CITY OF AUBURN

"History's Hometown"

Department of Municipal Utilities

Subject: Addendum #2, Biosolids Processing and Dryer Design

Date: June 10, 2020

To All Prospective Bidders:

Item #1- Biosolids Report

Attached is the “Engineering Report on Dewatered Sludge Conveyance Options” submitted to the City of Auburn in May 2018.

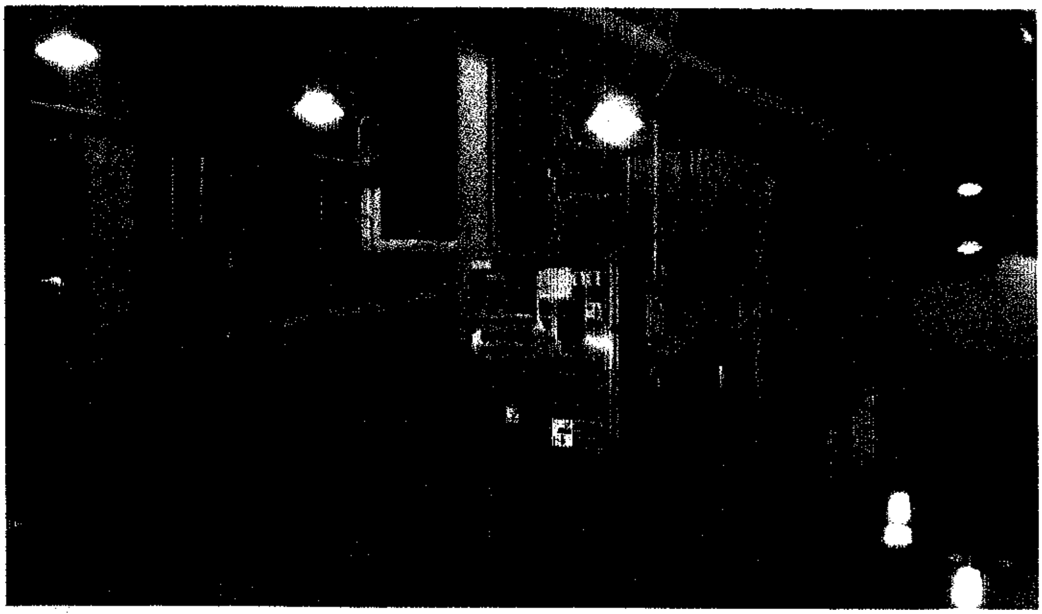
City of Auburn

35 Bradley Street
Auburn, New York, 13021

ENGINEERING REPORT ON DEWATERED SLUDGE CONVEYANCE OPTIONS

for the

AUBURN WASTEWATER TREATMENT PLANT
CITY OF AUBURN



May 2018

MRB Group Project No. 0140.18001

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I. Introduction

MRB Group has completed our evaluation of the dewatered sludge conveyance system and a brief evaluation of various options for alternate sludge processing. This report and the attachments describe the various options identified in our evaluation and should help the City consider what options will best serve it over the coming years.

II. Background Information

The Auburn Wastewater Treatment Plant (WWTP) currently dewaters comingled wastewater sludge using two belt filter presses. Primary sludge, waste activated sludge (WAS), final sludge, and scum are comingled in the sludge thickening tank before being processed by the belt filter presses. After belt pressing the filter cake is transferred to trucks for transport to disposal at a landfill.

After the belt filter presses process the sludge, the resulting filter cake contains 21-24% solids, with the remaining 76-79% of the mass being water. This filter cake falls into a loading hopper beneath the belt filter presses and is transferred from the hopper to the two truck bays, the storage bunker or an outdoor loading port by a large piston pump manufactured by the Schwing Company. This piston pump has been in service since approximately 1995 and has performed well and reliably.

The piston pump has a significant performance aspect which is limiting the optimization of the belt filter presses. The piston pump works more reliably and with less wear and maintenance required when the filter cake produced is wetter- with a percent solids of 21-24%. If the filter cake is dryer than 21-24% than the piston pump has difficulty moving it, requiring operator intervention to operate the pump. The newer of the two belt filter presses is capable of producing filter cake which is approximately 30% solids. Production of dryer filter cake approaching 30% solids would provide a significant economic benefit to the City because it would reduce the cost to haul and dispose of the filter cake at the landfill.

The City has hired MRB Group to identify the options for replacing the piston pump with another type of sludge conveyance machine which would allow the belt filter presses to produce dryer filter cake and reduce disposal costs. This report outlines the various equipment options for filter cake conveyance and options for additional sludge processing which could further reduce disposal costs.

III. Existing Dewatering Equipment

Currently there are two belt filter presses located in the dewatering area. The newer belt filter press is generally used, and the older belt filter press is still functional but is only used occasionally. The newer belt filter press is a BDP unit capable of producing filter cake of approximately 30% solids when operated to maximize the dryness of the filter cake. The belt filter press is currently intentionally operated at less than optimal performance in order to produce a consistent filter cake of 21-24% solids.

Filter cake of 21-24% solids is the preferred dryness because the existing filter cake transfer pump works more easily and reliably when the filter cake is wetter – less than 24% solids.

Sludge dewatering is conducted approximately 6 days per week, 24 hours per day. The belt filter press is typically shut down on Saturday or Sunday and cleaned. After the weekly cleaning the press is placed back into operation on Monday. While the press is out of operation, liquid sludge builds up in the sludge thickening tanks and within the wastewater process tanks.

IV. Existing Filter Cake Pumping System

The existing filter cake pump is a positive displacement piston pump manufactured by the Schwing Company and installed in 1995. The Schwing pump uses a piston to ram filter cake into a steel piping system which is connected to four discharge locations: truck bays #1 and #2, the filter cake storage bunker, and the outdoor truck loading port. The Schwing pump is powered by a hydraulic power unit which operates under high (1,800-2,200 psi) pressure. The Schwing system has operated reliably since 1995 with routine maintenance and periodic parts replacements. MRB Group contacted the local Schwing equipment supplier and were told that the existing pump model will continue to be supported with replacement parts for many years to come.

Filter cake dryer than 21-24% solids cannot be reliably pumped by the Schwing pump.

V. Current Filter Cake Production

Filter cake production at the WWTP has averaged approximately 650 tons per month in recent years, with an average dryness of 21-24% (see historical data in Appendix A). There is some disagreement in the results between WWTP laboratory analysis of filter cake samples for dryness and the results of testing by an independent laboratory. Outside laboratory results have reportedly been consistently in the 20-21% dry range, while WWTP laboratory results on sludge samples collected at approximately the same time have been in the 23-24% dry range. For the purposes of this study the filter cake samples of 20-21% dryness as reported by the outside laboratory will be considered similar to the 23-24% dryness reported by the in-house laboratory. This level of dryness is important to the study because this is the maximum dryness that the Schwing pump can move reliably. Once the dryness of the filter cake increases beyond this 21-24% dry range by just a percentage point or two, and dryer filter cake causes increased discharge pressures at the Schwing pump which can result in problems.

When primary sludge forms a large part of the influent to the belt press the filter cake is likely to be dryer, and when WAS forms a large part of the influent to the belt press the filter cake is likely to be wetter. The operators adjust the polymer dosage and sludge feed rate to produce filter cake in the 21-24% range.

VI. Current Filter Cake Disposal

The 21-24% solids filter cake currently produced at the WWTP is being hauled to the Ontario County Landfill for disposal. Approximately 300 tons of filter cake per month (or 46% of the total sludge production) is used by the landfill to mix with the garbage brought to the landfill in order to provide the perceived benefit of increased biogas production. This first 300 tons per month (quantified as 70 tons per week in the current agreement) is charged at a reduced rate of $31.00 per ton. The remaining filter cake amounts to approximately 350 tons per month (or 54% of the total), and is hauled under a contract with NE Organics for a fee of $54.00 per ton which includes transportation and disposal. Approximately one year remains on the current hauling contract, after which time prices may change depending on market conditions.

Based on these current disposal rates and a total annual filter cake production of 7,800 tons (650 tons per month x 12 months), the expected 2018 filter cake disposal cost will be approximately $337,500.00.

VII. Filter Cake Stabilization

In order for filter cake to be disposed of in a landfill in New York State it must meet one of the three "stabilization" criteria contained in NYSDEC Policy Memo DMM-SW-03-14 (see copy in Appendix B). The Memo describes how filter cake may be "stabilized" by digestion, composing, lime addition, or drying; or may be approved for disposal in a landfill based on the judgement of NYSDEC Regional Staff that the sludge is acceptable to the specific landfill where it will be disposed of. NYSDEC Regional Staff apparently approved the Auburn filter cake for unstabilized disposal at the Ontario County Landfill in 2009 after consideration of the risks and benefits of such disposal.

This item is important because it may affect the cost of filter cake disposal in the future. The unstabilized filter cake from Auburn is currently acceptable for disposal at the Ontario County Landfill. The landfill may or may not continue to accept the unstabilized filter cake into the future. The agreement to accept unstabilized filter cake could be rescinded if odor complaints are received at the landfill, or if regulatory climate concerning the disposal of unstabilized filter cake changes, and so this item poses a risk of future cost to the City.

VIII. Future Filter Cake Disposal

Future costs for filter cake disposal will depend on market values for tipping fees and transportation. Recent solid waste industry articles (contained in Appendix C) show that disposal costs in the Northeast have increased 2% per year from 2010-2017 (Waste Business Journal Jul 11-17, 2017). Central New

York enjoys below market-average disposal costs because of the availability of landfills in the area. Fuel costs for transportation have remained low in recent years, helping to limit costs.

Our evaluation of future disposal costs includes 2 options:

- a 5% increase in current fees with the continued reduced disposal rate for the first 300 tons per month. This scenario would result in increased annual disposal costs from the 2018 figure of $337,500 up to $354,375, an increase of $16,875 per year.
- a 10% increase in current fees with the continued reduced disposal rate for the first 300 tons per month. This scenario would result in increased annual disposal costs from the 2018 figure of $337,500 up to $371,250, an increase of $33,750 per year.

Each of the options considered is based on the overall tonnage of filter cake remaining at 650 tons per month. The filter cake processing modifications described in the next section may allow for dryer filter cake to be produced, which will result in a reduction in the number of tons produced, hauled, and disposed of, with a corresponding reduction in disposal fees. Increases in filter cake dryness from the current 21-24% level of 3% (to approximately 27% dry) and 6% (to approximately 30% dry) from the current levels are considered in the evaluations which follow.

If the filter cake is dried an additional 3% from the current condition due to better belt filter press performance, than monthly filter cake production will decrease from 650 tons to 570 tons, and annual production will fall from 7,800 tons to 6,825 tons. The resulting annual disposal costs will fall from $337,500 to $285,750, an annual savings of $51,750 based on 2018 costs.

If the filter cake is dried an additional 6% from the current condition due to better belt filter press performance, than monthly filter cake production will decrease from 650 tons to 506 tons, and annual production will fall from 7,800 tons to 6,070 tons. The resulting annual disposal costs will fall from $337,500 to $244,800, an annual savings of $92,750 based on 2018 costs.

IX. Cost Considerations

The cost of filter cake disposal must take into account the cost of the electricity and polymer used to produce the filter cake and move it from the belt filter presses to the truck loading bays, plus the cost of transportation and disposal of the filter cake at a landfill. Our economic evaluation of the various equipment options is based on the information in this section.

A. **Polymer.** Polymer is added to the sludge prior to belt pressing. The amount of polymer added to the sludge is the most significant factor in the overall dryness of the filter cake produced. The type of polymer added to the sludge was changed in 2015 when the new BDP belt filter press was installed and the polymer mixing system was modified. The current cost for polymer is approximately $14,000 per year, which equates to about $1.88 per ton of 21/22% filter cake produced. MRB Group contacted the BDP Company and asked them to estimate how much more polymer would be required above current usage levels to achieve the best dryness possible on filter cake produced. BDP replied that polymer usage is likely to increase by approximately 75-80% from currently levels to achieve 30% dryness on the filter cake produced. This would result in a new polymer cost of approximately $24,000 per year, an increase in polymer cost of $10,000 per year over current levels.

B. **Filter Cake Dryness.** The current filter cake produced is 21-24% solids. The new BDP filter press should be capable of producing filter cake of approximately 27-30% solids. Our evaluation will consider two tiers of improvement – an increase of 3% from current conditions to 24-27% solids, and an increase of 6% to 27-30% solids. The corresponding tonnage hauled for disposal and the calculated disposal costs at each percent solids is:

- 24% - 7,800 tons per year, $337,500 at 2018 rate structure
- 27% - 6,930 tons per year, $285,750 at 2018 rate structure
- 30% - 6,240 tons per year, $244,764 at 2018 rate structure

Increasing the solids content by just 3% from current levels provides an annual savings of over $52,750. If the optimized BDP belt press achieves a 6% solids increase from current levels than the annual savings in disposal costs will exceed $92,000. Increased polymer consumption and costs of $5,000 to $10,000 will be associated with the reduced disposal costs. Electrical costs to operate the belt filter press and polymer systems do not vary significantly depending on the dryness of the filter cake produced.

C. **Electrical Cost.** The cost for electrical energy to move the belt filter cake from the belt press hopper to the truck loading bays is considered in this section. The various filter cake moving machines considered in this report use significantly different amounts of electrical energy to transport the filter cake from the hopper below the belt filter press to the truck loading bays. The Schwing Pump has a 60 HP motor, the Progressive Cavity Pump has 13 HP of installed electrical motors, and the Tubular Drag Conveyor has 3.67 HP of installed electrical motors. All electrical motors are assumed to run 100% of the time that dewatering is occurring. An electrical cost of $0.065 per kWh is applied to all loads.

Currently dewatering occurs 6 days per week, for a total of 7,500 hours per year at current conditions. If 3% dryer filter cake is made, the annual time required to dewater will be reduced to approximately 6,650 hours, and would be further reduced to 6,000 hours per year if 6% dryer filter cake is made.

If the belt press motors and associated sludge supply pumps, polymer supply pumps and ancillary equipment are assumed to total approximately 30 HP, than the annual electrical cost of operation at each filter cake solids content is:

- 21-24% - 7,500 hours per year of operation, $10,900 in electrical costs per year
- 24-27% - 3% solids increase - 6,650 hours per year of operation, $9,660 in electrical costs per year, a savings of $1,240.
- 27-30% - 6% solids increase - 6,000 hours per year of operation, $8,720 in electrical costs per year, a savings of $2,180.

At the current 7,500 hours of operation, the various types of filter cake handling equipment considered would result in the following electrical costs:

- Schwing Pump – 60 HP - $1,330 per year
- Progressive Cavity Pump – 13 HP - $290 per year, a savings of $1,040 per year
- Tubular Drag Conveyor – 3.7 HP - $81 per year, a savings of $1,250 per year

So, in general, potential electrical savings due either to reduced hours of operation or more efficient filter cake transfer equipment are small when compared to filter cake disposal costs.

X. Filter Cake Handling Options

This section evaluates the options for moving filter cake from the collection hopper below the belt filter press discharge chutes to the truck bays, storage bunker, or outdoor loading port. The existing Schwing pump is quite old, and does not allow for optimal performance of the newer belt filter press because it cannot pump filter cake dryer than 21-24%. The following options exist for moving filter cake:

A. **Do nothing**. The existing Schwing pump system is in reasonable condition and is operating every day. It can deliver the filter cake to any of the four discharge locations and works well except when the filter cake is very dry and thus more difficult to pump. The existing screw conveyor from the storage bin back to the Schwing pump hopper is in poor condition, but can be fixed by in-house staff when it breaks. Points to consider for this option:

   i. No capital cost.
   ii. Does not allow City to optimize the new BDP press and make drier filter cake which would reduce disposal costs.
   iii. Uses more electricity for transportation of filter cake from belt press to truck bays than either drag conveyors or screw/belt conveyors.
   iv. Schwing pump components are available and should remain available for many years.
   v. System requires operator intervention - mixing wetter filter cake with dryer filter cake - during times when dry filter cake is being produced (early in the week when primary sludge forms a larger percentage of the total sludge being dewatered).

B. **Replace Schwing Pump with new Schwing Pump.** Replace the Schwing Pump and associated Hydraulic Unit. The Schwing pump system was installed in 1995. Many system parts have been replaced over the years and hydraulic unit appears to be the oldest original part. MRB Group requested a pricing proposal for a new Schwing Pump System. The pricing proposal is included in Appendix D, and includes the supply of a new piston pump and hydraulic unit. See Table #1 for an Opinion of Probable Construction Cost for a project to replace the existing Schwing Pump with a new one. Points to consider for this option:

i. Significant capital cost.
ii. Does not allow City to optimize the new BDP press and make drier filter cake which would reduce disposal costs.
iii. Works well on filter cake from 5% dry to 21% dry, and marginally well on filter cake of 22%-24%. Cannot be used on filter cake dryer than approximately 25%.
iv. Uses more electricity for transportation of filter cake from the belt press to truck bays than either drag conveyors or screw/belt conveyors.
v. A new pump would not handle the dry filter cake produced periodically any better than the existing pump.
vi. The screw conveyor used to transfer filter cake from the storage bunker to the pump hopper would remain a weak link.
vii. Provides no disposal savings over current situation.

C. **Tubular Drag Conveyor.** Replace the Schwing system with a Tubular Drag Conveyor. A tubular drag conveyor could be installed in place of the Schwing pump system, which would be demolished. Tubular drag conveyors are in widespread use to move dry and semi dry items such as cereals, nuts, pellets and filter cake from hoppers to trucks and storage bins. See Appendix E for a quotation from the Hapman Company for a new tubular drag conveyor system. Filter cake would be moved slowly through a 4" diameter 304 SST pipe along the same route that the current Schwing Pump system discharge piping follows. Tubular drag conveyors work more easily the drier the filter cake is, and so the belt press could be optimized to produce drier filter cake. See Table #2 for an Opinion of Probable Construction Cost and Simple Payback. Points to consider for this option:

a. Significant capital cost.
b. Allows the City to optimize the new BDP press and make drier filter cake which would reduce disposal costs.
c. Works well on filter cake from 18% dry to 90% dry.
d. Very wet filter cake, less than 18% dry, could stick to the chain and drag disks and require spray cleaning.
e. Uses less electricity for transportation of filter cake from belt press to truck bays than the Schwing system.
f. The system could either be routed to allow discharge into the truck bays and the storage bin, or could just be routed to the truck bays, reducing complexity, lowering capital costs, and requiring better truck control.
g. The use of the storage bunker could be eliminated.
h. A second, independent tubular drag conveyor system could be installed to provide redundancy. This second system could transfer filter cake from the belt presses to the storage bunker or the outdoor loading point.
i. If the storage bunker continues to be used, the screw conveyor from the storage bunker to the pump hopper would remain a weak link.

D. **Progressive Cavity Pump.** Replace the Schwing system with a Progressive Cavity Pump. A progressive cavity pump could be installed in place of the Schwing pump system. The Schwing pump, hydraulic unit, and 6" diameter transfer piping would be demolished. A new progressive cavity pump and new 4" diameter discharge piping could be installed along the route from the belt filter presses to the truck bays. These types of pumps are in widespread use and are frequently used to move filter cake. See Appendix F for a quotation from the Moyno Company for a new progressive cavity pump. A progressive cavity pump would work similarly to the existing Schwing pump, discharging the compressed filter cake into a new 4" diameter pipe. See Table #3 for an Opinion of Probable Construction Cost and Simple Payback. Points to consider for this option:

i. Significant capital cost.
ii. Allows the City to optimize the new BDP press and make drier filter cake which would reduce disposal costs.
iii. Works well on filter cake from 5% dry to 40% dry.
iv. The dryer the filter cake the more the pump impellers will wear.
v. Uses less electricity for transportation of filter cake from belt press to truck bays than the Schwing system.
vi. The system could either be routed to allow discharge into truck bays and the storage bin, or could just be routed to the truck bays, reducing complexity, and requiring better truck control.
vii. The use of the storage bunker could be eliminated.
viii. A second, independent progressive cavity pump could be installed to provide redundancy. This second system could be smaller and less expensive, and could transfer filter cake to the storage bunker only.
ix. If the storage bunker continues to be used, the screw conveyor from the storage bunker to the pump hopper would remain a weak link.

XI. SLUDGE PROCESSING OPTIONS

The WWTP currently does the minimum possible treatment of the sludges generated. The liquid sludges are comingled in the sludge thickening tanks and are then dewatered using the belt filter presses. The unstabilized filter cake is then transported to the landfill for disposal. Many area WWTPs provide additional treatment or processing of sludges beyond this minimum level. The following description of the common treatment and processing technologies is presented to describe the potential cost implications for filter cake disposal in coming years.

A. **Anaerobic Digestion**. Anaerobic digestion of the thickened comingled liquid sludges is in widespread use. The process requires at least two large tanks and would have the following characteristics:

i. The process would convert about 40% of the total solids in the sludge into methane and carbon dioxide, and so would reduce the amount of filter cake produced by the belt press by approximately the same 40%.

ii. The primary digester would need to be heated to maintain a liquid temperature of approximately 95 degree F to maintain the digestion biology.

iii. The methane produced is flammable and potentially explosive, and safety equipment would be needed to monitor for methane leaks.

iv. The methane produced would be used to heat the digester, and some excess heat might be available for plant heating. This excess heat has little value in Auburn because there is already heat available from the landfill gas generating plant.

v. Operation of an anaerobic digester is a complex biological operation which adds complexity to the overall wastewater treatment plant.

vi. Anaerobic digestion of the sludge is a qualified "stabilization" method, and so the filter cake produced would be considered stabilized sludge and could be landfilled in NYS.

vii. An Opinion of Probable Construction Cost for a new digester complex is shown in Table 4, and is $4.8M.

viii. Potential savings and project payback resulting from reduced volumes of filter cake produced are described in Table 4.

ix. It is possible that the Ontario County Landfill would not offer the preferential rate of $31/ton for digested sludge, because the biogas generation potential of the digested sludge will be less than it is currently.

x. The project payback period is over 26 years. This option is not justified on an economic basis.

B. **Aerobic Digestion**. Aerobic digestion of the thickened comingled liquid sludges is in limited use in the United States. A recent installation at the Geneva WWTP has operated successfully for several years. The aerobic process requires at least two large new concrete tanks and would have the following characteristics:

i. The process would convert about 60% of the total solids in the sludge through the aerobic digestion process, and so would reduce the amount of filter cake produced by the belt press by approximately the same 60%.

ii. The resulting filter cake would probably be qualified as Class A Biosolids, possibly resulting in a reduced disposal fee. At the City of Geneva WWTP, the filter cake from the aerobic process has been approved as Class A biosolids by NYSDEC, and a vendor is currently hauling the cake away for approximately $25 per ton (the City pays the vendor $25 per ton), and the vendor provides the transportation.

iii. Operation of an aerobic digester is a complex biological operation which adds complexity to the overall wastewater treatment plant.

iv. The process uses a large amount of electricity – over $70,000 per year even at the excellent rates the City has ($0.065). The electricity is consumed in by the aeration blowers needed to aerate the sludge in the digester.

v. Aerobic digestion of the sludge is a qualified "stabilization" method, and so the filter cake produced would be considered stabilized sludge and could be landfilled in NYS.

vi. An Opinion of Probable Construction Cost for a new digester complex is shown in Table 5, and is $6.3M.

vii. Potential savings and project payback resulting from reduced volumes of filter cake produced are described in Table 5.

viii. It is possible that the Ontario County Landfill would not offer the preferential rate of $31/ton for digested sludge, because the biogas generation potential of the digested sludge will be less than it is currently.

ix. The project payback period is over 40 years. This option is not justified on an economic basis.

C. **<u>Sludge Drying</u>**. Sludge drying has been in common practice for decades, but is not common in New York because landfill disposal costs have historically been low. Various types of sludge dryers add heat and air to the belt press filter cake in order to drive off water and increase the solids content of the filter cake from 20-25% up to 50-90%. A sludge dryer at the Auburn WWTP would likely be a horizontal belt dryer with hot air being driven through the filter cake to remove moisture. Such a sludge dryer would have the following characteristics:

i. The process would use natural gas or landfill gas, or a combination of these, as a heat source.
ii. Commercially available dryers can dry the filter cake to any dryness level. Drying to 50% solids, 75% solids and 90% solids are considered here.
iii. Drying to 50% solids would reduce the tons of filter cake disposed of from 6,800 tons per year to 3,300 tons per year.
iv. Drying to 75% solids would reduce the tons of filter cake disposed of from 6,800 tons per year to 2,200 tons per year. The resulting filter cake would be considered Class A Biosolids.
v. Drying to 90% solids would reduce the tons of filter cake disposed of from 6,800 tons per year to 1,800 tons per year. The resulting filter cake would be considered Class A Biosolids.
vi. If the resulting filter cake is qualified as Class A Biosolids, there would probably be an opportunity to locate a vendor who would use the Class A product for beneficial reuse. At the City of Geneva WWTP, the filter cake from the aerobic process has been approved as Class A biosolids by NYSDEC, and a vendor is currently hauling the cake away for approximately $25 per ton (the City pays the vendor $25 per ton), and the vendor provides the transportation.
vii. Operation of a dryer is a mechanical process, and not a biological process.
viii. The process uses a large amount of electricity – over $27,000 per year even at the excellent rates the City has ($0.065). The electricity is used to drive the large air blowers associated with the process.

ix. The process uses a large amount of natural gas – over $70,000 per year based on $7.00 per dekatherm of Natural Gas. If landfill gas is available this cost may be reduced.

x. Drying of the sludge is a qualified "stabilization" method if the sludge is dried to greater than 75% solids.

xi. An Opinion of Probable Construction Cost for a new digester complex is shown in Table 6, and is $2.1M. This estimate assumes that the new dryer could be located in the existing incinerator building basement.

xii. It may be possible to utilize the excess heat for Combined Heat and Power Plant located at the WTTP site to reduce the amount of natural gas needed for this option.

xiii. Potential savings and project payback resulting from reduced volumes of filter cake produced are described in Table 6.

xiv. The project payback period is 16 years based on current landfill disposal costs. If landfill disposal costs increase in the future, or if the Class A Biosolids produced by drying can be used for beneficial reuse, the payback may be much quicker.

D. **Lime Stabilization**. Lime stabilization is in widespread use in New York. Sludge stabilization by lime addition raises the pH of the sludge to 12 or higher for at least 30 minutes. No reduction in the sludge volume is accomplished by lime addition. Addition of a lime stabilization process at the Auburn WWTP would have the following characteristics:

i. The process would require a new lime silo to store the lime in bulk.

ii. Lime would be added to the filter cake just after the belt press discharge chute, and before the filter cake is moved to the trucks.

iii. Lime currently costs approximately $230 per ton, and annual usage at 2018 sludge production levels would be 310 tons per year, at a cost of $71,300 per year.

iv. The resulting filter cake would be qualified as "stabilized" sludge per NYSDEC Policy DMM-SW-03-14.

v. The lime stabilization process is a mechanical, and not a biological process.

vi. An Opinion of Probable Construction Cost for a new digester complex is shown in Table 7, and is $0.9M.

vii. There are no potential savings associated with lime stabilization because there would be no reduction in the volume of filter cake produced.

XII. NEW SLUDGE HANDLING FACILITY

The existing belt press area and truck loading bays are located in the incinerator building complex. WWTP staff asked that MRB Group include in this report an opinion of probable construction cost for a new, modern sludge handling facility. The existing sludge handling facility is functional but is collocated very near the control room, placing operators near the belt filter presses. This situation of having office space near the operating belt filter presses is less common in modern plants, where separation of these two types of areas is usually accomplished.

A new sludge handling facility would have the following characteristics:

a. Location in a separate building from the office space, or in a separate portion of the same building as the office space but with separate HVAC systems to serve each space.

b. Redundant belt filter presses or other dewatering equipment (screw presses, or centrifuges).

c. Closely collocated truck loading bays or dumpster loading bays to minimize the handling of filter cake.
d. An HVAC system to serve the dewatering area.
e. Facilities for chemical and polymer unloading, storage, mixing and injection systems.
f. An Opinion of Probable Construction Cost for a new sludge handling facility is shown in Table 8, and is $2.4M.

XIII. CONCLUSIONS

The MRB Group's evaluation of the sludge handling and sludge processing operations at the Auburn WWTP resulted in the following conclusions:

A. Operation of the newer belt filter press to produce filter cake 3-6% dryer than currently produced can result in savings of $50,000 to $90,000 per year, with potentially more future savings if disposal charges increase in the future (likely). Disposal costs are based solely on the tonnage hauled, and so producing dryer filter cake is directly proportional to reductions in disposal costs.

B. The existing Schwing Pump is not a good choice to transfer filter cake from the belt press hopper to the truck loading bays. The Schwing pump's limitations on percent dryness (24%) are a poor match for the desired and possible operation of the new BDP belt filter press (30%).

C. Replacement of the Schwing Pump system with a Progressive Cavity Pump system would allow optimization of the BDP belt press operation. The Progressive Cavity Pump system is not recommended for the Auburn WWTP because the pump impellers can be quickly degraded when large amounts of sand and grit are processed, as happens during periodic wet weather events at the WWTP.

D. Replacement of the Schwing Pump system with a tubular drag conveyor would allow for the optimization of the BDP belt press operation, without the downside of sand and grit problems. The tubular drag conveyor works well and without increased component wear throughout the entire range of possible conditions at the plant. Tubular drag conveyors are in use for moving filter cake at other WWTPs around the United States, but are not in common usage, probably because in most cases the required transfer route is a short distance in a straight line, and so the filter cake can be easily and economically moved using an open screw conveyors. The tubular drag conveyor appears to be the best solution for moving the filter cake at the WWTP, but operating tubular drag conveyors at other WWTPs will need to be visited before a decision to install one can be made in Auburn.

E. Replacement of the Schwing Pump system with a series of screw conveyors or belt conveyors system is not practical because the route between the belt press area and the truck loading bays is long and has many bends.

F. Elimination of the use of the sludge holding bunker and outdoor unloading port would be a significant benefit to the City in reduced project complexity and ongoing maintenance. Most WWTPs operate with 2 discharge points in truck bays, and not the 4 discharge locations which are currently possible in Auburn. The older screw conveyor could be retired if the sludge holding bunker were taken out of service.

G. Sludge hauling and disposal charges represent a significant liability to the City. Estimated total hauling and disposal costs in 2018 are approximately $337,500. When the current contract is completed in approximately 1 year, the contract will be advertised and publically bid. Costs are likely to increase by a minimum of 5-10%, increasing annual disposal fees by $17,000 to $34,000 per year.

H. Production of "unstabilized" sludge is another liability for the City. The current agreement with the Ontario Landfill and the NYSDEC could be revisited at any time, and could result in a requirement to add a sludge stabilization process at the WWTP. If sludge stabilization is required by the NYSDEC in the future, the City will likely have time to plan for and install an appropriate solution after the agency renders its opinion. No immediate action is required or suggested by MRB Group.

I. The addition of aerobic or anaerobic digestion processes at the WWTP would result in a reduction of the total filter cake produced, reducing disposal costs by 40-60%, even without optimizing the operation of the belt filter press. A digestion process would result in stabilized sludge, and possibly Class A Biosolids, which would reduce the costs for disposal. The cost to add a digestion process is very large, and is not justified by potential savings. Also, the operation of a digestion process is complicated and adds potential risks of flammable gases.

J. The addition of a sludge dryer at the WWTP would result in a reduction of the total filter cake produced, reducing disposal costs by 30-35%. The output of a dryer producing 75% or dryer sludge could be qualified as Class A Biosolids, which would probably further reduce the costs for disposal. The market for Class A biosolids is still developing, but it is clear that 75-90% dry Class A Biosolids would be much less expensive to dispose of than current landfill rates. If landfill gas could be used to provide heat to the dryer, additional savings could be realized.

K. The addition of a lime stabilization process at the WWTP would remove the uncertainty about future landfilling of the filter cake produced. Installation of a lime stabilization system is not recommended at this time. If a future determination is made by the NYSDEC or the Ontario Landfill that the unstabilized sludge cannot be disposed of at the landfill, the City will be able to consider its options at that time. There is no benefit in installing a lime stabilization system at this time.

TABLES

Table 1

Schwing Pump Replacement Costs

Apr-18

Item Description	*Unit Price*	*Qty*	*Units*	*Cost*
New Equipment Quote	$ 184,300.00	1	EA	$ 184,300
Installation of new items	$ 30,000.00	1	EA	$ 30,000
Demo of old items	$ 5,000.00	1	EA	$ 5,000
Electrical Work	$ 15,000.00	1	EA	$ 15,000

Construction Subtotal:	$234,300
Construction Contingency	$10,000
Construction w/ Contingency:	$244,300
Engineering	$10,000
Total Project Costs	**$254,300**

Estimated Annual Disposal Costs	**21% Dry**
Disposal costs at dryness indicated	$337,500
Belt Press Electricity Cost	$10,900
Filter Cake Handling Cost	$1,330
Polymer	$14,000
Current 2018:	**$363,730**

Potential Annual Savings **$0**

Table 2

Tubular Drag Conveyor Project Costs

Apr-18

Item Description	Unit Price	Qty	Units	Cost
New Equipment Quote - Primary Conv.	$ 115,100.00	1	EA	$ 115,100
Installation of new items	$ 20,000.00	1	EA	$ 20,000
Second Conveyor to Bunker	$ 30,000.00	1	EA	$ 30,000
Demo of old items	$ 5,000.00	1	EA	$ 5,000
Electrical Work	$ 15,000.00	1	EA	$ 15,000

Construction Subtotal:	$185,100
Construction Contingency	$10,000
Construction w/ Contingency:	$195,100
Engineering	$10,000
Total Project Costs	**$205,100**

Estimated Annual Disposal Costs *	**21-24% Dry**	**25-27% Dry**	**28-30% Dry**
Disposal costs at dryness indicated	$337,500	$285,750	$244,764
Belt Press Electricity Cost	$10,900	$9,660	$8,720
Filter Cake Handling Cost	$81	$73	$65
Polymer	$14,000	$19,000	$24,000
Total in 2018 $$	**$362,481**	**$314,483**	**$277,549**
Potential Annual Savings	**$1,249**	**$49,247**	**$86,181**
Simple Payback (Years)	**164**	**4.2**	**2.4**

*** Assumes no increase in disposal costs per ton above 2018 rate.**

Table 3

Progressive Cavity Pump Project Costs

Apr-18

Item Description	Unit Price	Qty	Units	Cost
New Equipment Quote - Primary Pump	$ 37,000.00	1	EA	$ 37,000
Installation of new items	$ 10,000.00	1	EA	$ 10,000
Second Pump to Bunker	$ 30,000.00	1	EA	$ 30,000
Demo of old items	$ 5,000.00	1	EA	$ 5,000
Electrical Work	$ 15,000.00	1	EA	$ 15,000

Construction Subtotal:	$97,000
Construction Contingency	$10,000
Construction w/ Contingency:	$107,000
Engineering	$10,000
Total Project Costs	**$117,000**

Estimated Annual Disposal Costs *	**21-24% Dry**	**25-27% Dry**	**28-30% Dry**
Disposal costs at dryness indicated	$337,500	$285,750	$244,764
Belt Press Electricity Cost	$10,900	$9,660	$8,720
Filter Cake Handling Cost	$81	$73	$65
Polymer	$14,000	$19,000	$24,000
Total in 2018 $$	**$362,481**	**$314,483**	**$277,549**
Potential Annual Savings	**$1,249**	**$49,247**	**$86,181**
Simple Payback (Years)	**94**	**2.4**	**1.4**

*** Assumes no increase in disposal costs per ton above 2018 rate.**

Table 4

Auburn WWTP - Anaerobic Digester

Opinion of Probable Construction Cost Apr-18

Item Description	*Unit Price*	*Qty*	*Units*	*Cost*
Primary Digester, 500,000 gallons	$ 2.00	500,000	EA	$ 1,000,000
Secondary Digester, 500,000 gallons	$ 2.00	500,000	EA	$ 1,000,000
Piping and Valving	$ 1.00	400,000	EA	$ 400,000
Sludge Pumps	$ 4.00	45,000	EA	$ 180,000
Heating and Mixing System	$ 1.00	175,000	EA	$ 175,000
Biogas Safety System	$ 1.00	180,000	EA	$ 180,000
Biogas Boiler	$ 1.00	75,000	EA	$ 75,000
Digester Building, 30' x 40'	$ 200.00	1,200	EA	$ 240,000
Electrical Work	$ 1.00	400,000	EA	$ 400,000
Grading and Paving	$ 10.00	4,000	EA	$ 40,000
SCADA and Controls	$ 75,000.00	1	EA	$ 75,000

Construction Subtotal:	$3,765,000
Construction w/ 10% Contingency:	$4,141,500
Engineering/Fiscal/Legal (15%)	$621,225
Total Project Costs	**$4,762,725**

Estimated Annual Disposal Costs (1)	**21-24% Dry**	**25-27% Dry**	**28-30% Dry**
Tons of Filter Cake Produced (3)	4,680	4,095	3,640
Disposal costs at dryness indicated	$169,900	$138,300	$113,800
Belt Press Electricity Cost (6)	$10,900	$9,660	$8,720
Digester Electricity (6)	$6,400	$6,400	$6,400
Digester Heat	$5,000	$5,000	$5,000
Filter Cake Handling Elec. Cost (6)	$50	$45	$40
Polymer Cost	$14,000	$19,000	$24,000
Total in 2018 $$	**$206,250**	**$178,405**	**$157,960**
Potential Annual Savings	**$131,250**	**$159,095**	**$179,540**
Simple Payback (Years)	**36.3**	**29.9**	**26.5**

Notes:

1. Assumes no increase in disposal costs per ton above 2018 rate.
2. Assumes 40% reduction in filter cake production due to digestion.
3. Benchmark disposal cost in 2018 is $337,500 for 7,800 tons.
4. Digester electricity assumed to be 15 HP continuous.
5. Digester heating assumed to be $5,000 per year in NG costs.
6. Electrical costs assumed to be $0.065 per kWh.

Table 5

Auburn WWTP - Aerobic Digester

Opinion of Probable Construction Cost — Apr-18

Item Description	Unit Price	Qty	Units	Cost
Aerobic 1st Stage Reactor - conc.tank	$ 2.00	400,000	EA	$ 800,000
Aerobic 2nd Stage Reactor	$ 2.00	400,000	EA	$ 800,000
Piping and Valving	$ 1.00	400,000	EA	$ 400,000
Sludge Pumps	$ 4.00	45,000	EA	$ 180,000
Aerobic Blowers, Internals, Controls	$ 1.00	1,810,000	EA	$ 1,810,000
Equipment Building, 30' x 40'	$ 200.00	1,200	EA	$ 240,000
Electrical Work	$ 1.00	700,000	EA	$ 700,000
Grading and Paving	$ 10.00	4,000	EA	$ 40,000

Construction Subtotal:	$4,970,000
Construction w/ 10% Contingency:	$5,467,000
Engineering/Fiscal/Legal (15%)	$820,050
Total Project Costs	**$6,287,050**

Estimated Annual Disposal Costs (1)	**21-24% Dry**	**25-27% Dry**	**28-30% Dry**
Tons of Filter Cake Produced (2)	3,100	2,800	2,500
Disposal costs at dryness indicated(1)	$96,100	$86,800	$77,500
Belt Press Elec. Cost (6)	$10,900	$9,660	$8,720
Aer Dig Elec. Cost (4,6)	$73,500	$73,500	$73,500
Aer Dig. Heat (5)	$1,000	$1,000	$1,000
Filter Cake Handling Elec. Cost (6)	$50	$45	$40
Polymer Cost	$14,000	$19,000	$24,000
Total in 2018 $S	**$195,550**	**$190,005**	**$184,760**
Potential Annual Savings	**$141,950**	**$147,495**	**$152,740**
Simple Payback (Years)	**44.3**	**42.6**	**41.2**

Notes:

1. Assumes no increase in disposal costs per ton above 2018 rate.
2. Assumes 60% reduction in filter cake production due to digestion.
3. Benchmark disposal cost in 2018 is $337,500 for 7,800 tons.
4. Digester electricity assumed to be $73,500 per year, per vendor.
5. Digester heating assumed to be $1,000 per year in NG costs.
6. Electrical costs assumed to be $0.065 per kWh.

Table 6

Auburn WWTP - Sludge Dryer

Opinion of Probable Construction Cost — Apr-18

Item Description	*Unit Price*	*Qty*	*Units*	*Cost*
Sludge Dryer	$ 1,105,556.00	1	EA	$ 1,105,556
Conveyors and Handling Equip	$ 100,000.00	1	EA	$ 100,000
HVAC Upgrades	$ 200,000.00	1	EA	$ 200,000
Electrical Work	$ 100,000.00	1	EA	$ 100,000
Installation Labor	$ 100,000.00	1	EA	$ 100,000
SCADA and Controls	$ 25,000.00	1	EA	$ 25,000

Construction Subtotal:	$1,630,556
Construction w/ 10% Contingency:	$1,793,612
Engineering/Fiscal/Legal (15%)	$269,042
Total Project Costs	**$2,062,653**

Estimated Annual Disposal Costs (1,2)	**50%Dry**	**75% Dry**	**90% Dry**
Tons of Filter Cake Produced (3)	3,300	2,200	1,800
Disposal costs at dryness indicated (2)	$102,300	$68,200	$55,800
Belt Press Electricity Cost (6)	$9,700	$9,700	$9,700
Dryer Elec Cost (6)	$27,600	$29,600	$31,600
Dryer Heat Cost in NG (5)	$70,000	$85,000	$92,000
Filter Cake Handling Elec. Cost (6)	$50	$45	$45
Polymer Cost	$19,000	$19,000	$19,000
Total in 2018 $$	**$228,650**	**$211,545**	**$208,145**
Potential Annual Savings	**$108,850**	**$125,955**	**$129,355**
Simple Payback (Years)	**18.9**	**16.4**	**15.9**

Notes:

1. Assumes no increase in disposal costs per ton above 2018 rate.
2. Alternate disposal as Class A may be possible for less $$.
3. Benchmark disposal cost in 2018 is $337,500 for 7,800 tons.
4. Dryer electricity usage supplied by vendor.
5. Dryer NG input value supplied by vendor.
6. Electrical costs assumed to be $0.065 per kWh.

Table 7

Auburn WWTP - Lime System

Opinion of Probable Construction Cost

Apr-18

Item Description	Unit Price	Qty	Units	Cost
Lime Silo	$ 200,000.00	1	EA	$ 200,000
Mixing Mill	$ 60,000.00	1	EA	$ 60,000
Conveyors	$ 180,000.00	1	EA	$ 180,000
HVAC	$ 45,000.00	1	EA	$ 45,000
Electrical Work	$ 120,000.00	1	EA	$ 120,000
Lime Unloading Station	$ 100,000.00	1	EA	$ 100,000
SCADA and Controls	$ 25,000.00	1	EA	$ 25,000

Construction Subtotal:	$730,000
Construction w/ 10% Contingency:	$803,000
Engineering/Fiscal/Legal (15%)	$120,450
Total Project Costs	**$923,450**

Comments:

1. There is no reduction in disposal costs per ton, but there may be an advantage because the sludge will be stabilized.

2. Lime costs per year are estimated at $230 per ton, with annual usage expected to be 310 tons per year. Estimated annual cost of $71,300 in 2018 $$. Based on actual costs a the Herkimer County WWTP.

Table 8

Auburn WWTP - New Sludge Handling Facility

Opinion of Probable Construction Cost

Apr-18

Item Description	*Unit Price*	*Qty*	*Units*	*Cost*
Foundation	$ 30.00	5,000	SF	$ 150,000
Building	$ 115.00	5,000	SF	$ 575,000
Underground Piping	$ 40.00	1,200	LF	$ 48,000
Sludge transfer pumps	$ 50,000.00	2	EA	$ 100,000
Electrical System	$ 350,000.00	1	EA	$ 350,000
HVAC System	$ 120,000.00	1	EA	$ 120,000
Relocate Belt Presses	$ 20,000.00	1	EA	$ 20,000
Relocate Polymer System	$ 5,000.00	1	EA	$ 5,000
New Chemical Unloading Area	$ 20,000.00	1	EA	$ 20,000
Chemical Storage Area	$ 50,000.00	1	EA	$ 50,000
Conveyor System	$ 110,000.00	1	EA	$ 110,000
Building Piping and Valves	$ 350,000.00	1	LOT	$ 350,000

Construction Subtotal:	$1,898,000
Construction w/ 10% Contingency:	$2,087,800
Engineering/Fiscal/Legal (15%)	$313,170
Total Project Costs	**$2,400,970**

Comments:

1. Building size is estimated at 50' by 100'.

2. Building Costs estimated at $115/sf, and includes building frame, walls, roof, windows and doors.

3. Underground piping estimated at 4 runs of 300 LF each, for sludge, filtrate, potable water and non-potable water.

4. Electrical System includes supply, transformers, MCCs, lights, receptacles, fire alarm system, controls.

APPENDIX A

ANNUAL SLUDGE PRODUCTION
2010-2017

Appendix A

Auburn NY WWTP Annual Sludge Production

Year	Dry Metric Tons	Wet Tons	% Solids	% Volatile Solids
2010	1821.3	9159		
2011	1335.6	7474.7		
2012	1484.6	7439.9	22.2	77.2
2013	1443.7	7235.3	23.6	75
2014	1428	7426.5	22.3	76.1
2015	1368.8	7942.6	21.78	75.68
2016	1595	7451.6	21.54	77.8
2017	1445.5	7344.3	21.34	75.29

New belt press installed in 2015.

APPENDIX B

NYCDEC SLUDGE STABILIZATION MEMORANDUM

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

Policy DMM-SW-03-14 Sludge Stabilization for Disposal in NY Landfills

I. Summary:

This Program Policy (Policy) provides the criteria that are to be used to determine if a sludge has been stabilized as required for disposal in a landfill.

II. Policy:

It is the policy of the Division of Materials Management (DMM) that sludge that is disposed in a municipal solid waste landfill in New York State meet one of the following criteria:

1. The sludge is either digested or lime stabilized. If lime is used, sufficient lime must be added to raise the pH of the sludge to 12 for at least 30 minutes. The level of treatment does not have to be equivalent to Class B pathogen reduction, but must be adequate to reasonably prevent nuisance conditions and provide some pathogen reduction.
2. For a sewage treatment plant (STP) that has a biosolids treatment process other than digestion or lime stabilization, the STP must be able to demonstrate compliance with one of the following criteria. (Note: These criteria can also be used for an STP with digestion, during periods when the digester is not operating normally; e.g., plant upset, etc.)

   a. The mass of volatile solids in the sludge is reduced by a minimum of 38 percent.
   b. For sludge treated in an aerobic process, the specific oxygen uptake rate (SOUR) is equal to or less than 1.5 milligrams of oxygen per hour per gram of total solids (dry weight basis), at a temperature of 20 degrees Celsius.
   c. The sludge is composted for a minimum of 14 days. Throughout that treatment time, the temperature of the sludge must remain higher than 40 degrees Celsius, and the average temperature of the sludge must be higher than 45 degrees Celsius.
   d. The percent solids of the sludge is equal to or greater than 75 percent.
3. Based on Department experience and/or judgement, Regional staff have determined that a sludge source is acceptable for the particular landfill.

NOTE: If a landfill has a special permit condition that is more stringent than this guidance, the permit condition must be followed. As in the case of disposal of any solid waste, it is the landfill operator's final discretion as to whether the facility will accept a specific load of sludge for disposal.

III. Purpose and Background:

The purpose of the Policy is to provide more specific technical criteria for the 6 NYCRR Part 360 definition of "stabilized sludge." The definition of stabilized sludge in Part 360 is somewhat vague which has led to differing interpretations across the state.

Subdivision 360-2.17(n) requires that all sludges, including publicly-owned treatment work sludges and septage authorized by the Department for disposal in landfills, must first be stabilized and dewatered to 20 percent solids with no free liquid evident in the dewatered sludge. "Stabilized sludge," as defined in paragraph 360-1.2(b)(162), "means sludge that has been digested or otherwise treated to reduce putrescibility and odor, reduce pathogenic organisms and, except for lime stabilization, reduce the volatile solids content."

The technical criteria included in this Policy are taken from the vector attraction reduction standards found in federal 40 CFR Part 503, Standards for the Use or Disposal of Sewage Sludge, and more specifically define the intent of the definition of stabilized sludge that appears in paragraph 360-1.2(b)(162).

IV. Responsibility:

Responsibility for the interpretation and update of this Policy document resides with the Bureau of Permitting and Planning within the Division of Materials Management. The Bureau of Permitting and Planning can provide guidance concerning testing frequency and method, if needed.

V. Procedure:

The criteria contained in this Policy will be used to determine if a sludge is stabilized for the purpose of disposal in a landfill.

APPENDIX C

SOLID WASTE DISPOSAL ARTICLES

WASTE**DIVE**

BRIEF

Report: Average landfill tip fees up 3.5% so far this year

By **Cole Rosengren** • July 12, 2017

Dive Brief:

- The average landfill tip fee in the U.S. increased to $50.60 as of May, up 3.5% from the end of 2016, according to new analysis from Waste Business Journal.
- Landfills in the Northeast remained the most expensive at $79.30, followed by $57.90 in the Pacific, $52.70 in the Midwest, $43.60 in the Southeast and $35.70 in the West.
- The largest increases occurred in the Midwest and the Southeast, by 8.9% and 6.6% respectively, due in part to their continued popularity as export destinations for the Northeast.

Dive Insight:

According to Waste Business Journal's ongoing surveys of nearly 2,000 landfills around the country, average tip fees have increased by 16.9% since 2010. This increase comes as landfill volumes reportedly dropped by 0.7% since the end of 2016. James Thompson, principal of Waste Business Journal, believes this decline is likely temporary or seasonal rather than part of a larger trend. Overall, he said that increased volumes from population growth have been balanced out by trends in the recycling stream including less paper and more lightweight plastics.

Thompson told Waste Dive that his team has also noticed increasing export volumes from the Northeast as landfills become more expensive or close entirely. The latest annual report from the Massachusetts Department of Environmental Protection showed an increase in export volumes for 2015 and projected that the state could potentially be left with only one landfill by 2021. Waste-to-energy combustion remain a common alternative in many Northeastern states, though Thompson said that in many cases those plants are already near capacity. In some cases, he said, it can also be less expensive for municipalities to pay export costs rather than tip fees at these facilities. One key factor in this equation is low energy prices, which have reduced revenue opportunities for some WTE operators. This was part of the inspiration behind a new law in Connecticut intended to improve the state's renewable energy credit market for WTE.

As for the states on the receiving end of all this waste — such as Virginia, Ohio, South Carolina, Kentucky, Michigan, Pennsylvania, and others — Thompson said the financial incentives often outweigh community concerns. As seen last year with a decision by Kentucky's Big Run Landfill to stop accepting out-of-state waste this isn't always the case, but in many instances these host community benefits can make up a sizable portion of local budgets. The latest annual report from Virginia's Department of Environmental Quality showed that imports increased by nearly 14% in 2016, driven partially by changing coal ash regulations in other states, and that could increase once Waste Management begins exporting material from New York under a new long-term contract.

Recommended Reading:

Waste Business Journal

The Cost to Landfill MSW Continues to Rise Despite Soft Demand

SWEEP

The Cost to Landfill MSW in the US Continues to Rise Despite Soft Demand

The cost to Landfill MSW Continues to Rise Despite Soft Demand

Date: July 11, 2017

Source: Waste Business Journal

The cost to Landfill MSW Continues to Rise Despite Soft Demand

The average price to dispose municipal solid waste (MSW) has edged up to $50.60 per ton last month, up about 3.5% over the average price in 2016. The price continues to rise despite relatively flat to slightly declining landfill volumes. The rising price reflects pricing discipline among the major waste management firms and is reflective of ever more precious landfill capacity in a society that loathes and often protests their presence.

This is according to **Waste Business Journal**'s latest industry report which includes data through May 2017. These statistics are gathered through direct survey of the landfills themselves.

The 0.7% decline in landfilled MSW since last year is remarkable since the waste we generate as a society tends to increase with population growth. The primary cause is lower generation of waste paper, the largest component at 27% of the waste stream as digital media supplants printed material. Between 2000 and 2016, the volume of paper and paperboard Americans have sent to facilities has dropped 25%, even more so for landfills as recycling diverts ever more paper away from them.

Offsetting declines in waste paper are ever increasing volumes of some other waste types, especially plastic waste whose volume has increased nearly 30% in that time period but which weighs much less than paper. These changing material ratios, what the industry calls an "evolving ton", have led to higher processing costs for recyclers, as they have to process larger volumes of waste through their facilities to yield each one-ton bale of raw material.

Nonetheless, landfill pricing remains strong, but varies among regions. The biggest gains are in the Southeast at 8.9% year over year and the Midwest at 6.8% year over year price increases. This trend evidences the Southeast and Midwest as the preeminent destinations for waste exported from the Northeast. Consequently, landfill pricing in the Northeast grew only 2% since last year as it landfills less of its own waste.

The Average Price to Landfill a Ton of MSW by Region and Year

	2010	2011	2012	2013	2014	2015	2016	2017*	% Change
Northeast	$69.0	$69.3	$72.9	$74.9	$76.1	$77.0	$77.8	$79.3	2.0%
Southeast	$38.1	$38.2	$39.3	$39.8	$40.2	$40.4	$40.9	$43.6	6.8%
Midwest	$44.0	$44.0	$45.9	$46.2	$47.2	$47.6	$48.4	$52.7	8.9%
Western	$30.3	$30.4	$33.3	$34.0	$34.4	$34.4	$34.8	$35.7	2.6%
Pacific	$50.5	$51.8	$54.0	$55.3	$56.7	$56.8	$57.2	$57.9	1.2%
Entire US	**$43.3**	**$43.5**	**$45.9**	**$46.8**	**$47.6**	**$48.1**	**$48.8**	**$50.6**	**3.6%**

* As of May 2017

*Source: **Waste Business Journal***

APPENDIX D

SCHWING PUMP REPLACEMENT PROPOSAL

SCHWING BIOSET

350 SMC DRIVE
SOMERSET, WI 54025
PH: (715) 247-3433
FAX: (715) 247-3438
WWW.SCHWINGBIOSET.COM

March 29, 2018

Auburn WWTP
35 Bradley St
Auburn, NY 13021

Attention: Mr. Tim Carpenter – MRB Syracuse

Subject: Schwing Bioset, Inc. Quotation No. 2018113
Pump and Replacement Hydraulic Power Unit

Schwing Bioset, Inc. is pleased to propose the following as our scope of supply for the project referenced above.

PISTON PUMP

Quantity:	One (1)
Model:	KSP 17 V(HD)
Diameter of Pumping Cylinder	5.91 inches (150 mm)
Hydraulic Cylinder Diameter	4.92 inches (125 mm)
Cylinder Ratio	1.44
Suction Poppet Opening	4.92 inches (125 mm)
Discharge Pressure Poppet	5.91 inches (150 mm)
Cylinder Stroke Length	39.4 inches (1000 mm)

Scope includes:

1. The Sludge Pump shall be equipped with a 4-inch discharge flange.
2. The pump water box shall have 1-inch connections for water supply and 1-1/2" connections for overflow and drain lines. Water lines and valves shall be supplied by others.
3. Casters for maintenance shall be furnished.
4. Local maintenance panel shall be furnished, mounted on the Sludge Pump, wiring by others. The panel includes MAINTENANCE MODE ON / OFF switch, FORWARD / OFF / REVERSE switch, PUMP JOG pushbutton, and E-STOP pushbutton. The installing contractor shall be responsible for field wiring between the between the Local Maintenance Panel and the existing Pump Control Panel.

SLUDGE FLOW MEASURING SYSTEM (SFMS)

1. Schwing Bioset's Sludge Flow Measuring System (SFMS) shall be supplied.
   - The SFMS shall calculate and record the cylinder filling efficiency (%), instantaneous pumping rate (GALLONS/MIN), and total accumulated pumped volume for previous 24

hours (GALLONS) to an accuracy of +/-5%, in accordance with USEPA 40 CFR Part 60 and Part 503 regulations.
- These values shall be displayed at the Sludge Pump Control Panel.

2. If calibration of the SFMS is required for regulatory approval, others shall be responsible for coordination and all associated material and labor costs.
   - For SFMS calibration testing, sludge cake is typically pumped into a container (truck, dumpster, etc.) for a set period of time, and weighed using a certified scale.
   - During the test run, the SFMS measures the total volume pumped. Bulk density of the sludge cake is input into the PLC. The SFMS and scale results are then compared.
   - Specific requirements for regulatory approval may vary based on local, state, and federal statutes.
   - A Schwing Bioset field service technician can be made available to supervise SFMS calibration. This service is **not included** in this quotation, and may be purchased separately at standard rates.

HYDRAULIC POWER UNIT

Quantity:	One (1)
Model:	440-60HP
Motor horsepower:	60 horsepower
Reservoir size:	115 Gallon
Hydraulic pump for KSP 17 V(HD):	A11VO130EP
Hydraulic pump for SD 350:	A11VO40EP
Electrical service:	480 volt, 3 phase, 60 hertz

Scope includes:
1. Rexroth axial piston pumps shall be supplied to drive the separate hydraulic circuits for the Sludge Pump and Screw Feeder.
2. Recirculating hydraulic oil conditioning loop shall include the following:
   - A constant volume hydraulic pump.
   - Conditioning oil filter.
   - Water – Oil Cooler
3. Premium efficient, TEFC motor shall be supplied.
4. Power Unit shall include initial fill of oil, pressure gauge, pressure switch, relief valves, clean-out cover, and combination temperature and sight gauges.
5. Hydraulic hoses to connect hydraulic unit to existing hydraulic tubing lines.
6. Concrete pad modifications and new anchor bolts by others. Frame dimension have changed an do NOT match existing.

SLUDGE PUMP CONTROLS

Quantity:	One (1)
Electrical Service:	480 Volt / 3 Phase / 60 Hertz

Scope includes:

1. Panel shall be NEMA 4X, 304 SS, panel shall be factory mounted to the HPU.
2. Allen Bradley CompactLogix PLC shall be used to control all panel functions.
3. Schwing Bioset standard Allen-Bradley HMI shall be included in lieu of existing input and output devices. E-stop, power indication, fault reset, annunciator, and beacon shall be supplied on the panel.
4. Motor starters for new HPU, and existing 7.5 & 3HP conveyors included in separate enclosure mounted on non-motor end of HPU. I/O shall be included to connect to the existing four (4) Livebottom VFDs to be consistent with existing control.
5. Panel controls Hydraulic Power unit, Sludge Pump, and Screw Feeder.

SPARE PARTS

No spare parts are included with this quotation.

Exclusions:

- Installation or supply of any equipment not specifically mentioned in this proposal is excluded.

FIELD SERVICE

Schwing Bioset shall provide a trained service technician as follows:
The service technician shall be made available for Eight (8) days over Two (2) trips.

If required, additional service may be purchased at the prevailing rates at the time service is performed. Current service rates are as follows:

- US $137.00 per hour – standard eight (8) hour day.
- US $205.50 per hour – overtime (over and above the standard eight (8) hour day.)
- US $274.00 per hour – Sundays and holidays.
- Travel and per diem (i.e., hotel, food, car) expenses at cost + 15%.

PAINTING

Schwing Bioset primer and finish coatings shall be factory applied as follows, **unless otherwise noted above**. Stainless steel surfaces shall not be painted.

Equipment:

- Surface Preparation – Sandblast SSPC-SP6.
- 1st Coat – Tnemec N140F Pota-Pox Plus Epoxy 2-3 mils DFT
- 2nd Coat – Tnemec N69 Hi-Build Epoxoline II, 3-5 mils DFT
- 3rd Coat – Tnemec N69 Hi-Build Epoxoline II, 3-5 mils DFT.

All field touch-up painting of equipment shall be performed by installing contractor.

COMPLETE SCOPE OF SUPPLY SUMMARY

Piston Pump KSP 17 V(HD)	One (1)
Hydraulic Power Unit 440 / 60 HP	One (1)
Control Panel	One (1)
Spare Parts	none
Field Service	One (1) lot

Total price for the above listed scope of supply.. **$ 184,300.00**

All prices are quoted:
DDP Job Site
Price is Valid for Sixty Days.

TERMS

20% with purchase order.
20% upon approval of submittals, net 30 days.
55% upon shipment, net 30 days.
5% upon final acceptance, not to exceed 90 days from delivery.

Payment terms offered are subject to final credit approval

SUBMITTALS

Eight (8) to ten (10) weeks after receipt of approved order.

O & M MANUALS

Two (2) electronic and Two (2) hard copies shall be furnished.

DELIVERY

Eighteen (18) to twenty-four (24) weeks after receipt of approved submittals.

EQUIPMENT AND SERVICES TO BE PROVIDED BY OTHERS

1. Electrical, Plumbing, and Mechanical Installation of the Schwing Bioset, Inc. (SBI) supplied equipment.
2. Storage of equipment and/or costs for long-term storage (longer than 3 months).
3. Racks, trays or supports for control wiring.

APPENDIX E

TUBULAR DRAG CONVEYOR PROPOSAL

Mr. Tim Carpenter, P.E.
Project Manager
MRB GROUP
220 Salina Meadows Parkway #180
Syracuse, NY 13212

Cell: 315-350-8125
Email: tcarpenter@mrbgroup.com

Performantee®
Designed for you – guaranteed.

Mr. Carpenter:

Thank you for the opportunity to submit our proposal for a HAPMAN Tubular Drag Conveyor. In accordance with your request, the following is submitted for your review and consideration.

MATERIAL PARAMETERS

Material:	Belt Filter Press Cake	***Particle Size:***	Fine
		Moisture Content:	70 – 80% Water
Bulk Density:	52 – 58 Lbs/Ft³	***Temperature of Material:***	65° F
Abrasiveness:	Mildly	***Flowability:***	Sluggish
Material Characteristics:	None Known		

CONVEYOR PARAMETERS

Conveyor Size:	4" diameter	***Chain Speed:***	18 Feet/Min
Convey Rate:	1 Ft³/Min	***Conveyor Circuit:***	Z-Style
Voltage Service Available:	480V/3Ph/60Hz	***Operation Characteristics:***	
		Frequency:	Continuous
		Operation:	24 Hours/Day 6 Days/Week

Our proposal is based solely on the information described above, thus our equipment may not perform as expected, if actual circumstances differ. Any information that is incorrect should be communicated to us immediately to avoid misapplication and/or future inconvenience.

In addition to the standard equipment warranty, Hapman provides our exclusive **Performantee®**:

- HAPMAN guarantees equipment we manufacture will achieve specific results for which it was designed.
- Should it not perform as designed, we will revise, repair or make whatever improvements are necessary to satisfy the performance criteria outlined in the application parameters section of our proposal.

Contact Hapman for details on how you can benefit from the Performantee®.

We propose to furnish one (1) **HAPMAN TUBULAR DRAG CONVEYOR SYSTEM** to convey material from Belt Press to two discharge locations that will feed belt conveyors.

The conveyor should be interlocked to the upstream process in such a way as to assure that the conveyor will be running whenever material is being delivered to it. The VFD monitors for a jam condition and will immediately stop the conveyor if one is detected, displaying the corresponding fault code on the VFD module. Likewise, the VFD will monitor for a no-load condition such as if the chain were to derail or break, again displaying the corresponding fault code.

TUBULAR DRAG CONVEYOR

- Flanged inlet with 8" square flanged opening. Stainless steel construction.
- 224 feet of Hapman series #48 stainless steel sealed pin chain with white nitrile washers. Assembled complete with U.H.M.W. polyethylene flights.

  Hapman heavy-duty chains permit routine starting & stopping under fully loaded conditions.
- 220 feet of 4" schedule #40 conveyor casing and slotted round flanges with joint gaskets. Stainless steel construction.

  Pipe flanges are offset on pipe ends to create male-female joints. Male pipe ends point in the direction of chain movement through the installed circuit. Each flange is match-marked to coincide with the joint identification specified on general arrangement drawings to facilitate ease of assembly beginning and ending at the conveyor's drive box.
- Three (3) 4" schedule #40, 90° bends. Stainless steel construction.
- Drive Box (90 degrees) complete with inlet tube, outlet tube, and flight guides. Includes removable sprocket cover. Stainless steel construction.
- Drive Plate Assembly consisting of a drive plate with a high efficiency, right-angle bevel gear reducer, driven by a 3 HP, TEFC motor. Stainless steel construction.
- Lower 180° Idler Box with bearings and idler sprocket. Includes conveyor chain take-up. Stainless steel construction.
- Upper 180° Idler Box with bearings and idler sprocket. Includes discharge transition with 8" diameter outlet. Stainless steel construction.
- Discharge Gate. Includes solenoid and position switches. Includes discharge transition with 8" diameter outlet. Stainless steel construction.

  Unique gate design precisely fits the profile of the convey pipe in the closed position so as to preclude any void that would otherwise cause material to accumulate.
- Two (2) chain vibrators with ⅓ HP, TEFC motors. Mounted at conveyor discharges to enhance release of material from the conveyor chain and minimize carry back. Stainless steel construction.
- Two (2) inspection openings for chain installation and inspection. Stainless steel construction.

CONTROL PANEL

- NEMA 4 enclosure.
- Disconnect w/ fusing.
- *Yaskawa* VFD for 3 HP tubular conveyor drive motor.
    - VFD provides electronic shear pin and monitors for no load condition.
- Two (2) IEC non-rev. contactor & OL for ⅓ HP chain vibrator motors.
- 150 VA control transformer.
- MANUAL / OFF / AUTO selector switch (discrete enable from remote PLC by others).
- Green START pushbutton.
- Red STOP pushbutton.
- Black REVERSE JOG pushbutton (works only in "maintenance" mode).
- Green ON pilot light.
- Ships loose for field location and wiring by others.

MISCELLANEOUS

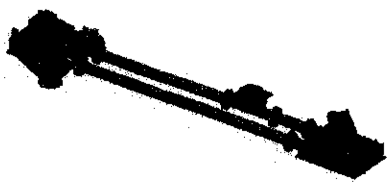
- Major components are set up, chain is installed and the conveyor is test run prior to shipment (some long straight sections of pipe may be omitted from the circuit due to space limitations).
- Requires #304 stainless steel on all metallic, material contact surfaces.
- All external hardware will be zinc plated carbon steel.
- All gaskets will be white nitrile.
- Approval drawings showing general equipment layout with dimensions
- Two (2) copies of maintenance, installation and operation manuals.

YOUR NET PRICE.. $115,100

Plus – Sales Tax (if applicable)
Many states require that we collect state sales tax. Your state <u>sales tax exemption certificate</u> is required or sales tax must be added to the above price.

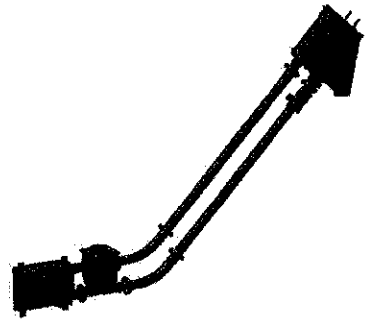
NOTES

- When controls are not desired as part of our offering, it is imperative that an electronic shear pin type feature be included in the controls to protect the machine from failure. Not including a Hapman approved control system inclusive of this capability will void equipment warranty.
- Most applications require that the tubular drag conveyor be meter fed in such a way as not to exceed an 80% fill between flights. Whether by rotary valve or other means, reliable performance cannot be guaranteed without such provision.
- It is the intent of our offer to meet all requirements put forth in the purchaser's bid documents. However, where our proposal appears to differ, this document shall supersede. We reserve the right to make component substitutions and amend our pricing where necessary to bring this proposal into compliance with the purchaser's actual requirements.
- Materials of construction specified herein are offered in accordance with the purchaser's request and approval. While we make every effort to understand the corrosive potential of the material to be conveyed, Hapman defers to the purchaser's intimate knowledge of their particular material, experience handling it as well as any process conditions that may have a mitigating or exacerbating influence.

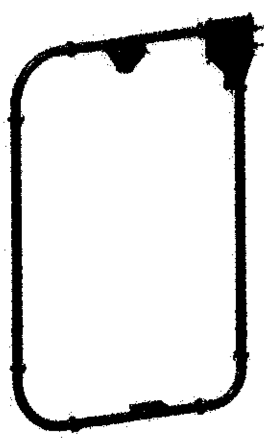


Straight Horizontal

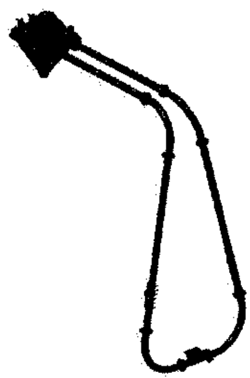
Straight Inclined



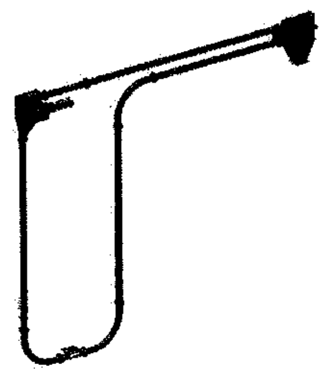
L-Style



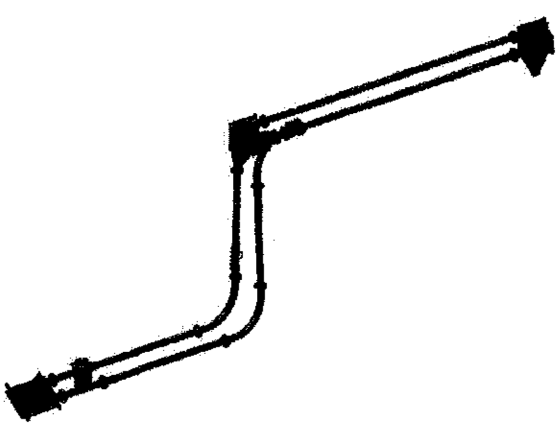
Square Loop



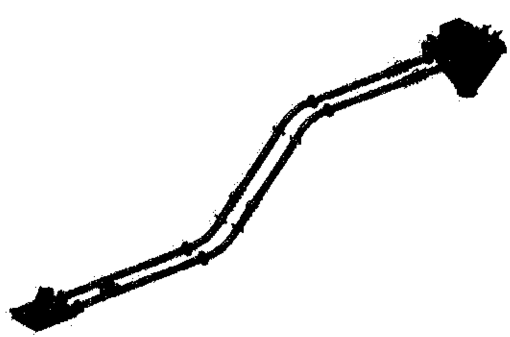
Bulb Loop with Gooseneck



Square Loop with Gooseneck



Z-Style



Lazy Z-Style

HAPMAN
Ideas that move.

Please note: These are common configurations only. Additional options and sizes available.

APPENDIX F

PROGRESSIVE CAVITY PUMP PROPOSAL

Shrier-Martin Process Equipment
PO BOX 368 - 1355 PITTSFORD-MENDON RD - MENDON, NY 14506 ph. 585-624-4490

March 24, 2018

Mr. Tim Carpenter
MRB Engineers
220 Salina Meadows
Suite 180
Syracuse, NY 13212

Sub: Auburn WWTP
Cake Transfer Pump

Tim –

Appreciate both your time on the phone earlier this week & the opportunity to offer the following:

Sizing is based on 2700 pounds per hour of 30% cake solids in a 6" diameter line with 35 ft of static head & an equivalent length of 120 ft.

NOV Moyno: 4E102G3M10CDQ3AAA

- Four stage Progressive Cavity Pump
- Rated for 10 gpm @ 100 rpm
- 16" x 25" Suction Housing
- Carbon Steel Bridge Breaker with 3 hp TEFC 230 / 460 v Motor
- Ribbon Auger
- Cast Iron Housing
- Nitrile Stator
- Chrome Plated Alloy Steel Rotor
- Sealed Crown Gear Universal Joint on the Connecting Rod
- 4" ANSI Discharge Flange
- Braided Teflon / Graphite Impregnated Packing
- 10 hp Gear Motor / TEFC 230-460 volt
- Carbon Steel Baseplate

Budget price for the above is $37,000. Delivery is about 12 weeks after drawing approval.

Please Note:

1. Have review the sizing with the factory & they strongly suggest the Bridge Breaker (G3 Design). If you wish to eliminate the Bridge Breaker & use only the Open Throat (G2 Design), the deduct is approximately $10,000.

2. We did not offer an EZ Strip as it is not available with a Bridge Breaker.

If favored with your purchase order, PLEASE MAKE IT OUT TO:

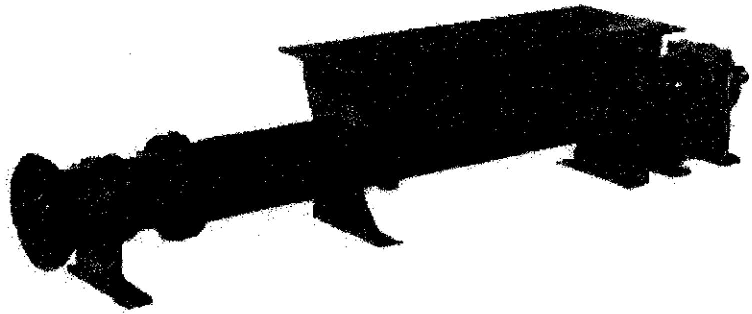
Shrier-Martin Process Equipment
PO Box 368
Mendon, NY 14506

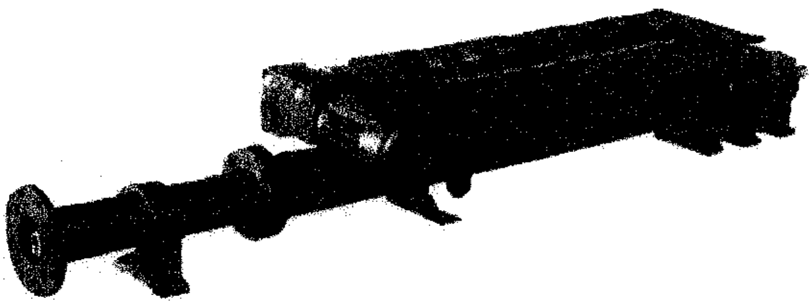
Pricing:	Valid for 30 days
Terms:	Net 30 days
Freight:	FOB Factory, freight charges prepaid & added to invoice

Thank you for your interest in SHRIER-MARTIN PROCESS EQUIPMENT. If you have any questions, please call me at 585 738-7733.

Best Regards,

Jim Coyne
Sales Engineer
phone: 585 624 4490
fax: 585 624 5373
cell: 585 738-7733
jcoyne@smpe.com





Moyno® 2000 G2 Pumps

The Moyno® 2000 G2 Pump is a versatile, high-performance pump featuring a wide, open throat hopper design that minimizes plugging that could occur in a

standard inlet. A single auger feed mechanism ensures positive prod- uct feed into the pumping elements for increased fill efficiency when handling semi-dry or high solids content sludges.

The Moyno 2000 G2 also features Moyno's crown gear-type universal joint drive train and optimized rotor/stator pumping element geometry.

Moyno® 2000 G3 Pumps

The Moyno® 2000 G3 Pump is ideally suited for handling semi-dry, high solids content fluids that have a tendency to "bridge" in the inlet hopper. Featuring a series of finger mechanisms mounted on two counter-rotating shafts positioned

APPENDIX G

SLUDGE DRYER PROPOSAL

GRYPHON
environmental, LLC
Advanced Drying Technology

Made In the U.S.A.

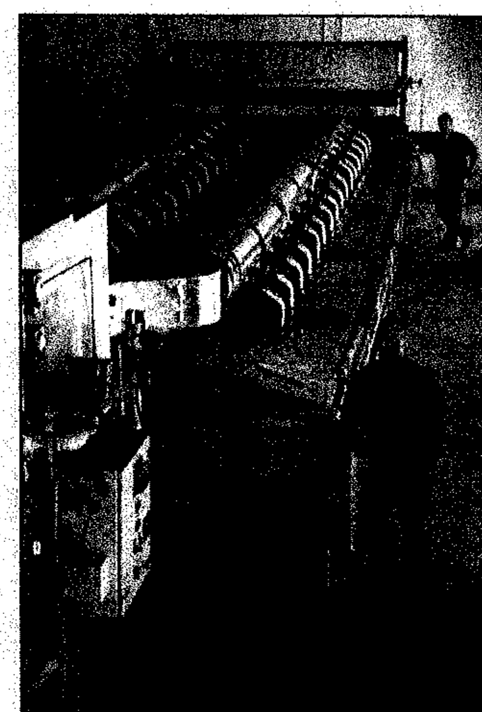
Proposal # AUB-1020-050418-V1

City of Auburn, NY
Biosolids Dryer

Location: Water Pollution Control Plant
35 Bradley St.
Auburn, NY 13021

Engineering Firm: MRB Group
Manufacturer's Rep: Koester & Associates, Gregg Palmer

Capital Equipment, Design, Installation, Training & Commissioning of a Gryphon Model 1020 Drying Unit Utilizing Natural Gas for Thermal Drying



Gryphon Environmental, LLC
2920 Fairview Drive
Owensboro, KY 42303
Contact: Tid Griffin, CEO (270) 485-2680
Manufacturer's Representatives: Koester & Associates; Gregg Palmer

AUTO-ADJUSTING, MODEL 1020 DRYER WITH AUTOMATED CLEANING, CERAMIC/TEFLON INJECTION PLATES, NATURAL GAS BURNER, ROCKWELL CONTROLS, UPGRADED BLOWER, PRE / POST-PROCESS SENSORS, AUTOMATED TREND MONITORING, LID LIFTING ASSEMBLY, INFEED SIFTER, COOLING TOWER AND RE-CIRCULATING AIR STREAM

INSTALLED AND OPERATIONAL WITH ONE-YEAR WARRANTY

2.0 DRYER INSTALLATION

2.1 Pricing – Capital Equipment, Installation, Training & Commissioning

Capital Equipment Purchase Price

Line Item	QTY.	Description	Unit Price	Total
1	1	Gryphon MODEL 1020 Dryer Unit	$1,198,414	$1,198,414
	1	Controls/Automation System - Rockwell		
	1	304 SS Upgrade to Burner Interior		
	1	480 Volt, 3PH Power Disconnect and Assembly		
	1	304 SS Upgrade to blower interior		
	1	SS 304 Pre-Heat Internal Tubing for Return Air		
	1	Automated Belt Tracking System		
	1	PLC Design for Infeed Monitoring and Feed Regulation		
	1	Dryer Conveyor Package (Motors, High Temp PPS Belting)		
	1	Dryer Insulation Blanket (Includes Heated Ducting Insulation)		
	1	Complete Thermal Monitoring and Automation Software		
	1	High Pressure, Automated Belt Washing Station (Model 10)		
	1	304 SS Ductwork Upgrade - All Ducting (exclude Transitions)		
	1	304 SS Ductwork Upgrade - Transitions		
	1	Maintenance-Free Bearings Option (all bearings)		
	1	Automated Washing System (internal chambers)		
	1	Solenoid Stand and Assembly		
	1	Low Pressure/High Volume Blower Units		
	1	Standard Safety Guards and E-Stop Package		
	1	SS 304 Exit Table Hood Assembly (Model 10)		
	1	Automated Lid Lift and Safety Assembly		
	1	10 foot Material Sifter Assembly		
	1	Moisture Sensor for PLC Feedback (Dried residuals discharge)		
	1	In-let Residuals, Single Temperature Sensor - PLC Feedback Loop		
	1	Exit Residuals, Dual Temperature Sensor - PLC Feedback Loop		
	1	Dual Brush Leveling Kit (Model 10)		
	1	Additional 120V power disconnect for HMI "on" during lock-out		
	1	Trend-monitoring package and development of customized reporting		
2	1	Ceramic/Teflon Coating on Injection Plates	included	
	1	- Cleaning Tool for lid injection place surfaces		
3-A	1	Gryphon Re-Circulating Air Stream Assembly (Condenser)	included	
	1	304 SS Coil/ Aluminum Fins with 304 SS Casing		
	1	Automated, Redundant, Condensate Removal Switch and Pump		
	1	Differential Pressure Switch - w/ Transmitter		
	1	"Slide-In" and "Slide-Out" Filters for Ease of Maintenance		
	1	Roll-out Exchanger Coil Assembly		

	1	304 SS, 49 micron Condenser Filter Assemblies	
	1	304 SS, 49 micron Condenser Filter Assemblies (SPARE)	
3-B	1	~750 GPM Cooling Tower (cold water re-circ.)	included
	1	~750 GPM pump skid	
	1	Pump skid, valves and flange mounts	
	1	Carbon steel (painted) frame - if required	
	1	Winterization Kit – Online and Offline kits for cold water supply lines	
		3-B EXCLUDES PIPING TO AND FROM CONDENSER/COOLING TOWER	
4	1	Controls Design - Site Specific	included
	1	Controls Design - For Site Specific HMI Design as per client protocols	
	1	Field Controls Design Services	
5	1	In-Line Natural gas burner	included
	1	~2.0-5.0 MMBTUH In-line Natural gas burner	
	1	304 SS (as per above) upgrade to valve train and interior	
	1	Controls and Feedback Package	
	1	Skid Mounting Assembly	
		TOTAL CAPITAL PURCHASE PRICE	$1,198,414

APPENDIX H

AEROBIC DIGESTER PROPOSAL

Thermal Process Systems

March 29, 2018

Tim Carpenter, P.E.
MRB Group
220 Salina Meadows Parkway #180
Syracuse NY 13212

Thermal Process Systems is pleased to offer the following proposal for the solids handling for your budgetary ATAD estimate based on the information provided by you. Note that TPS supplies only quality equipment and state-of-the-art technology in its patented ThermAer process. Please find attached the following:

- This Letter of Transmittal;
- ThermAer™ Budget Proposal;
- ThermAer™ Applications Reports;
- Thermal Process Systems' ThermAer™ Brochure;
- Thermal Process Systems' BiofiltAer™ Biofiltration Brochure; and
- Thermal Process Systems' Terms and Conditions.

We look forward to working with you on this project. Please feel free to contact me with questions and/or comments at (315) 440-9750 or by email ehaslam@thermalprocess.com.

Sincerely,

Eric Haslam

Eric Haslam, P.E.
Cc: Gregg Palmer, Koester Associates

Thermal Process Systems provides process and design engineering and design support to the design engineer. Technical instructions for the ThermAer unit, start-up, as well as, operation and maintenance are also included. Thermal Process Systems' personnel will be there every step of the way to ensure a smooth transition to the **ThermAer™** process operation, from initial training and information sessions, access to design data, assistance in permitting, equipment shakedown, startup, operation, and trouble shooting.

Provide ThermAer™ treatment for Class A solids

Proposed design average daily loading of 10,000 lb/day of sludge material loaded on a 7 day work week.

ThermAer Package

Sludge Type	
Primary and Secondary	10,000 ppd average design 7-day/week
Number of ThermAer Reactors	1
Number of SNDR Reactors	1
%TS Average	~5%
%TS Range	4 - 6%
%VS	78%

ThermAer Reactor Sizing

One new concrete tank – 70 ft. x 30 ft. x 24 ft deep, with a proposed SWD of ~18 ft. (By contractor)

One (1) ThermAer Reactor complete with:

1) One (1) 150 HP, 54-20 ThermAer jet motive pump.
2) One (1) 75 HP positive displacement blower.
3) Four (4) Foam control SplashCone™ with assemblies.
4) One (1) in-basin FRP piping for the ThermAer systems including the 20" liquid and 8" air jet aeration system header with 16 nozzles, pipe supports, connection hardware and anchor bolts for this piping.
5) One (1) Radar foam level sensor.
6) One (1) ORP probe and analyzer with temperature readout.
7) One (1) Vacuum gauge sensor.
8) One (1) Liquid level sensor with local readout.

SNDR Reactor Sizing

One new concrete tank – 70 ft. x 30 ft. x 24 ft deep, with a proposed SWD of ~18 ft. (By contractor)

One (1) SNDR Reactor complete with:

1) One (1) 60 HP, 52-16 SNDR jet motive pump.
2) One (1) 25 HP positive displacement blower.
3) Three (3) Foam control SplashCone™ with assemblies.
4) One (1) in-basin FRP piping for the ThermAer systems including the 16" liquid and 8" air jet aeration system header with 10 nozzles, pipe supports, connection hardware and anchor bolts for this piping.
5) One (1) Radar foam level sensor.
6) One (1) ORP/pH probe and analyzer with temperature readout.
7) One (1) Liquid level sensor with local readout.

Additional Equipment
1) One (1) 75 HP positive displacement blower. (Spare)
2) One (1) 3" Magnetic flow meter and transmitter for feed control and monitoring.
3) One (1) 4" Magnetic flow meter and transmitter for intra-process control and monitoring.
4) One (1) Heat Exchanger.
5) Two (2) 15 HP Transfer pumps.
6) Three (3) 4" Actuated Plug valves.
7) Three (3) 6" Actuated Plug valves.
8) One (1) Pre-wired control panel complete with PLC, and system programming.
9) One (1) Battery backup system.

Included Spare Parts
1) One (1) ORP/pH Probe.
2) One (1) Blower Filter.
3) Four (4) Spare Belts one (1) set per pump/blower size.

BiofiltAer Odor Control Unit
One new concrete Biofilter tank – 40 ft. x 24 ft. x 10 ft. deep (By others)

One (1) Biofilters each complete with:
1) One (1) 25 HP 8,000 SCFM @ 9" WC Fan.
2) One (1) Scrubber Unit.
3) One (1) Aluminum Biofilter Cover.
4) One (1) Lot, Biofilter plenum for even air flow distribution.
5) One (1) Lot, inorganic Biofilter media.
6) One (1) Lot, organic Biofilter media.
7) One (1) RTD temperature sensor.
8) One (1) Biofilter instrument cabinet.

ThermAer™ Base Proposal Package Pricing **$1,810,632.00**

Optional Electrical Package MCC/VFDs

MCC mounting arrangement with Allen Bradley 6 pulse VFDs.

1) One (1) ThermAer Jet Motive Pumps 150 HP VFD.
2) One (1) ThermAer PD blowers 75 HP VFD.
3) One (1) SNDR Jet Motive Pump 60 HP VFD.
4) One (1) SNDR PD blower 25 HP VFD.
5) One (1) Spare PD blower 75 HP VFD.
6) Two (2) Transfer Pumps 15 HP VFD.
7) One (1) Off Gas Fan 25 HP VFD.
8) One (1) 120/240 VAC Lighting Panel w/ 10 – 20 Amp Breakers.
9) One (1) Control Panel Power Monitor.
10) One (1) Control Panel Transformer.
11) One (1) Main Disconnect.

Optional Electrical Proposal Package Pricing **$311,104.00**