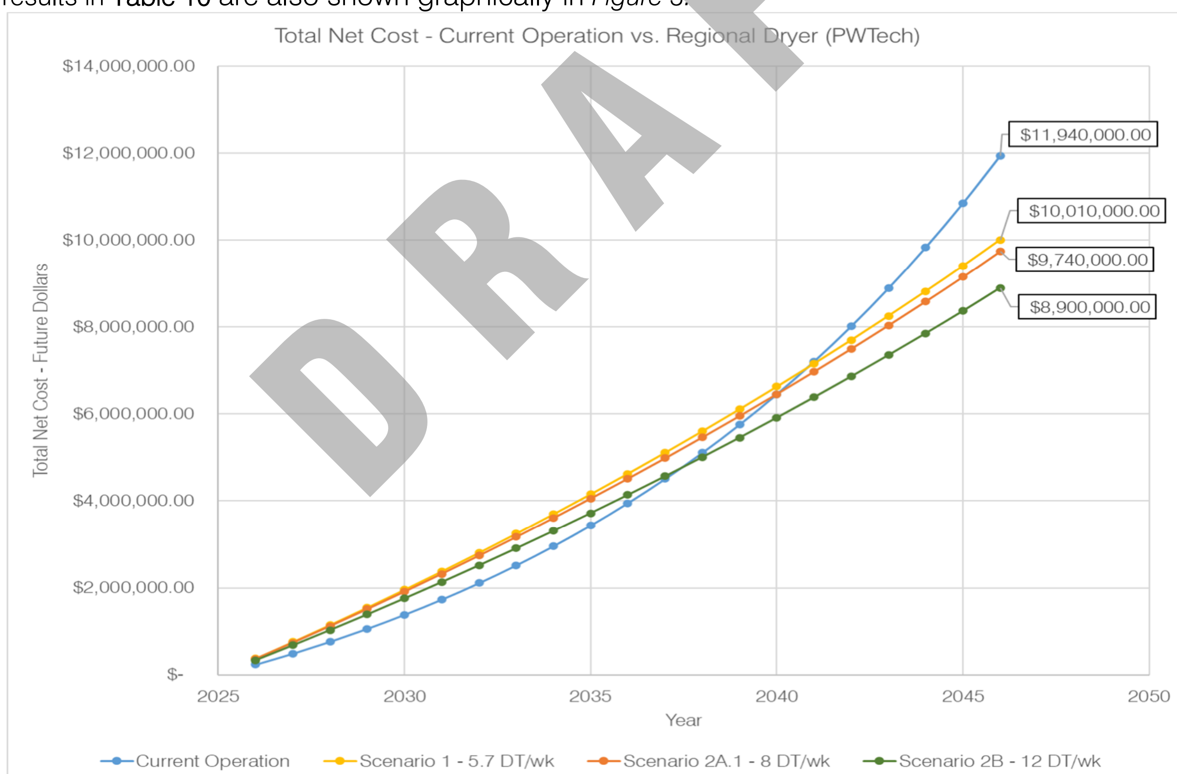

Figure 3 – Life Cycle Cost Estimates for Dryer Alternatives Compared to Current

Due to the volatile solids disposal market and rapid increases over the last several years, the installation of a dryer system provides a lower cost over the 20-year evaluation period for the project. This is true for all scenarios of implementing a dryer, as long as the current regional partners – as a minimum – continue to bring sludge to Montague. The costs only decrease as more regional partners discharge sludge at the Montague CWF.

This analysis uses current market trends to predict associated costs across the 20-year life cycle. There are unforeseen circumstances that will affect these values. However, given the current market of biosolids disposal, it would be in the Town's best interest to properly plan a biosolids reuse/disposal method that does not rely on outside sources hauling their biosolids.

It should be noted that the capital cost of the PWTech dryer equipment is offered at a discount compared to the other market prices for similar drying equipment. PWTech is positioning themselves to gain installations in the US municipal biosolids market. This manufacturer has informed our team that they will hold this price for Montague, aside from material inflation costs, until the decision is made to purchase the equipment after the Town vote in Spring 2025. However, an additional analysis was performed with a separate manufacturer to determine the financial impact of a market-price dryer. For this, the BCR Bio-Scru was chosen due to its compact footprint and high solids throughput. A 20-year cost summary is shown in Table 11, as a direct comparison to Scenario 2A with the PWTech unit.

Table 11 – Life Cycle Costs of PWTech vs. BCR

Parameter	Scenario 0	Scenario 2A.1	Scenario 2A.2
Manufacturer	N/A	PWTech	BCR
Model no.	N/A	MBD-9/D	Bio-SCRU IC-1800
Regional Solids Throughput, dry ton/week	2	4.3	4.3
Montague Solids Throughput, dry ton/week	3.7	3.7	3.7
Total Solids Throughput, dry ton/week	5.7	8	8
Regional Acceptance Rate, per 9,000-gal Truck	$800	$950	$1,200
*Capital Cost	$0	$5,166,000	$8,950,000
*Annual O&M Costs (Compared to Current)	$0	$318,800	$286,200
*Annual Disposal Costs	$324,400	$0	$0
*Annual Revenue from Regional Facilities	$117,700	$253,200	$357,000
Total 20-Year Cost	$11,940,000	$9,740,000	$10,430,000

**All capital and annual costs are shown in 2024 dollars. These values increase over the 20-year period per the assumptions above. The Total 20-year cost portrayed includes all these projected increases.*

To conservatively estimate a reduction in 20-year costs using the BCR dryer compared to the current operating conditions, the regional acceptance rate for a 9,000-gallon truck would need to be $1,200, compared to the lower cost of $950 per truck for the PWTech dryer. We want to show this scenario to convey that a market-price dryer still provides a responsible and reliable biosolids reuse system that offers a lower cost for the regional partners than the alternative disposal options available. Refer to Figure 4 for the conceptual life cycle costs in a graphical format.

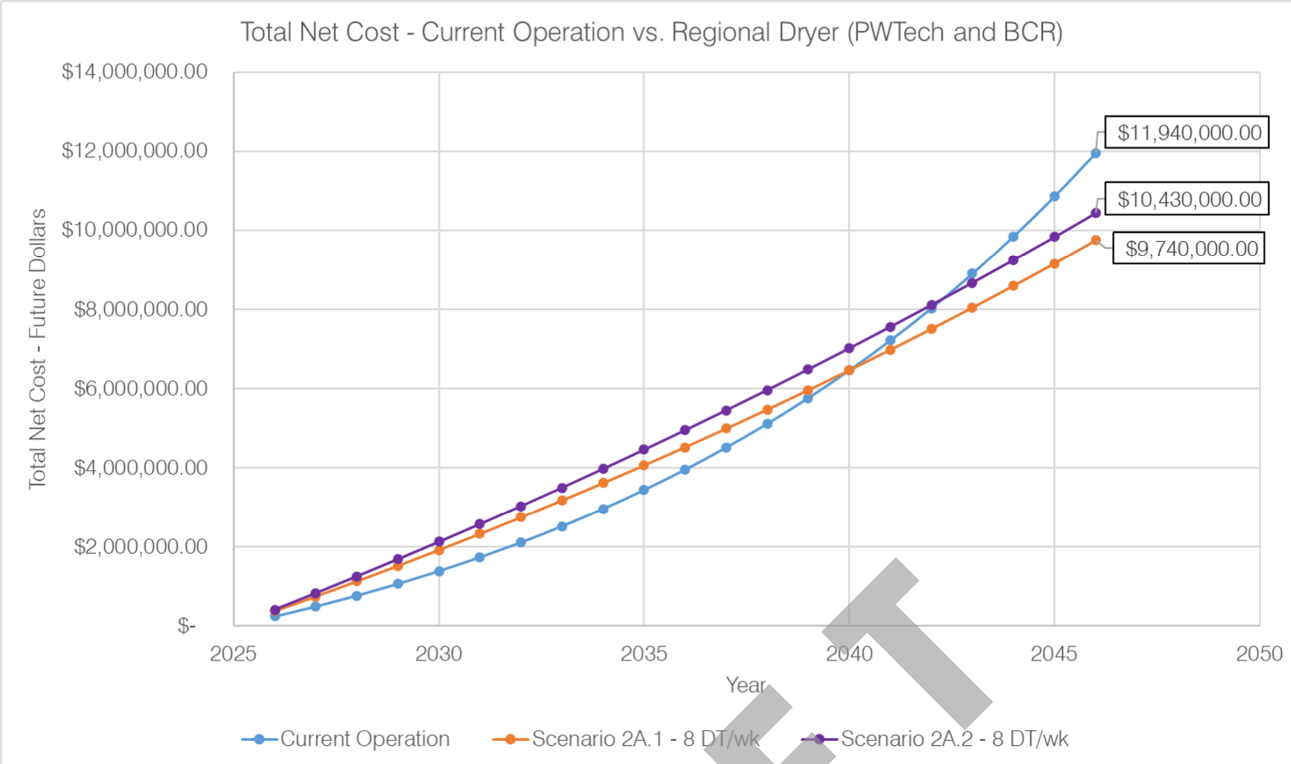

Figure 4 – Life Cycle Conceptual Cost Estimates for Current Scenario vs. PWTech/BCR Dryers

Another analysis involved was to estimate a 30-year life cycle cost of a mechanical dryer so that the Town can plan for extended long-term expenditures. Also, this will assist in the comparison to a composting system as a 20- and 30-year analysis was conducted for composting. It is recommended to replace most of the mechanical dryer components at year 20. Table 12 below shows the results of the 30-year life cycle costs compared to existing. These values show all scenarios (throughput and PWTech vs. BCR).

Table 12 – 30-Year Life Cycle Costs of All Dryer Scenarios

Parameter	Scenario 0 Current	Scenario 1 PWTech	Scenario 2A.1 PWTech	Scenario 2A.2 BCR	Scenario 2B PWTech
Regional Solids Throughput, dry ton/week	2	2	4.3	4.3	7
Montague Solids Throughput, dry ton/week	3.7	3.7	3.7	3.7	5
Total Solids Throughput, dry ton/week	5.7	5.7	8	8	12
Regional Acceptance Rate, per 9,000-gal Truck	$800	$950	$950	$1200	$950
*Capital Cost	$0	$4,956,000	$5,166,000	$8,950,000	$5,166,000
*Annual O&M Costs (Compared to Current)	$0	$245,700	$318,800	$286,200	$458,100
*Annual Disposal Costs	$324,400	$0	$0	$0	$0
*Annual Revenue from Regional Facilities	$117,700	$117,700	$253,200	$357,000	$412,200
Total 30-Year Cost	$28,600,000	$21,320,000	$20,820,000	$23,220,000	$19,370,000

The results shown in Table 12 are displayed graphically in Figure 5.

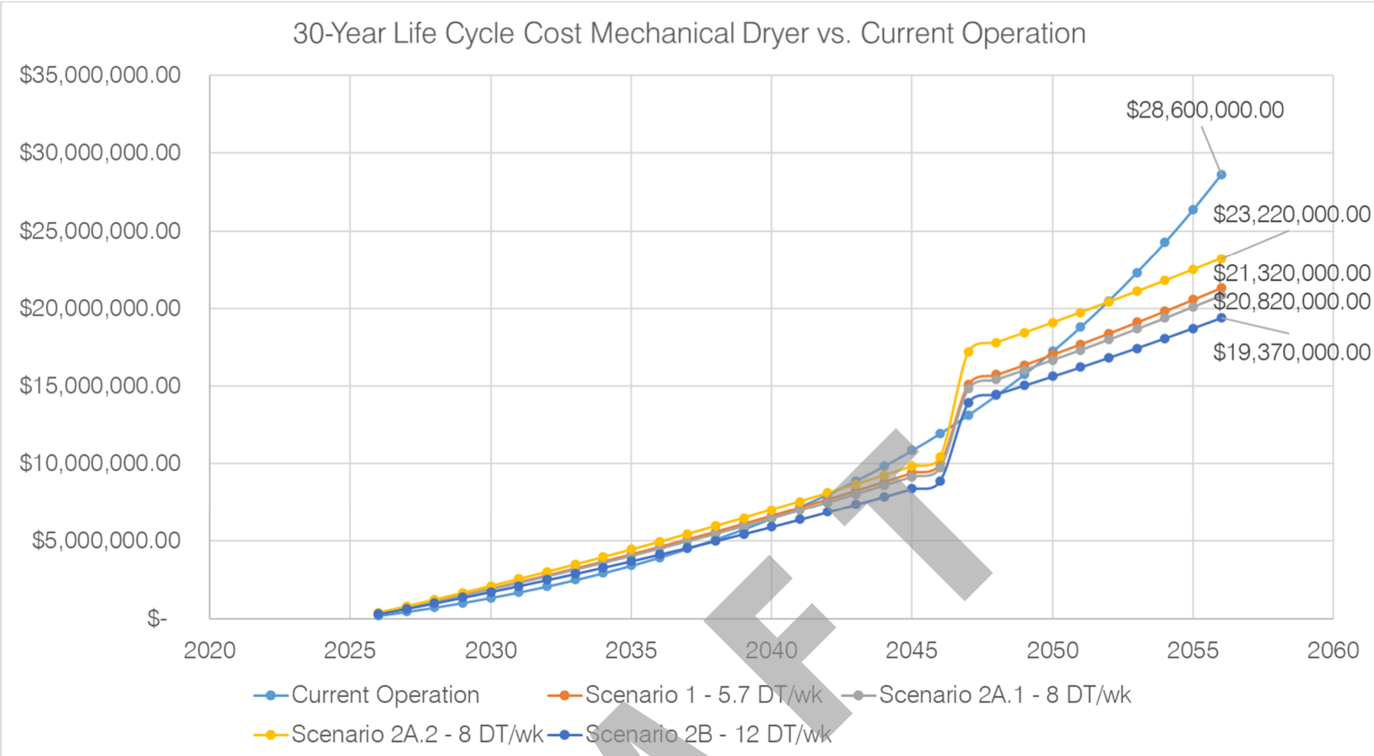

Figure 5 – 30-year Life Cycle Costs of Mechanical Dryers

In addition to the financial advantages of implementing a dryer system, there are environmental benefits that align with the Town of Montague CWF's mission statement to make a conscious effort to sustainably care for the environment. Although there will be additional energy costs to dry the biosolids, this essentially offsets the required energy of incinerating the biosolids at a third-party site. Creating a small regional biosolids drying facility at the Montague CWF will reduce the number of trucks hauling sludge hundreds of miles to Lowell or elsewhere. A summary of the impact on carbon footprint for this regional drying facility is described in Table 13

Table 13 – Carbon Footprint of Trucking for Each Scenario

Parameter	Scenario 0	Scenario 1	Scenario 2A	Scenario 2B
Truck Miles Driven per Month	29,100	28,400	11,500	11,500
Total Annual CO_2 Emissions from Trucking, kg	349,164	341,064	138,108	138,108

These values are based on all regional facilities that either bring their biosolids to Montague CWF or could possibly bring their biosolids to the CWF in the future. It is important to note the difference between Scenario 0 (the current operating conditions) and scenarios 2A and 2B, where more regional facilities could discharge their biosolids to the CWF. Instead of hauling solids an average of 85 miles to the current regional facilities that haul away the CWF cake or regional biosolids sludge, the average distance driven for each facility to bring their solids to the CWF would be about 13 miles. This results in a savings of approximately 211,000 kg of CO_2 per year, the equivalent of four commercial airline flights from New York to Los Angeles. It has been an important aspect of the Town's mission to reduce carbon emissions and treat wastewater in an environmentally friendly manner. This project would align with this vision.

If a mechanical dryer is selected as the preferred option, it is recommended to proceed with the PWTech MBD-9/D and accept process between 8 and 12 dry tons per week.

2.3 Update Siting Evaluation

2.3.1 Conceptual Composting Layout

The proposed conceptual composting layouts for 6 and 12 dry tons per week are displayed in Figure 6 and Figure 7, respectively. Each siting option reserves space for future expansion.

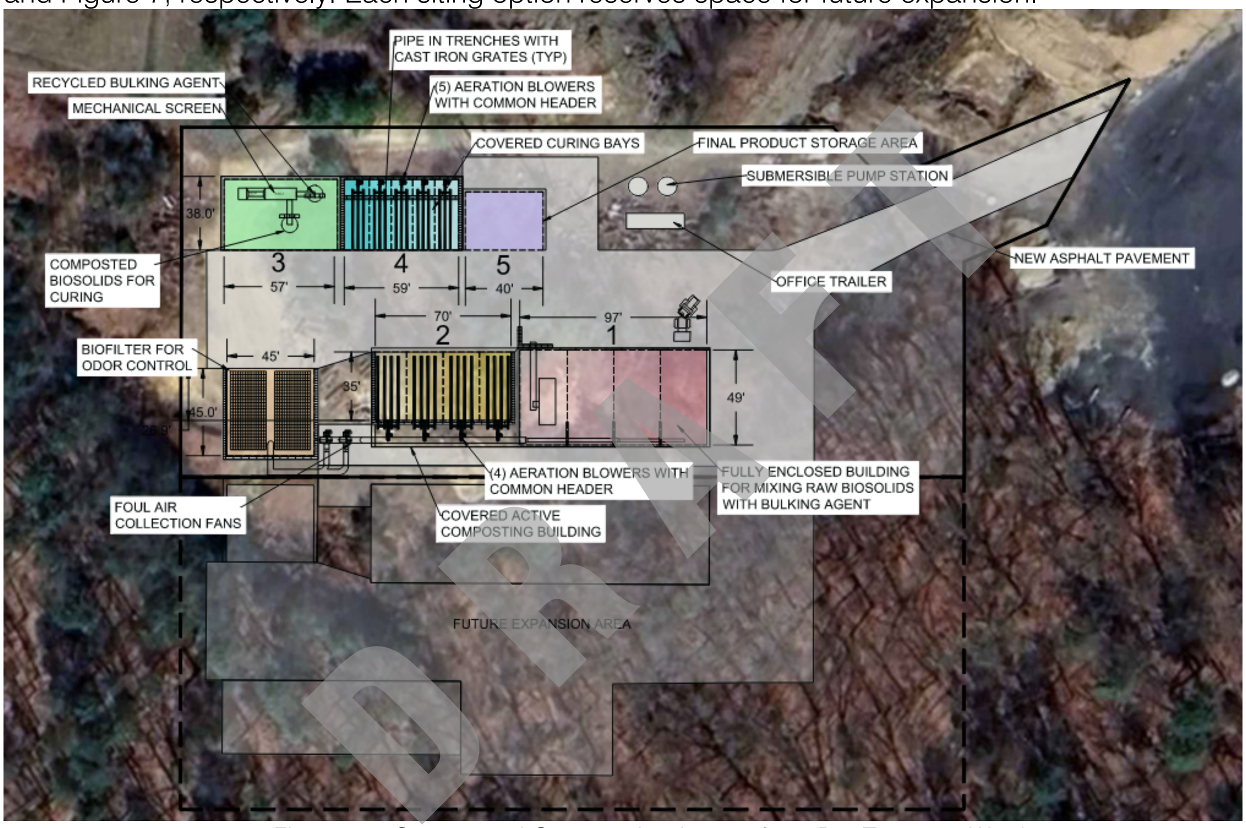

Figure 6 – Conceptual Composting Layout for 6 Dry Tons per Week

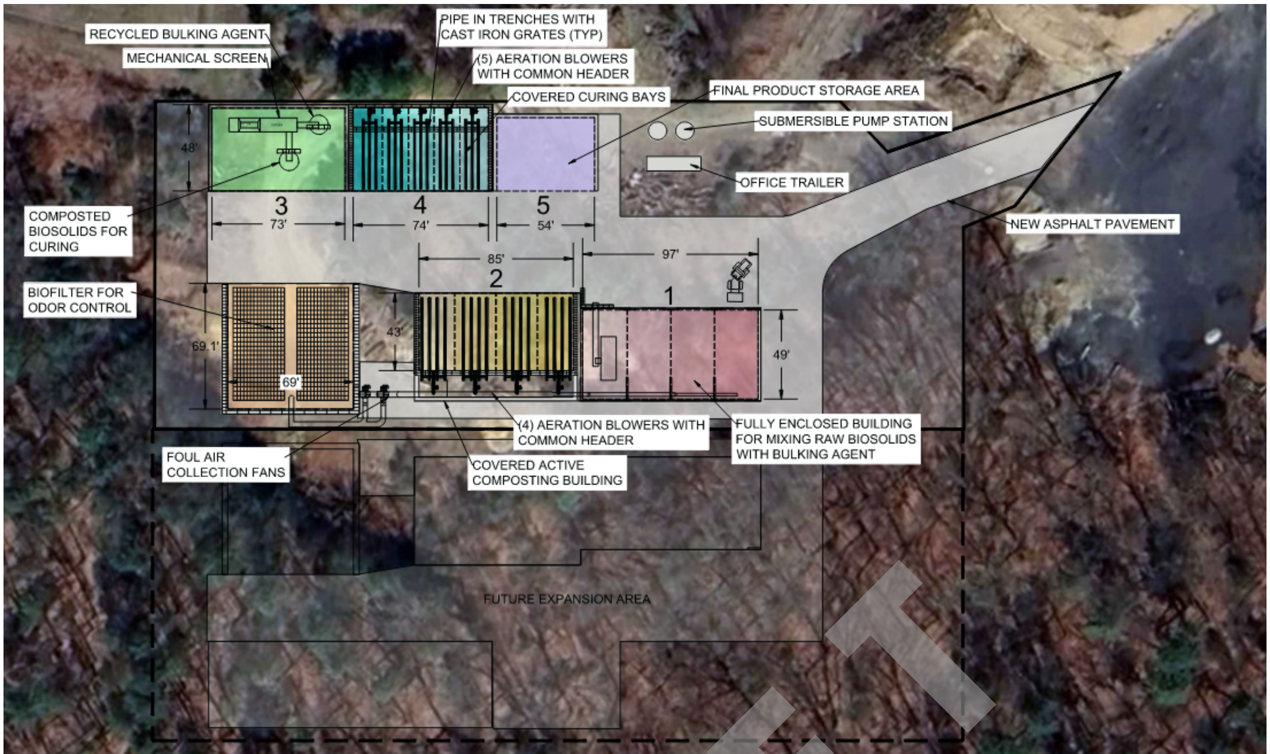

Figure 7 – Conceptual Composting Layout for 12 Dry Tons per Week

The sizing of the bays is dependent on the quantity of biosolids processes, the solids content of the biosolids, and the solids content of the bulking agent. The bays were sized conservatively to allow for fluctuations on a weekly basis. Table 14 shows the required average depths in the active and curing bays for each scenario based on the square footages shown in the conceptual layouts.

Table 14 – Biosolids Composting Sizing Calculations		
Parameter	6 DT/wk	12 DT/wk
Weekly Throughput, dry tons	6	12
Solids %	19%	19%
Weekly Throughput, wet tons	31.6	63.2
Weekly Throughput, wet lbs	63158	126316
Weekly Throughput, cubic ft	1012	2025
Bulking Agent (BA) Solids %	60%	60%
Weekly Bulking Agent Throughput, cubic ft	1012	2025
Mixed Solids %	39.50%	39.50%
Total Batch Volume - Active Phase, cubic ft	2025	4050
Active Bay Surface Area, sft	613	914
Required Avg Active Bay Depth, ft	3.3	4.4
Estimated % transfer of BA to Curing	15%	15%
Total Batch Volume - Curing Phase, cubic ft	1164	2329
Curing Bay Surface Area, sft	354	592
Required Avg Curing Bay Depth, ft	3.3	3.9

2.3.2 *Conceptual Dryer Layout*

To reduce costs as much as possible, the existing dumpster bay was used as the primary site location for a mechanical dryer system. It was an important factor when analyzing different manufacturers of dryer systems. The suggested layout would include the removal of the existing rotary fan presses and appurtenances which are no longer needed. It also includes the removal of the cake dumpster where the new dryer system components would be located. Because the proposed system would require about 75% less storage in a dumpster after processing, we recommend installing a lean-to shelter with a 5 or 10 yard dumpster underneath it outside the existing dumpster bay.

Refer to *Figure 8* for a conceptual layout of the proposed dryer systems for Scenarios 1 and 2A/B. It is recommended to install the same dryer model for 6 or 12 dry tons/week (larger model), since the capital cost difference is negligible. The dryer would only run for a shorter duration if the throughput remained around 6 dry tons/week.

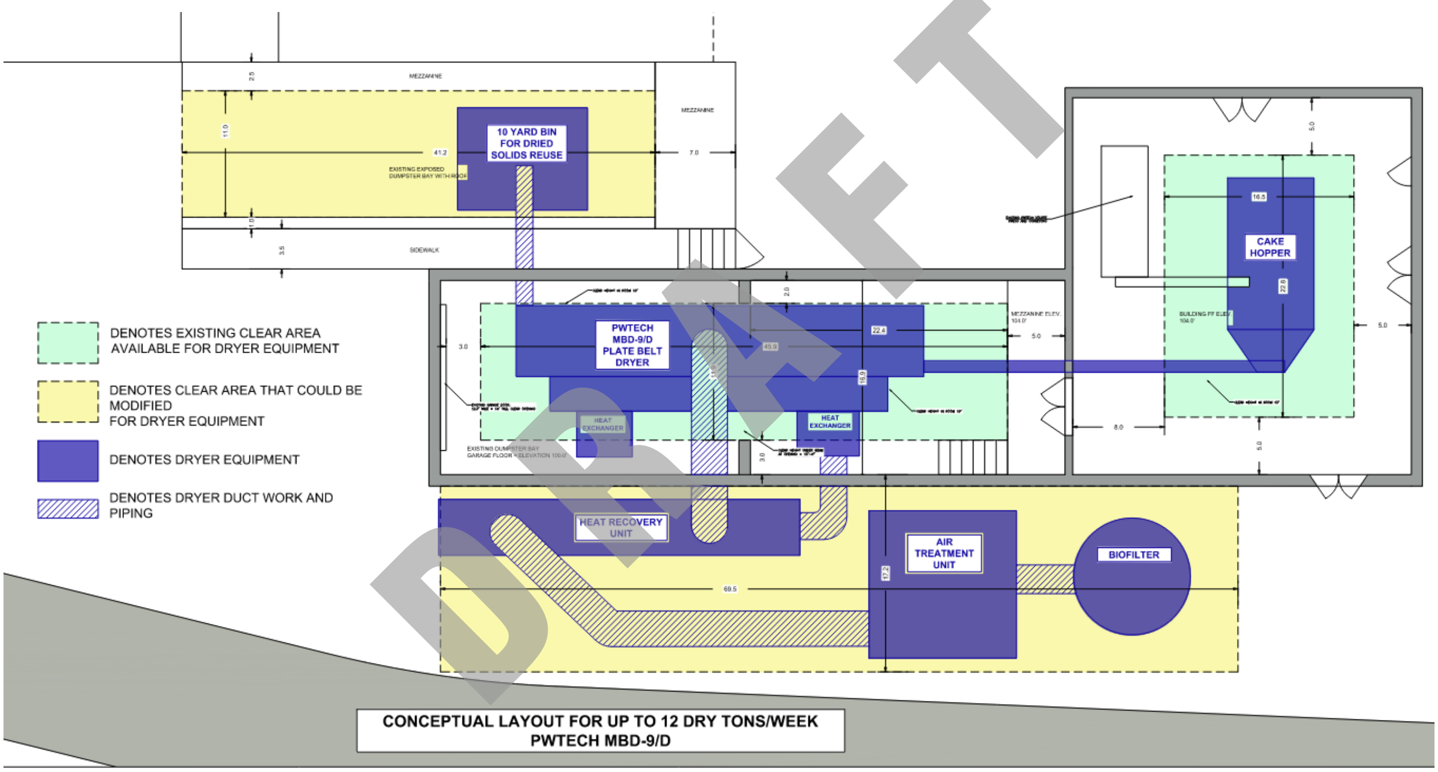

Figure 8 – Conceptual Mechanical Dryer Layout at CWF

3.0 PUBLIC OUTREACH AND COORDINATION

As part of this evaluation, Weston & Sampson reached out to a regional biosolids management district to determine the demand for additional regional biosolids disposal/processing options. In addition, a public informative meeting was held to gain insight and feedback from the public and pertinent governing agencies involved. The feedback was used to develop further conclusions to the overall analysis.

3.1 Regional Partner Coordination

A call was held between Weston & Sampson, Montague CWF personnel, and Jan Ameen from the Franklin County Solid Waste Management District (FCSWMD), who manages the biosolids hauling contracts and logistics for 10 facilities in the region, including Ashfield, Old Deerfield, South Deerfield, Erving, Greenfield, Hadley, Hatfield, Northfield, Orange, and Sunderland. Jan relayed information that the average cost for hauling a 9,000-gallon truck of biosolids to Lowell is $1,400-1,500. Currently, Montague accepts biosolids from a number of these facilities at an average of two dry tons per week, charging between $750-900 per truck, a significant discount from the alternative disposal options. Jan expressed that FCSWMD is greatly interested in transferring a larger portion of biosolids to Montague if they were willing and able to accept them.

Montague has also expressed that if they were to operate a regional composting or drying facility, that they would be willing to accept as much biosolids as possible, while reliably operating the given system.

3.1.1 Current Regional Biosolids Hauling Scenario

Currently, FCSWMD sends approximately two dry tons of biosolids per week to the Montague CWF. These solids are hauled in 9,000-gallon trucks and discharged into the headworks of the facility. The latest data from July 2023 through March 2024 is shown in Table 15.

Table 15 – Current Regional Hauling Data to Montague, Jul-23 to Mar-24

Facility	Gallons	Avg. Solids %	Dry Tons
Ashfield	0	2.28%	0.0
Old Deerfield	24,000	2.29%	2.3
So. Deerfield	387,000	2.07%	33.4
Erving	81,000	2.08%	7.0
Greenfield	0	4.06%	0.0
Hadley	0	2.05%	0.0
Hatfield	45,000	1.90%	3.6
Northfield	36,000	1.86%	2.8
Orange	126,000	2.29%	12.0
Sunderland	180,000	2.28%	17.1
Total	879,000		78
Per Day	3,208		0.29
Per Week	22,456		2.00

At this time, Ashfield, Greenfield, and Hadley do not send any solids to Montague.

3.1.2 Potential Regional Biosolids Hauling Scenario

FCSWMD has made it clear that they would like to maintain their hauling relationship with their current facility (Lowell, MA), but would be willing to send the majority of their loads to a regional facility at Montague, given the proximity. The data in Table 16 describes the quantity of biosolids that could be transported to and processed at the Montague CWF. The total weekly volume in dry tons correlates to the data presented previously in the dryer/composting analyses.

Table 16 – FCSWMD FY23 Biosolids Data and Potential Regional Disposal at Montague CWF					
Facility	Total Gallons	Avg. % solids	Total Dry Tons	*% Loads To Montague	Dry Tons to Montague
Ashfield	27,000	2.28%	2.57	70.00%	1.80
Old Deerfield	207,000	2.29%	19.77	70.00%	13.84
So. Deerfield	819,000	2.07%	70.70	70.00%	49.49
Erving	225,000	2.08%	19.52	70.00%	13.66
Greenfield	2,400,000	4.06%	406.32	0.00%	0.00
Hadley	1,242,000	2.05%	106.17	70.00%	74.32
Hatfield	234,000	1.90%	18.54	70.00%	12.98
Northfield	144,000	1.86%	11.17	70.00%	7.82
Orange	441,000	2.29%	42.11	70.00%	29.48
Sunderland	342,000	2.28%	32.52	70.00%	22.76
Total Annual	6,081,000		729.38		226.14
Per Day	16,660		2.00		0.62
Per Week	116,622		13.99		4.34

**Total Annual*, *Per Day*, *Per Week* rows as printed.*

**These are conceptual numbers, if the Montague CWF were to implement a regional composting or drying system. It is recommended that these values be discussed at length between FCSWMD, Montague, and the regional facilities.*

The total of 4.3 dry tons/week was used in the cost-effectiveness analysis, for a total of 8 dry tons/week once the local Montague solids volumes are accounted for. Given that the dryer and composting systems would be sized for 12 dry tons/week, it allows for additional capacity, thus revenue, to accept additional regional biosolids. It was assumed that 70% of the biosolids from all facilities except Greenfield would be transported to Montague's regional facility. Greenfield produces the most biosolids per year and likely would not be able to be processed at Montague's facility. However, if adequate capacity allows, it could be a potential option for Greenfield to transport a portion of its biosolids to Montague. Oversizing the drying or composting system in a calculated manner is critical for the region's biosolids reuse situation.

All facilities that utilize FCSWMD to manage their biosolids have been tested for PFAS compounds. Montague has yet to accept facilities that have detectable results of these compounds. However, Hadley, for example, has shown limited compounds in concentrations of approximately 3-4 parts per trillion, which is lower than the EPA hazardous limits. It could be worth considering accepting some of these solids, but this is ultimately a decision that Montague would need to make.

3.2 Public/Stakeholder Outreach

3.2.1 Public Meeting

3.2.2 Revisions to the Evaluation Based on Outreach

4.0 IMPLEMENTATION

4.1 Permitting Needs

4.1.1 Composting System

The CWF has obtained a permit for operating a composting system at a pilot scale at the CWF. If a regional composting facility were to be constructed at the Sandy Lane site, this permit would need to be revised. There are special circumstances involved with the CWF site and Sandy Lane. At the CWF, any construction activities or systems within 200 feet of the mean high-water mark of the Connecticut River requires additional documentation that there would be no adverse impacts to the river as a result. For Sandy Lane, the project would need to avoid any construction activities within 100 feet of the existing wetlands on the site.

A composting system would require an updated permit from Massachusetts Department of Environmental Protection (MA DEP), but it is our opinion that this would be straightforward to obtain, especially because the Town operates a waste transfer station near the proposed Sandy Lane composting site.

4.1.2 Mechanical Dryer System

The mechanical dryer system would require a wastewater construction permit through MA DEP. This is a standard permit application for all major wastewater treatment facility upgrades in the state. If any proposed construction activities or components are located within 200 feet of the Connecticut river mean high water mark, certain regulations and documentation will need to be followed to show that there is no adverse impact. Additionally, if a propane storage system over 2,000 gallons is utilized to fuel the dryer, the system will be required to obtain a license as required by 527 CMR 6.07. There are also certain code requirements for locating the propane storage. For underground tanks, the tanks must be located at least 10 feet from any piece of equipment or building wall. Certain flame arrest and alarm systems would be installed with the propane system in accordance with 527 CMR 6.00. Finally, a permit to install the system will need to be obtained by the local fire department.

4.2 Updated Cost Information

The detailed cost breakdowns for the composting and drying options are described in the individual sections and also attached as Appendix A. A summary of the capital and lifecycle costs are given in Table 17. For sake of comparison, a throughput of 8 dry tons/week was used for this summary.

Table 17 – Summary of Costs			
Parameter	Current Operation	Composting 8 DT/wk	Drying 8 DT/wk
Capital Cost	$0	$9,024,000	$5,166,000
Annual O&M Cost, 2024 Dollars	$245,700	$480,000	$318,800
Additional Revenue, 2024 Dollars	$0	$257,200	$253,200
Total 20-year Cost, Future Value	$11,940,000	$15,133,000	$9,740,000
Total 20-year Cost, Present Worth	$6,611,000	$8,379,000	$5,393,000
Total 30-year Cost, Future Value	$28,600,000	$24,850,000	$20,820,000
Total 20-year Cost, Present Worth	$11,783,000	$10,246,000	$8,578,000

4.3 Finance and Funding Program

4.4 Summary of Implementation Steps

4.4.1 Town Approval

4.4.2 Design

4.4.3 Construction

APPENDIX A

Detailed Cost Breakdowns

SANDY LANE COMPOSTING CONCEPTUAL OPTION 1 - 6 DRY TONS/WK

Engineer's Opinion of Probable Cost

Project no. ENG23-0487

By: ICO

Date: 5/15/2024

Item no.	Description	Qty	Units	Material Cost	Installation Cost	Total Unit Cost	Total Cost
1	Mobilization	0.05	LSUM	N/A	N/A	$ 4,386,698.86	$ 219,334.94
2	New Asphalt	870	TON	$ 100.00	$ 100.00	$ 200.00	$ 174,044.44
3	Mixing Area/Sludge Storage Space - Fully Enclosed, 25 ft tall	5050	SF	$ 100.00	$ 100.00	$ 200.00	$ 1,010,000.00
4	Mixer	1	EA	$ 25,000.00	$ 15,000.00	$ 40,000.00	$ 40,000.00
5	Active Composting Building - Roof Only, 21 ft tall, includes blower gallery	3700	SF	$ 50.00	$ 50.00	$ 100.00	$ 370,000.00
6	Concrete Block Wall - 10 ft tall, in Active Composting Building	200	LFT	$ 100.00	$ 150.00	$ 250.00	$ 50,000.00
7	Perforated PVC Pipes - Active Composting & Curing	337	LF	$ 50.00	$ 100.00	$ 150.00	$ 50,595.00
8	Perforated PVC Pipes Cleanout - in Blower Gallery (Active Composting & Curing)	9	EA	$ 500.00	$ 500.00	$ 1,000.00	$ 9,000.00
9	Trench Digging (Active Composting & Curing)	119	CYD	$ 5.00	$ 50.00	$ 55.00	$ 6,556.92
10	Cast Iron or Stainless Steel Grates (Active Composting & Curing)	3219	SF	$ 25.00	$ 25.00	$ 50.00	$ 160,942.50
11	Screening Building - Prefabricated Roof Only	2280	SF	$ 50.00	$ 75.00	$ 125.00	$ 285,000.00
12	Aeration Blower (Active Composting & Curing)	6	EA	$ 80,000.00	$ 25,000.00	$ 105,000.00	$ 630,000.00
13	Hopper Feed + Screen	1	EA	$ 95,000.00	$ 20,000.00	$ 115,000.00	$ 115,000.00
14	Precast Concrete Blocks - Screening/Curing Building	36	LFT	$ 100.00	$ 150.00	$ 250.00	$ 9,000.00
15	Curing Building - Roof Only, 21 ft tall, includes Blower Gallery	2395	SF	$ 50.00	$ 50.00	$ 100.00	$ 239,500.00
16	Concrete Block Wall - 10 ft tall, in Curing Building	360	LFT	$ 100.00	$ 150.00	$ 250.00	$ 90,000.00
17	Minor Site Grading for Compost Pile Storage	7000	SF	$ 5.00	$ 5.00	$ 10.00	$ 70,000.00
18	Biofilter Media (6 ft deep)	8880	CF	$ 5.00	$ 5.00	$ 10.00	$ 88,800.00
19	Biofilter Concrete Block Walls	150	LFT	$ 100.00	$ 150.00	$ 250.00	$ 37,500.00
20	Foul Air Collection Fan	2	EA	$ 25,000.00	$ 5,000.00	$ 30,000.00	$ 60,000.00
21	Foul Air Collection System Ductwork	544	LF	$ 100.00	$ 100.00	$ 200.00	$ 108,760.00
22	Perforated Baseplates for Biofilters	1480	SF	$ 10.00	$ 15.00	$ 25.00	$ 37,000.00
23	Biofilter Surface Irrigation System	1	EA	$ 10,000.00	$ 5,000.00	$ 15,000.00	$ 15,000.00
24	Office Trailer, with sanitary facilities	1	EA	$ 75,000.00	$ 10,000.00	$ 85,000.00	$ 85,000.00
25	Additional Staff	1	EA	$ 80,000.00	$ -	$ 80,000.00	$ 80,000.00
26	Front-End Loader	1	EA	$ 175,000.00	$ -	$ 175,000.00	$ 175,000.00
27	Dump Truck	1	EA	$ 100,000.00	$ -	$ 100,000.00	$ 100,000.00
28	Pump Station	1	EA	$ 150,000.00	$ 50,000.00	$ 200,000.00	$ 200,000.00
29	Force Main to MH	300	LFT	$ 150.00	$ 150.00	$ 300.00	$ 90,000.00
						Sub-total	*$ 4,607,000.00*
					Contractor OH&P	20%	$ 921,400.00
						Bidding Cost Estimate	***$ 5,528,400.00***
					Contingency	25%	$ 1,151,750.00
					Design & Construction Engineering & Inspection	15%	$ 691,050.00
						Construction Total	**$ 7,372,000.00**

SANDY LANE COMPOSTING CONCEPTUAL OPTION 2 - 8-12 DRY TONS/WK

By: ICO
Engineer's Opinion of Probable Cost
Date: 5/15/2024
Project no. ENG23-0487

Item no.	Description	Qty	Units	Material Cost	Installation Cost	Total Unit Cost	Total Cost
1	Mobilization	0.05	LSUM	N/A	N/A	$ 5,370,939.18	$ 268,546.96
2	New Asphalt	863	TON	$ 100.00	$ 100.00	$ 200.00	$ 172,577.78
3	Mixing Area/Sludge Storage Space - Fully Enclosed, 25 ft tall	5050	SF	$ 100.00	$ 100.00	$ 200.00	$ 1,010,000.00
4	Mixer	1	EA	$ 25,000.00	$ 15,000.00	$ 40,000.00	$ 40,000.00
5	Active Composting Building - Roof Only, 21 ft tall, includes blower gallery	6030	SF	$ 50.00	$ 50.00	$ 100.00	$ 603,000.00
6	Concrete Block Wall - 10 ft tall, in Active Composting Building	380	LFT	$ 100.00	$ 150.00	$ 250.00	$ 95,000.00
7	Perforated PVC Pipes - Active Composting & Curing	417	LF	$ 50.00	$ 100.00	$ 150.00	$ 62,610.00
8	Perforated PVC Pipes Cleanout - in Blower Gallery (Active Composting & Curing)	9	EA	$ 500.00	$ 500.00	$ 1,000.00	$ 9,000.00
9	Trench Digging (Active Composting & Curing)	166	CYD	$ 5.00	$ 50.00	$ 55.00	$ 9,123.40
10	Cast Iron or Stainless Steel Grates (Active Composting & Curing)	4479	SF	$ 25.00	$ 25.00	$ 50.00	$ 223,938.00
11	Screening Building - Prefabricated Roof Only	3180	SF	$ 50.00	$ 75.00	$ 125.00	$ 397,500.00
12	Aeration Blower (Active Composting & Curing)	6	EA	$ 100,000.00	$ 25,000.00	$ 125,000.00	$ 750,000.00
13	Hopper Feed + Screen	1	EA	$ 95,000.00	$ 20,000.00	$ 115,000.00	$ 115,000.00
14	Precast Concrete Blocks - Screening/Curing Building	52	LFT	$ 100.00	$ 150.00	$ 250.00	$ 13,000.00
15	Curing Building - Roof Only, 21 ft tall, includes Blower Gallery	3340	SF	$ 50.00	$ 50.00	$ 100.00	$ 334,000.00
16	Concrete Block Wall - 10 ft tall, in Curing Building	330	LFT	$ 100.00	$ 150.00	$ 250.00	$ 82,500.00
17	Minor Site Grading for Compost Pile Storage	9900	SF	$ 5.00	$ 5.00	$ 10.00	$ 99,000.00
18	Biofilter Media (6 ft deep)	20664	CF	$ 5.00	$ 5.00	$ 10.00	$ 206,640.00
19	Biofilter Concrete Block Walls	225	LFT	$ 100.00	$ 150.00	$ 250.00	$ 56,250.00
20	Foul Air Collection Fan	2	EA	$ 25,000.00	$ 5,000.00	$ 30,000.00	$ 60,000.00
21	Foul Air Collection System Ductwork	604	LF	$ 100.00	$ 100.00	$ 200.00	$ 120,700.00
22	Perforated Baseplates for Biofilters	3444	SF	$ 10.00	$ 15.00	$ 25.00	$ 86,100.00
23	Biofilter Surface Irrigation System	1	EA	$ 10,000.00	$ 5,000.00	$ 15,000.00	$ 15,000.00
24	Office Trailer, with sanitary facilities	1	EA	$ 75,000.00	$ 10,000.00	$ 85,000.00	$ 85,000.00
25	Additional Staff	2	EA	$ 80,000.00	$ -	$ 80,000.00	$ 160,000.00
26	Front-End Loader	1	EA	$ 175,000.00	$ -	$ 175,000.00	$ 175,000.00
27	Dump Truck	1	EA	$ 100,000.00	$ -	$ 100,000.00	$ 100,000.00
28	Pump Station	1	EA	$ 150,000.00	$ 50,000.00	$ 200,000.00	$ 200,000.00
29	Force Main to MH	300	LFT	$ 150.00	$ 150.00	$ 300.00	$ 90,000.00

Sub-total		*$ 5,640,000.00*
Contractor OH&P	20%	$ 1,128,000.00
Bidding Cost Estimate		***$ 6,768,000.00***
Contingency	25%	$ 1,410,000.00
Design & Construction Engineering & Inspection	15%	$ 846,000.00
Construction Total		**$ 9,024,000.00**

COMPOSTING LIFE CYCLE COSTS

	Inflation Rates	Current rate	
Capital Loan Interest	2%		
Utility Inflation	3%		
Sludge Cake Disposal	7%	$ 208.00	per wet ton
Revenue Rate Charges	3%		
Capital Replacement Inflation	3%		
Regional Rate Markup	3%		
Current Electrical Rate	$ 0.23	per kWh	
Current Montague Solids	3.70	DT/wk	
Current Regional Solids	2.00	DT/wk	
Mid Regional Solids	4.30	DT/wk	
FULL Montague Solids	4.50	DT/wk	
FULL Regional Solids	7.50	DT/wk	
Cake %	19%		
Regional sludge %	2.20%		
Current Regional Sludge	21,801	gallons per week	
Mid Regional Sludge	46,872	gallons per week	
Full Regional Sludge	81,753	gallons per week	

Annual Expenses Subtracting Revenue

Regional rate per 9,000 gal truck	$ 725.00	$ 950.00	$ 950.00	$ 950.00	$ 1,100.00	$ 1,300.00
Total Capital Cost		$ 7,372,000.00	$ 9,024,000.00	$ 9,024,000.00	$ 9,024,000.00	$ 9,024,000.00
Average Electricity Use, kW		100	125	150	150	150
Average Electric Cost		$ 199,728.00	$ 249,660.00	$ 299,592.00	$ 299,592.00	$ 299,592.00
Annual Salary/O&M		$ 130,000.00	$ 230,000.00	$ 230,000.00	$ 230,000.00	$ 230,000.00
Total Annual Cost		$ 329,728.00	$ 479,660.00	$ 529,592.00	$ 529,592.00	$ 529,592.00
Annual Revenue	$ 91,320.88	$ 119,661.85	$ 257,272.97	$ 448,731.92	$ 519,584.33	$ 614,054.21
Year	Current Operation	Scenario 1 - 6 DT/Wk	Scenario 2A - 8 DT/Wk	Scenario 2B - 12 DT/Wk	Scenario 2B - 12 DT/Wk	Scenario 2B - 12 DT/Wk
2026	$ 233,159.12	$ 455,799.49	$ 523,187.03	$ 381,660.08	$ 310,807.67	$ 216,337.79
2027	$ 486,292.21	$ 922,815.63	$ 1,059,061.67	$ 771,761.96	$ 627,931.56	$ 436,157.71
2028	$ 760,907.04	$ 1,401,335.77	$ 1,607,944.39	$ 1,170,498.73	$ 951,501.02	$ 659,504.07
2029	$ 1,058,620.19	$ 1,891,654.91	$ 2,170,164.07	$ 1,578,068.09	$ 1,281,648.03	$ 886,421.30
2030	$ 1,381,164.83	$ 2,394,075.87	$ 2,746,058.23	$ 1,994,672.41	$ 1,618,507.35	$ 1,116,953.93
2031	$ 1,730,398.88	$ 2,908,909.58	$ 3,335,973.25	$ 2,420,518.90	$ 1,962,216.48	$ 1,351,146.58
2032	$ 2,108,313.95	$ 3,436,475.19	$ 3,940,264.65	$ 2,855,819.72	$ 2,312,915.81	$ 1,589,043.94
2033	$ 2,517,044.76	$ 3,977,100.43	$ 4,559,297.30	$ 3,300,792.06	$ 2,670,748.63	$ 1,830,690.73
2034	$ 2,958,879.25	$ 4,531,121.71	$ 5,193,445.68	$ 3,755,658.33	$ 3,035,861.19	$ 2,076,131.66
2035	$ 3,436,269.46	$ 5,098,884.47	$ 5,843,094.15	$ 4,220,646.23	$ 3,408,402.77	$ 2,325,411.48
2036	$ 3,951,843.10	$ 5,680,743.38	$ 6,508,637.25	$ 4,695,988.94	$ 3,788,525.76	$ 2,578,574.85
2037	$ 4,508,416.00	$ 6,277,062.58	$ 7,190,479.90	$ 5,181,925.19	$ 4,176,385.70	$ 2,835,666.39
2038	$ 5,109,005.39	$ 6,888,215.97	$ 7,889,037.76	$ 5,678,699.45	$ 4,572,141.38	$ 3,096,730.61
2039	$ 5,756,844.10	$ 7,514,587.47	$ 8,604,737.49	$ 6,186,562.07	$ 4,975,954.85	$ 3,361,811.88
2040	$ 6,455,395.83	$ 8,156,571.29	$ 9,338,017.04	$ 6,705,769.41	$ 5,387,991.55	$ 3,630,954.42
2041	$ 7,208,371.42	$ 8,814,572.22	$ 10,089,325.98	$ 7,236,583.97	$ 5,808,420.37	$ 3,904,202.24
2042	$ 8,019,746.31	$ 9,489,005.94	$ 10,859,125.82	$ 7,779,274.59	$ 6,237,413.68	$ 4,181,599.13
2043	$ 8,893,779.16	$ 10,180,299.28	$ 11,647,890.32	$ 8,334,116.60	$ 6,675,147.45	$ 4,463,188.58
2044	$ 9,835,031.90	$ 10,888,890.55	$ 12,456,105.82	$ 8,901,391.94	$ 7,121,801.30	$ 4,749,013.79
2045	$ 10,848,391.03	$ 11,615,229.89	$ 13,284,271.63	$ 9,481,389.37	$ 7,577,558.61	$ 5,039,117.59
2046	$ 11,940,000.00	$ 13,359,779.54	$ 15,132,900.32	$ 11,074,404.64	$ 9,042,606.55	$ 6,333,542.42
2047	$ 13,120,000.00	$ 14,123,014.21	$ 16,002,518.14	$ 11,680,740.64	$ 9,517,136.19	$ 6,632,330.26
2048	$ 14,390,000.00	$ 14,905,421.42	$ 16,893,665.37	$ 12,300,707.59	$ 10,001,342.60	$ 6,935,522.62
2049	$ 15,750,000.00	$ 15,707,501.86	$ 17,806,896.71	$ 12,934,623.25	$ 10,495,424.90	$ 7,243,160.43
2050	$ 17,220,000.00	$ 16,529,769.74	$ 18,742,781.68	$ 13,582,813.06	$ 10,999,586.35	$ 7,555,284.07
2051	$ 18,790,000.00	$ 17,372,753.20	$ 19,701,905.02	$ 14,245,610.38	$ 11,514,034.47	$ 7,871,933.24
2052	$ 20,480,000.00	$ 18,236,994.64	$ 20,684,867.12	$ 14,923,356.69	$ 12,038,981.08	$ 8,193,146.95
2053	$ 22,300,000.00	$ 19,123,051.18	$ 21,692,284.44	$ 15,616,401.74	$ 12,574,642.46	$ 8,518,963.42
2054	$ 24,250,000.00	$ 20,031,495.03	$ 22,724,789.96	$ 16,325,103.83	$ 13,121,239.36	$ 8,849,420.07
2055	$ 26,350,000.00	$ 20,962,913.92	$ 23,783,033.65	$ 17,049,829.98	$ 13,678,997.16	$ 9,184,553.42
2056	$ 28,600,000.00	$ 21,917,911.53	$ 24,867,682.91	$ 17,790,956.17	$ 14,248,145.97	$ 9,524,399.03
annualized	$ 398,000.00	$ 445,325.98	$ 504,430.01	$ 369,146.82	$ 301,420.22	$ 211,118.08
20-yr present worth	$ 6,611,000.00	$ 7,397,000.00	$ 8,379,000.00	$ 6,132,000.00	$ 5,007,000.00	$ 3,507,000.00
30-year present worth	$ 11,783,000.00	$ 9,030,000.00	$ 10,246,000.00	$ 7,330,000.00	$ 5,871,000.00	$ 3,924,000.00

MONTAGUE DRYER CONCEPTUAL OPTION 1 - 6 DRY TONS/WK

By: JSS

Engineer's Opinion of Probable Cost

Date: 5/15/2024

Project no. ENG23-0487

Item no.	Description	Qty	Units	Material Cost	Installation Cost	Total Unit Cost	Total Cost
1	Mobilization	0.05	LSUM	N/A	N/A	$ 2,950,000.00	$ 147,500.00
2	PWTech BioDryer MBD-12/2D, w/ heater, air cleaning, control system	1	EA	$ 1,300,000.00	$ 750,000.00	$ 2,050,000.00	$ 2,050,000.00
3	Demolition of existing Fan Press	1	LSUM		$ 100,000.00	$ 100,000.00	$ 100,000.00
4	HVAC upgrades	1	LSUM	$ 25,000.00	$ 25,000.00	$ 50,000.00	$ 50,000.00
5	Dumpster Bay Wall modification	1	LSUM	$ 25,000.00	$ 25,000.00	$ 50,000.00	$ 50,000.00
6	Conveyor to exterior dumpster	1	LSUM	$ 100,000.00	$ 50,000.00	$ 150,000.00	$ 150,000.00
7	Electrical Service	1	LSUM	$ 50,000.00	$ 50,000.00	$ 100,000.00	$ 100,000.00
8	Propane Storage Tanks (underground 4,000 gal)	1	LSUM	$ 50,000.00	$ 50,000.00	$ 100,000.00	$ 100,000.00
9	Roof Modifications for Air Exhaust	1	LSUM	$ 25,000.00	$ 50,000.00	$ 75,000.00	$ 75,000.00
10	Shelter for Exterior Dumpster	1	LSUM	$ 50,000.00	$ 25,000.00	$ 75,000.00	$ 75,000.00
11	Miscellaneous Site Changes	1	LSUM	$ 100,000.00	$ 100,000.00	$ 200,000.00	$ 200,000.00
						Sub-total	*$ 3,097,500.00*
					Contractor OH&P	20%	$ 619,500.00
						Bidding Cost Estimate	***$ 3,717,000.00***
					Contingency	25%	$ 774,375.00
					Design & Construction Engineering & Inspection	15%	$ 464,625.00
						Construction Total	**$ 4,956,000.00**

MONTAGUE DRYER CONCEPTUAL OPTION 2 - 8-12 DRY TONS/WK

By: JSS
Engineer's Opinion of Probable Cost
Date: 5/15/2024
Project no. ENG23-0487

Item no.	Description	Qty	Units	Material Cost	Installation Cost	Total Unit Cost	Total Cost
1	Mobilization	0.05	LSUM	N/A	N/A	$ 3,075,000.00	$ 153,750.00
2	PWTech BioDryer MBD-9/D, w/ heater, air cleaning, control system	1	EA	$ 1,400,000.00	$ 750,000.00	$ 2,150,000.00	$ 2,150,000.00
3	Demolition of existing Fan Press	1	LSUM	$ -	$ 100,000.00	$ 100,000.00	$ 100,000.00
4	HVAC upgrades	1	LSUM	$ 50,000.00	$ 25,000.00	$ 75,000.00	$ 75,000.00
5	Dumpster Bay Wall modification	1	LSUM	$ 25,000.00	$ 25,000.00	$ 50,000.00	$ 50,000.00
6	Conveyor to exterior dumpster	1	LSUM	$ 100,000.00	$ 50,000.00	$ 150,000.00	$ 150,000.00
7	Electrical Service	1	LSUM	$ 50,000.00	$ 50,000.00	$ 100,000.00	$ 100,000.00
8	Propane Storage Tanks (underground 4,000 gal)	1	LSUM	$ 50,000.00	$ 50,000.00	$ 100,000.00	$ 100,000.00
9	Roof Modifications for Air Exhaust	1	LSUM	$ 25,000.00	$ 50,000.00	$ 75,000.00	$ 75,000.00
10	Shelter for Exterior Dumpster	1	LSUM	$ 50,000.00	$ 25,000.00	$ 75,000.00	$ 75,000.00
11	Miscellaneous Site Changes	1	LSUM	$ 100,000.00	$ 100,000.00	$ 200,000.00	$ 200,000.00
						Sub-total	*$ 3,228,750.00*
					Contractor OH&P	20%	$ 645,750.00
						Bidding Cost Estimate	***$ 3,874,500.00***
					Contingency	25%	$ 807,187.50
					Design & Construction Engineering & Inspection	15%	$ 484,312.50
						Construction Total	**$ 5,166,000.00**

MONTAGUE DRYER CONCEPTUAL OPTION 3 - 8-12 DRY TONS/WK
Engineer's Opinion of Probable Cost
Project no. ENG23-0487

By: JSS
Date: 5/15/2024

Item no.	Description	Qty	Units	Material Cost	Installation Cost	Total Unit Cost	Total Cost
1	Mobilization	0.05	LSUM	N/A	N/A	$ 5,325,000.00	$ 266,250.00
2	BCR BioScru IC-1800	1	EA	$ 4,000,000.00	$ 500,000.00	$ 4,500,000.00	$ 4,500,000.00
3	Demolition of existing Fan Press	1	LSUM	$ -	$ 100,000.00	$ 100,000.00	$ 100,000.00
4	HVAC upgrades	1	LSUM	$ 50,000.00	$ 25,000.00	$ 75,000.00	$ 75,000.00
5	Dumpster Bay Wall modification	1	LSUM	$ 25,000.00	$ 25,000.00	$ 50,000.00	$ 50,000.00
6	Conveyor to exterior dumpster	1	LSUM	$ 100,000.00	$ 50,000.00	$ 150,000.00	$ 150,000.00
7	Electrical Service	1	LSUM	$ 50,000.00	$ 50,000.00	$ 100,000.00	$ 100,000.00
8	Propane Storage Tanks (underground 4,000 gal)	1	LSUM	$ 50,000.00	$ 50,000.00	$ 100,000.00	$ 100,000.00
9	Roof Modifications for Air Exhaust	1	LSUM	$ 25,000.00	$ 50,000.00	$ 75,000.00	$ 75,000.00
10	Shelter for Exterior Dumpster	1	LSUM	$ 50,000.00	$ 25,000.00	$ 75,000.00	$ 75,000.00
11	Miscellaneous Site Changes	1	LSUM	$ 50,000.00	$ 50,000.00	$ 100,000.00	$ 100,000.00
						Sub-total	*$ 5,591,250.00*
					Contractor OH&P	20%	$ 1,118,250.00
						Bidding Cost Estimate	***$ 6,709,500.00***
					Contingency	25%	$ 1,397,812.50
					Design & Construction Engineering & Inspection	15%	$ 838,687.50
						Construction Total	**$ 8,946,000.00**

MECHANICAL DRYER LIFE CYCLE COST ANALYSIS

	Inflation Rates	Current rate	
Capital Loan Interest	2%		
Utility Inflation	3%		
Sludge Cake Disposal	7%	$ 208.00	per wet ton
Revenue Rate Charges	3%	$ 900.00	per 9,000 gallon truck
Capital Replacement Inflation	3%	$ 2,400,000.00	for full price dryer
Regional Rate Markup			

Current Montague Solids	3.70	DT/wk
Current Regional Solids	2.00	DT/wk
Mid Regional Solids	4.30	DT/wk
FULL Montague Solids	4.50	DT/wk
FULL Regional Solids	7.50	DT/wk
Cake %	19%	
Regional sludge %	2.20%	
Current Regional Sludge	21,801	gallons per week
Mid Regional Sludge	46,872	gallons per week
Full Regional Sludge	81,753	gallons per week

Annual Expenses Subtracting Revenue

		Current Operation	Scenario 1 - 5.7 DT/wk	Scenario 2A.1 - 8 DT/wk	Scenario 2A.2 - 8 DT/wk	Scenario 2B - 12 DT/wk
Regional rate per 9,000 gal truck		$ 725.00	$ 950.00	$ 950.00	$ 1,200.00	$ 950.00
	Year					
Dryer Installed	2026	$ 233,159.12	$ 373,849.09	$ 365,393.50	$ 408,505.78	$ 336,117.78
	2027	$ 486,292.21	$ 756,435.65	$ 739,165.81	$ 824,793.73	$ 679,736.10
	2028	$ 760,907.04	$ 1,147,972.24	$ 1,121,516.63	$ 1,249,007.85	$ 1,031,028.31
	2029	$ 1,058,620.19	$ 1,548,676.83	$ 1,512,650.61	$ 1,681,294.70	$ 1,390,171.93
	2030	$ 1,381,164.83	$ 1,958,772.88	$ 1,912,777.52	$ 2,121,803.36	$ 1,757,348.76
	2031	$ 1,730,398.88	$ 2,378,489.54	$ 2,322,112.31	$ 2,570,685.57	$ 2,132,744.97
	2032	$ 2,108,313.95	$ 2,808,061.79	$ 2,740,875.31	$ 3,028,095.69	$ 2,516,551.22
	2033	$ 2,517,044.76	$ 3,247,730.58	$ 3,169,292.32	$ 3,494,190.79	$ 2,908,962.79
	2034	$ 2,958,879.25	$ 3,697,742.98	$ 3,607,594.78	$ 3,969,130.66	$ 3,310,179.65
	2035	$ 3,436,269.46	$ 4,158,352.39	$ 4,056,019.92	$ 4,453,077.91	$ 3,720,406.62
	2036	$ 3,951,843.10	$ 4,629,818.64	$ 4,514,810.89	$ 4,946,197.92	$ 4,139,853.47
	2037	$ 4,508,416.00	$ 5,112,408.21	$ 4,984,216.93	$ 5,448,658.97	$ 4,568,735.07
	2038	$ 5,109,005.39	$ 5,606,394.39	$ 5,464,493.51	$ 5,960,632.24	$ 5,007,271.48
	2039	$ 5,756,844.10	$ 6,112,057.44	$ 5,955,902.52	$ 6,482,291.86	$ 5,455,688.11
	2040	$ 6,455,395.83	$ 6,629,684.84	$ 6,458,712.42	$ 7,013,814.97	$ 5,914,215.85
	2041	$ 7,208,371.42	$ 7,159,571.38	$ 6,973,198.39	$ 7,555,381.74	$ 6,383,091.22
	2042	$ 8,019,746.31	$ 7,702,019.46	$ 7,499,642.57	$ 8,107,175.44	$ 6,862,556.46
	2043	$ 8,893,779.16	$ 8,257,339.22	$ 8,038,334.17	$ 8,669,382.49	$ 7,352,859.76
	2044	$ 9,835,031.90	$ 8,825,848.78	$ 8,589,569.70	$ 9,242,192.47	$ 7,854,255.34
	2045	$ 10,848,391.03	$ 9,407,874.42	$ 9,153,653.13	$ 9,825,798.20	$ 8,367,003.62
Dryer Replaced	2046	$ 11,940,000.00	$ 10,010,000.00	$ 9,740,000.00	$ 10,430,000.00	$ 8,900,000.00
	2047	$ 13,120,000.00	$ 15,094,706.97	$ 14,804,706.97	$ 17,178,972.09	$ 13,904,706.97
	2048	$ 14,390,000.00	$ 15,720,000.00	$ 15,410,000.00	$ 17,800,000.00	$ 14,460,000.00
	2049	$ 15,750,000.00	$ 16,360,000.00	$ 16,030,000.00	$ 18,430,000.00	$ 15,030,000.00
	2050	$ 17,220,000.00	$ 17,020,000.00	$ 16,670,000.00	$ 19,080,000.00	$ 15,610,000.00
	2051	$ 18,790,000.00	$ 17,700,000.00	$ 17,320,000.00	$ 19,740,000.00	$ 16,200,000.00
	2052	$ 20,480,000.00	$ 18,390,000.00	$ 17,990,000.00	$ 20,410,000.00	$ 16,810,000.00
	2053	$ 22,300,000.00	$ 19,100,000.00	$ 18,670,000.00	$ 21,090,000.00	$ 17,430,000.00
	2054	$ 24,250,000.00	$ 19,820,000.00	$ 19,370,000.00	$ 21,790,000.00	$ 18,060,000.00
	2055	$ 26,350,000.00	$ 20,560,000.00	$ 20,090,000.00	$ 22,500,000.00	$ 18,710,000.00
	2056	$ 28,600,000.00	$ 21,320,000.00	$ 20,820,000.00	$ 23,220,000.00	$ 19,370,000.00
	annualized	$ 597,000.00	$ 500,500.00	$ 487,000.00	$ 521,500.00	$ 445,000.00
20-yr present worth		$ 6,611,000.00	$ 5,543,000.00	$ 5,393,000.00	$ 5,775,000.00	$ 4,928,000.00
30-year present worth		$ 11,783,000.00	$ 8,784,000.00	$ 8,578,000.00	$ 9,567,000.00	$ 7,981,000.00