CH2MHILL
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MEMORANDUM

TO: Patrick Pahl, Chairman, Water Sewer Committee

FROM: Scott Blair, Project Manager, CH2M HILL OMI

DATE: March 23, 2009

COPY: Septage Finance Committee

SUBJECT: Evaluation of Options to Improve Financial Condition of the Septage Treatment Facility

Committees and individuals concerned with improving the financial circumstances of the Septage Facility have raised and discussed a range of ideas. Plante Moran and URS put forth a list of recommendations in their report titled *The Grand Traverse County Septage Treatment Facility Financial and Operations Analysis*. And, CH2M HILL OMI has some additional ideas on optimization of the facility that we would like to offer for consideration.

The sheer number and variety of suggestions and options almost becomes an obstacle. Simple efficiency improvements are contemplated right along with potentially visionary but undeveloped concepts. Some options are exclusive of others. I think CH2M HILL OMI can be useful to the Water and Sewer Committee in sorting out and ranking the many ideas and recommendations.

My comments in this memo pertain to technical and operational issues, and thus to the subject of cost savings. We have less to say about the revenue side of the financial health equation. To begin to make the set of technical /operational ideas manageable, I have divided them into three categories:

1) What we are doing now to minimize cost
2) Measures that could be implemented with moderate investment
3) Big-picture conceptual ideas.

There is an elephant in the room I might as well mention. As CH2M HILL OMI, plainly, I have an interest and a stake in how you regard the value we bring to your septage treatment operation. While perhaps not from a perfectly disinterested perspective, I nonetheless give you the following information just as I see it. I am providing for the committee's use, a CH2M HILL OMI view on each of the three categories of actions listed above. I would be pleased to discuss them further at any time convenient or at meetings of the Septage Finance Committee.

1) What we are doing now?

The current financial condition of the septage treatment program naturally causes people to look closely at the efficiency with which the plant is operated. I need to make clear to this committee, and all the stakeholders in the septage program, that you are doing very well in this regard. Given the loadings actually received, and the plant as actually constructed, operational costs are very nearly as low as they can be without making plant modifications (which I address in the next sections of this memo). Where there are opportunities to increase efficiency, we are perusing them creatively and energetically.

Below, I bullet-list some of circumstances of our contract, and actions we are taking, that are the means by which you can know that the operational cost for your Septage Facility is as low as it can be at present.

- **Shared Resources** - The septage plant operation benefits from integration with the operation of the regional plant. The two plants share the functions of laboratory, maintenance, administration, biosolids, IPP, and safety program. As a stand-alone operation, the septage plant would be more expensive to operate, either through higher costs to directly staff and equip it or through greater use of outside services. The efficiencies of sharing these functions are currently reflected in the cost to operate the septage plant. The management of the two plants as one system also avoids some regulatory complications in biosolids handling and the Industrial Pretreatment Program.

- **Advantageous Contract Terms** - The contract terms with CH2M HILL OMI for operation of the facility are advantageous to the septage program's stakeholders. Some of the financial challenges were beginning to emerge at the time that scope and fee were first negotiated; the annual cost to operate appeared to be higher than the County anticipated. It was plain that we needed to offer every possible mechanism to ensure the county received value. We negotiated with an open book, revealing all assumptions used in our cost model and seeking concurrence from the facility's design engineers that each assumption was reasonable. We then applied a below-market margin and agreed to language that provides for an ***annual rebate to the County of 100% of any amount by which actual direct costs are under the budgeted direct costs***.

- **CH2M HILL OMI Commitment** - CH2M HILL OMI is a partner with the County, committed to long term successes of the septage program. We have provided significant projects to the County that are not part of our work scope without additional fee: We wrote, submitted, and had approved by MDEQ, a Residuals Management Plan that provides for flexibility in biosolids handling (which is allowing us to save County money right now). We designed and executed a testing program to evaluate the septage plant's performance against construction contract criteria. We developed guidelines to assist in finding and evaluating potential special wastes to bring in additional revenue. Following the structural failure, we created a way to continue receiving waste deliveries, at reduced fee, while rebuild was underway. And, when we found a way to reduce cost further, we rebated additional money while under no obligation to do so.

- **Electrical Consumption Management** - Our staff takes measurements each day of electrical consumption. We review it for deviation from expected usage. We have determined what percentage of plant electrical consumption is attributed to each unit process and explored whether each process can accomplish its goal with less motor runtime or motor

speed and thus lower electrical consumption. We are also pursuing competitive pricing for providing electricity to the septage plant.

- **Water Consumption Management** – Screens, concentrators, and other processes in the plant use a significant amount of municipal water for sprays, polymer activation, and wash-down. We have performed a water balance on plant service water. That is, we measure water usage by the plant as a whole, and then account for the usage of water in each process at the facility. "In" has to equal "out". This ensures that we have no unrecognized loss of water and that we are using no more than the correct and expected amount in each treatment process. We contemplated using effluent as service water to reduce cost. However, there are two obstacles. First, there are complications related to the fact that Bay Harbor water is mixed into effluent in the post equalization basin, which is the point where we could draw it off for use as service water. Second, there are times when we must divert untreated septage to the post equalization basin and that means there is always a potential to have debris present in the effluent that can clog spray nozzles. We can reevaluate this option of using effluent as service water if circumstances change.

- **Chemical Consumption Management** - Staff has experimented with combinations of polymer and ferric chloride to find ways of lowering the cost of chemicals used for concentrating and dewatering biosolids.

- **Biosolids Optimization** - At the time of the last contract amendment, we added into our scope, the disposal of biosolids (biosolids disposal had initially been a County responsibility). We now optimize the treatment, concentration, and disposal of biosolids together as a single process, to the financial benefit of the County. We stopped running the belt filter press. We are land applying biosolids to farm fields as a liquid. The savings in chemical costs, land fill costs, and labor are significant, and the biosolids are beneficially reused rather than landfilled.

- **Exploring Cost Recovery for Biosolids Hauling** – There is quantifiable value to the nutrients in biosolids now injected into area farmland. Currently no money is exchanged with farmers that receive biosolids. We are beginning to investigate the potential to recover part of the cost of hauling and injecting biosolids into farmland from the farmers that receive it.

- **Overall Cost and Labor Savings** - We have had significant success in reducing costs, and assisting the County in finding additional revenues for the septage plant. CH2M HILL OMI's annual fee has gone down or stayed the same each year since start-up. We have reduced the labor component such that we are currently applying 1.6 full time equivalents (FTEs) to the project. The county receives the benefit of these savings through rebates and downward fee adjustment at the end of each contract year.

2) What can be done with moderate investment?

MBR aeration control

The positive displacement blowers in the MBR building supply air to the two bioreactor vessels and to the membrane cassettes. We do not have a way to effectively control the distribution of air between those three locations. The effect is that we over supply it in two locations in order to get adequate air to the third. Aggravating this, the two bioreactor vessels are designed to operate as independent trains so the liquid level in them is seldom the same. Slight differences

in level skew the volume of air a vessel receives. This makes process control more difficult as well as affecting our ability to manage energy use. The system also lacks turn-down capability. Blowers are on or off, they cannot be slowed down to match demand. The combined result of the above is high rate of consumption of electricity for the amount of material being treated.

Installation of an air control system consisting of variable frequency drives (speed control) on the blowers, dissolved oxygen metering in the reactor vessels, and control valves would allow operators to exert control over air applied and minimize energy consumed by the blowers. URS proposes conversion from course bubble to fine bubble diffusers in the bioreactor vessels. We support this; it can save substantial electricity. We add that it must be done in conjunction with the installation of air distribution control and blower speed control in order to realize full advantage.

Convert from air-lift to mechanical pumping through membranes

A URS suggestion describes conversion from air-lift to direct pumping to move mixed liquor through the membrane modules. X-flow (the membrane manufacturer) designs their equipment to use air-lift pumping (although sometimes in combination with direct pumping) because they believe the air is essential to get the required rate of "scour" or "cross-flow" with considerably less energy consumption than if they were to use direct pumping alone. The inefficiency URS observed would be substantially addressed by an air control system described in the preceding paragraph, which would not require installation of an additional mechanical pumping system.

Heat exchanger to cool SNDR for lower polymer consumption.

The process to dewater biosolids relies on a chemical we call polymer. It is a flocculent, that is, a chemical that makes tiny particles suspended in water clump together so that we can separate the clumps (floc) from the water. ATAD biosolids are notoriously difficult to flocculate; they require high doses of polymer. This is a characteristic of the heat-loving bugs that grow in ATAD. Simply cooling the ATAD biosolids is not likely to improve its dewaterability, but, as URS points out, cooling the biosolids and then allowing digestion to continue at that lower temperature, would allow different kinds of bugs to grow that would consume and displace the heat-loving microbes. That lower temperature biology is generally more amenable to polymer flocculation and thus should dewater with less expense. Conveying the excess heat to the membrane bioreactor vessels might be and option, particularly in the winter and spring, as the biology in the membrane bioreactor would perform better with additional heat. Also, permeability of the membranes would improve with temperature, thus their capacity would be greater.

The cost to implement this would be significant and the benefit is difficult to predict. We ran the dewatering process on biosolids that had significant reaction time at near-ambient temperatures and did not experience the hoped-for improvement in required polymer dosage. Also, if there is a benefit to be realized with this modification, it would only be useful if the plant is committed to continue using the ATAD process and to routinely producing a dewatered biosolids. Some alternatives to ATAD are being discussed and currently, we find it advantageous to land apply as a liquid rather than a dewatered biosolid. I suggest storing this idea for possible reevaluation if circumstances change.

Conversion to equipment to feed dry polymer

The polymer used in concentrating and dewatering solids must be dissolved into water and activated prior to use. Specialized mixing equipment is required to do that. The polymer can be purchased in different forms and the mixing equipment is specific to the form in which it is purchased. The polymer mixers at the septage plant uses polymer purchased in a drum as a

liquid emulsion. An alternative is to purchase bags of dry powder. There would of course be a capital cost to purchase mixing equipment to mix the dry form, but polymer in the dry form is half the cost of liquid emulsion. Whether to consider this also depends on what plan for biosolids handling is ultimately settled upon; the savings would occur only when dewatering with the belt press. The payback would be over a period of years.

Addition of grit removal process

Grit is the industry term for inert, heavy solids found in wastewater. It is actually mostly sand. The septage plant, as designed and constructed, is not equipped with a grit removal system or device. Grit collects in the equalization basin at a rate of about 100 yards per year. It occupies space there, reducing equalization basin capacity. We now plan and execute two events per year to remove grit from the equalization basin. This consist of ceasing operation of the MBR, bypassing loads received to the regional plant for several days, and cleaning the basin using an outside service provider with a vactor truck and tanker. We are now budgeting $16,000 per year for this and it will be required more frequently as loadings to the plant increase. Being heavy and abrasive, grit can also accelerate wear on treatment equipment; this cost is harder to quantify. Installation of a grit removal process would address these issues but would be a significant capital cost and payback would be over a period of years.

Addition of grease screening and separation

The designed method for unloading restaurant grease trap material is to pump it directly to the ATAD. There is no opportunity to screen this material. The recirculation pumps and nozzles in the ATAD should be protected from plastic bags, cocktail straws, and other debris that is likely to be present. There would be significant cost to take that process out of service, clean the equipment, and then restart the ATAD biology if the difficulties we can envision come to pass. Also, grease is usually removed from restaurant traps along with a lot of water. There is a cost for downstream treatment associated with all volume fed to the ATAD. A separator that would allow us to feed only the grease to the ATAD and apply the water to the MBR could result in savings. In short, the ability to screen and separate grease would be beneficial. Such a device would also facilitate diversion of concentrated restaurant grease to a bio-fuels producer should that prove feasible. I believe there is a local biofuels producer interested in the grease.

Competitive bidding for operations

CH2M HILL OMI has been a committed partner from the beginning of the septage treatment program, making sacrifices and investments toward its eventual success right along with the Water Sewer Committee and the Board of Public Works. We committed to helping the County get the program to a successful condition, recognizing that starting circumstances might make that a long road for both of us. We have taken on non-scoped work without additional fee. We have structured our contract and relationship with the County to have the transparency necessary for the County to know they are receiving value.

URS might not have been fully aware of the above circumstances when suggesting that the County seek competitive bids for operations. Their suggestion would seem to come from a standing assumption rather than from any information gathered as part of their evaluation. There is cost and effort for all involved to conduct and then respond to a bidding process. I would not like to see the Water Sewer Committee, Board of Public Works, and CH2M HILL OMI distracted from the issues at hand to work through a bidding process when an evaluation of already available information would indicate that there is likely no advantage to be gained by doing so.

3) The big-picture conceptual ideas.

Some of the ideas discussed involve a widening of the role that the Septage Treatment Facility would play in the community. They would involve significant changes to its configuration and new capital investment. And, they tend to overlap with energy issues –not just the efficient use of energy, but the production of it as well. I call these the big-picture arm-waving ideas. A challenge when contemplating these possibilities is that each is still conceptual and undeveloped, yet if to be eventually implemented, they could affect the economics of decisions regarding the simpler improvements already discussed. Do we refrain from making straightforward investments in efficiency because the money might be wasted if one of these grander concepts proves viable?

Here are the big-picture ideas that I know are out there:

Utilize surplus digestion capacity at the septage plant to serve the next treatment plant constructed to treat sewered wastewater.

This could be convenient if in fact that future plant is in the offing and if the geography is not an obstacle. Either the new plant would need to be proximal to the septage plant, or its biosolids would need to be piped or trucked to the digester at the Septage Facility.

Convert the ATAD vessel to an anaerobic digester

If the priorities of the stakeholders have shifted from producing exceptional quality (EQ) biosolids to energy conservation and production, anaerobic digestion of biosolids may make sense under some circumstances. Anaerobic digestion can produce an excellent biosolids suitable for reuse as fertilizer applied in bulk to farm fields while also producing a methane-containing gas that burns with about 75% of the BTU content of natural gas. Such a conversion is not likely to be viable as a stand-alone project however. It would require significant and costly modification to the digester, and anaerobic digestion is not generally a good option when the feed material is predominantly a waste activated sludge as would be the case at the septage plant.

However, the idea might be viable if:

- A new treatment system for sewered wastewater is to be constructed that would share the converted digester, and that new plant includes primary clarifiers in its treatment scheme (sludge from primary clarifiers makes a great feed for anaerobic digesters) or,

- Area fruit processing or similar industries have wastes that are determined to be suitable for anaerobic treatment and are committed to participating in the project. Perhaps such an opportunity will emerge form Dr. Loves efforts.

Conversion of the ATAD to a conventional aerobic digester

Conventional aerobic digestion (contrast with anaerobic discussed above) can produce biosolids class B for pathogens. This product would be less challenging to concentrate or dewater (thus less expensive) than ATAD biosolids. Conventional aerobic digestion consumes less energy than ATAD but it would not produce a fuel as would anaerobic digestion. The modifications necessary would be minor compared to conversion to an anaerobic process. As a mater of fact,

it may prove possible to perform aerobic digestion using only the existing SNDR (biosolids storage) tank and associated mixer and blower while not using the ATAD tank, mixer, and blower at all.

One other requirement would be that grease loads would need to be handled in another way. Conventional aerobic digestion would not tolerate much grease. If we put in a separator (described in previous section) and provided the grease to a biofuels producer this conversion might, in that way, produce as well as conserve energy. I believe there is at least one entity interested in receiving that grease.

Summary

To review all three categories of actions:

CH2M HILL OMI will continue to provide day to day optimization of the facility as it currently exists.

From the list of actions that would require "moderate investment," these are the ideas I think have potential for payback regardless of which big-picture ideas are, or are not, eventually implemented:

MBR aeration control
Addition of grit removal process
Addition of grease screening and separation

I recommend that at such time the county is in a position to do so, you engage engineering services to do cost benefit evaluations and perhaps design solutions for the above items.

From the big-picture list, there is one item that is more within reach than the others at present. As a matter of fact, perhaps it belongs in the "moderate investment" category. In any case, I encourage evaluation of this item as well:

Conversion of the ATAD to a conventional aerobic digester

These are my thoughts after having been engaged in the operation of the plant since start-up and having observed and participated in the discussions with committees and stakeholders so far. I would be pleased to discuss further whenever convenient.