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Operation/Financial Feasibility Analysis and Report

for the

Mendham East Wastewater Treatment Facility Conversion

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SECTION 1 – INTRODUCTION

1.1 BACKGROUND

The Township of Mendham has been operating the Mendham East Wastewater Treatment Plant (WWTP) since July 1996. The plant was constructed by Jackson Homes at Mendham, Inc. and placed into service in 1987. The WWTP serves the Drakewick Subdivision, the Corners at Mendham Condominiums and the Mendham Knolls Condominiums. The WWTP utilizes a breakpoint chlorination treatment process that generally consists of mixing the aerated/screened sewage with various chemicals, alum to coagulate and then filter solids Chlorine to remove ammonia-nitrogen and kill pathogens followed by Sodium Bisulfite for chemical dechlorination, and then re-aeration prior to subsurface effluent disposal to the ground. The WWTP was designed to process a maximum flow of 40,000 gallons per day (gpd), based on 362 bedrooms at 110 gpd/bedroom, and on average receives recorded flows between 20,000 to 25,000 gpd. .

Mendham Township, in performing capital planning and a review of the Town's infrastructure, had come to realize that the existing plant relies on an antiquated technology, is labor intensive to operate, produces an effluent quality that, while generally within permit limits, is a long term detriment to the health of the effluent disposal fields and is expensive in terms of both chemicals used as well as the associated environmental impact related to those chemicals. Furthermore, it has been noted by WhiteWater, the contract operations firm that oversees and operates the Mendham East plant on behalf of the Township, that the system is in need of significant repair and upgrade in order to continue to process the incoming sewage to produce an effluent to meet the New Jersey Department of Environmental Protection's (NJ DEP) required standards. At this time, it became apparent that, prior to investing additional funds to repair this antiquated technology, a full evaluation of the possible replacement of the system with a state of the art biologically based treatment system should be commissioned in order to provide guidance to Mendham on the most cost effective and environmentally responsible path moving forward.

Therefore, Mendham Township commissioned an engineering evaluation and study of the existing plant to determine viable options for its replacement in a cost effective manner. Consideration during the evaluation was given to the overall environmental benefit associated with new state of the art technologies, short term capital costs to implement changes, long term operational costs as well as any potential environmental impacts. Onsite Engineering, Inc. was chosen to complete this assessment and prepare this summary report of the findings and recommendations for future actions.

SECTION 2 – WWTF UPGRADE OPTIONS ANALYSIS

2.1 PHASE I – SURVEY AND EVALUATION OF AVAILABLE TECHNOLOGIES FOR WWTP

As required in our scope of work, the initial step in the evaluation process was to assess the available treatment technologies commensurate for a WWTP of this size, which could be installed within the confines of the existing Mendham East Plant, while also maintaining the functionality of the existing system to the largest extent practical. The first phase included assessing the building layout and tankage available at the WWTP and determining how that relates to modern treatment systems available for WWTP of this size. Once technologies were identified and determined to be feasible during our preliminary assessment, the second phase of this process was to solicit input from system manufacturers of those wastewater technologies relative to assessing how each system may be a suitable fit for the proposed upgrade.

During the initial phase, the screening of biological treatment systems was undertaken to narrow the focus to technologies that were most applicable and suitable to achieve Mendham's stated goals based on the existing building layout and tankage. It is important to note that the current best available technology for decentralized wastewater treatment systems revolve around biological processes. As the Township knows, physical/chemical processes are no longer considered economically viable or environmentally friendly. Typically the physical/chemical based system along with the energy required to perform treatment in that manner is prohibitive from a cost and environmental perspective and therefore was no longer considered as an option for potential upgrades to the Mendham East Plant. In this phase, we considered technologies such as;

- Rotating Biological Contactors (RBCs)
- Activated Sludge (AS)
- Membrane Bio Reactors (MBRs)
- Sequencing Batch Reactors (SBRs)
- As well as several proprietary systems using variations and/or hybrid versions of the technologies noted above.

For each technology considered, we prepared a preliminary assessment of its suitability for this project and, if it appeared favorable, requested manufacturing input as described above to complete the phase two evaluation, which consisted of a more in depth cost benefit analysis of that technology. If the system was not considered suitable, due to site constraints and/or cost considerations, it was not pursued beyond the preliminary assessment stage. A summary of our assessment and findings for each technology are included below.

<u>Rotating Biological Contactors (RBCs):</u> An RBC system employs a fixed media that is attached to a horizontal shaft to achieve biological treatment of organic and inorganic pollutants in the wastewater. The media is used to grow bacteria that use the wastewater as a food source, thereby removing pollutants as it passes through the tank. As the media rotates, it passes through both wastewater and the air above the tank, thereby providing an aerobic environment for the bacteria to perform aerobic biological treatment. In addition to the RBC unit, the typical RBC WWTP includes a clarifier tank to remove solids after processing in the RBC and then a tertiary

denitrification sand filter system for nitrogen removal. As these processes are temperature dependent, they are typically installed in an enclosure or building of some type.

As part of our analysis, we considered our previous experience with similar installations to determine rough sizes of the equipment that would be required. We had estimated that the RBC tank would be approximately 16-feet by 24-feet, the clarifier would be a circular tank 10 feet in diameter, and the tertiary filter would be approximately 10-feet by 10-feet. Based upon these sizes, a new building that was approximately 40-feet wide by 50-feet long and 20 feet inside height would be necessary. Given the site constraints and the expense required to construct a building of this size adjacent to the active treatment facility, we estimated that the cost for a system of this type would be in excess of $2 million dollars and not financially viable for this project. Therefore, an RBC WWTP was eliminated from consideration and not included in our phase two assessment.

Activated Sludge (AS): A conventional activated sludge WWTP consists of multiple biological treatment tanks, configured in a flow through regime, which is intended to provide extended contact time between the pollutants found within the wastewater and the microorganisms in the treatment tanks. By keeping the wastewater completely mixed in either an aerobic or anoxic environment, biological treatment of the wastewater is achieved. Typically, these systems include primary clarifiers to remove screening and grit from the sewage, an aerobic tank for organic pollutant removal, an anoxic tank for nitrogen removal, and a secondary clarifier used to capture the biological solids and return them to the aerobic tank to continue the treatment cycle again. As one can see from this description, this process, while very effective and well known, is more geared towards larger municipal facilities that have ample room for outdoor tankage and do not need to be concerned with odors and/or effects on neighbors.

A conventional activated sludge system designed to replace the Mendham East Plant would require additional land as well as providing new tankage and intermediate piping to design a plant in the configuration described above. As the site is very limited relative to adding tankage, it is our opinion that a conventional activated sludge WWTP is not a viable option, and therefore, was not considered further. However, it is important to note that while several of the other technologies presented here, such as MBR and SBR treatment systems utilize activated sludge principals to achieve treatment, these system are based on a smaller hybridized scale that is more applicable to this project.

Membrane Bio-Reactors (MBRs): An MBR system employs an activated sludge process that uses a very high concentration of microorganisms to achieve biological treatment. The reason that high concentrations of bacteria can be achieved with MBRs is that the final step of the process relies on a membrane barrier that prevents particles larger than a certain size from passing through the membrane. In this instance clean water is “pulled” through the membrane as final effluent, by vacuum pumps, on a controlled timed basis. This physical barrier acts to keep biological solids, bacteria and even viruses suspended in the wastewater without the ability to pass through with the effluent. The result is that the MBR system produces a highly treated effluent while using smaller biological treatment tanks and unit processes. In addition, several of the MBR systems can be fully fabricated at the factory and delivered to the site ready to be connected to the system. While these systems typically have a higher equipment cost compared to other treatment systems, the small footprint required for the system as well as the ability for complete factory fabrication

resulting in decreased installation costs made the MBR an attractive option for further consideration.

Sequencing Batch Reactors (SBRs): SBRs, like MBR systems, employ an activated sludge process that uses a more standard concentration of microorganisms to achieve biological treatment. The difference between a conventional activated sludge plant, as described earlier, and a SBR plant is that all the individual treatment steps in the AS process are performed in stages within a single tank by using a computer controlled sequence. SBR systems are typically provided with two reactor basins because the treatment occurs in batches, such that raw sewage is filling one basin, while the other basin is treating the batch it had received. Similar to the MBR's reduced footprint, the SBR system has a smaller footprint than a conventional AS plant since the aeration, clarification and anoxic treatment steps are all combined into a single tank. While these types of systems have a lower overall equipment cost, there is a higher installation cost since the entire system is essentially fabricated at the site. Given that this type of system, due to its reduced footprint, could be incorporated at the site, the SBR remained an attractive option for further consideration.

Amphidrome System: The Amphidrome system is a proprietary fixed film treatment system that utilized sand media bed reactor vessels to provide a fixed surface for promoting microorganism growth required to achieve biological treatment. Wastewater is treated in a series of underground concrete tanks that provide aerobic and anoxic biological treatment as well as filtration to remove solids and to keep the treatment microorganisms in the system. The reactors function similar to that of the SBR, where multiple treatment steps are completed in the single tank. However, as pre and post reactor equalization is required to manage the flows and a dual reactor system would be necessary for this plant upgrade (to effectively manage batches at these flows) there is a significant amount of new underground concrete tankage that would be required with this system. While these types of systems have a lower overall equipment cost, there is a higher installation cost since the entire system is essentially fabricated at the site in addition to requiring additional tankage. While additional tankage at the site would be necessary to accommodate this system, it is our opinion that the Amphidrome System remained a viable option for further consideration.

2.2 PHASE II - COST BENEFIT ANALYSIS

Phase two of the options analysis involved a more in-depth review of the MBR, SBR and the Amphidrome system as they specifically relate to upgrading the Mendham East WWTP. This task included having detailed discussions with equipment manufacturers relative to how their system would be configured into the existing site to achieve the necessary treatment levels to meet effluent discharge requirements. To accomplish this, we prepared a preliminary scope of services request form detailing the design criteria of the existing plant and the existing NJ DEP Groundwater Discharge Permit (GWDP) effluent requirements. The key aspects of the equipment assessment were;

- The ability of the system to meet the discharge permit conditions based on the flow and loading to the plant;

- The overall footprint of the proposed system and how it would mesh with the existing infrastructure at the Plant (i.e. reuse of tanks, new tanks required, etc.)
- Level of "at the site" construction that would be required to complete the upgrades and the impacts that construction would have on maintaining flows and treatment during construction;
- and cost considerations, including capital costs for the equipment, flow diversion costs, construction costs and operational costs.

In addition to providing the scope of services request form, we provided a layout of the site and the existing WWTP building as-built drawing to the vendors. This was done so that they could proposed the use and/or reuse the available area and WWTP building space as efficiently as possible in an effort to keep the disturbance to the existing WWTP to a minimum while reusing as much infrastructure as possible. Responses from the following manufacturers in the aforementioned subcategories were received;

MBRs:

- GE Zenon
- Ovivo

SBRs

- AquaAerobics

Amphidrome:

- FR Mahony (this is FR Mahony's proprietary system so they were the only respondent in this system category)

The proposals from each manufacturer were reviewed and evaluated relative to the previously discussed selection criteria. A summary table detailing the key advantages and disadvantages for each system, including opinions of system costs, was prepared and presented to the Township for discussion and preliminary evaluation purposes. A detailed description of each system for which proposals were received is presented here-in.

GE Zenon MBR:

GE Zenon proposed an MBR system using their hollow fiber ZeeWeed Membrane package. The proposal is based on the membranes being housed in pre-fabricated skid shipped to the site for installation. The proposal also includes a circular steel tank that is approximately 15-feet in diameter and 16-feet high to house anoxic and aerobic treatment zones. We envisioned that this tank would be installed above grade, outdoors next to the WWTP on the existing spill containment concrete pad. The MBR skid and membrane tank would be located within the building with the associated controls, pumps and blowers. Also, their proposal included replacement of the existing screen system with a new screen system in the same location. This proposal would not require significant modifications to building structure, if any.

As part of the proposal, GE detailed their anticipated operational costs for utilities, chemicals, etc., as well as costs associated with major equipment replacement, such as the membranes. Table 1 below details our estimate of probable construction, reserve and operational costs associated with the GE Zenon MBR system. The construction cost includes furnishing, installing and startup of the treatment system, along with estimates for bypass pumping etc. Please see the complete vendor proposal summary table for all the technologies considered attached to this report for a detailed breakdown of the various costs carried in this evaluation.

Table 1
GE Zenon MBR Estimated Probable Costs
Mendham East WWTP – Upgrade Evaluation
Mendham Township, NJ

Line Item	*Estimated Probable Cost*
Construction	$1,595,125
Annual Reserves	$27,000
Annual Operation, Maintenance and Expense Costs	$102,800

In addition to evaluating the feasibility of installing this system at the site, future expansion potential was assessed. Based on correspondence with Zenon, the proposed design could accommodate approximately 5,000 to possibly 10,000 gpd of additional flow, based on the anticipated influent wastewater strength without modifying the equipment/tankage. However with an increase in flow above 10,000 gpd, an additional skid system would need to be provided along with additional headworks, pumps, blowers and anoxic and aerobic treatment tanks. It is important to note that any increase in flow would require additional leaching capacity that is independent of the WWTP process being used.

Ovivo MBR:

The Ovivo proposed design is based on providing one prefabricated MBR treatment system complete with all process tanks, membranes and pumps/blowers as one large process system skid, which would be installed in the area presently occupied by physical/chemical treatment processes and sand filter. The installation of this MBR system would require a modification to building structure to allow for the installation of the tank and would require modification to ceiling/roof to provide a means to remove membrane cartridges for future maintenance. In addition, as the existing system would have to be demolished prior to installing the MBR skid, there would be costs associated with the bypassing of the plant during that time. In addition to providing the new MBR system, this option includes modifying the sludge holding tank to provide additional influent equalization, similar to that of the GE Zenon MBR system.

As part of the proposal, Ovivo detailed their anticipated operational costs for utilities, chemicals, etc., as well as costs associated with major equipment replacement, such as the membranes. Table 2 below summarizes our opinion of probable construction, reserve and operational costs

associated with the Ovivo MBR system. The construction cost includes furnishing, installing and startup of the system, along with estimates for bypass pumping etc. Please see the complete vendor proposal summary table for all the technologies considered attached to this report for a detailed breakdown of the various costs carried in this evaluation.

Table 2
Ovivo MBR Estimated Probable Costs
Mendham East WWTP – Upgrade Evaluation
Mendham Township, NJ

Line Item	*Estimated Probable Cost*
Construction	$1,555,650
Annual Reserves	$28,300
Annual Operation, Maintenance and Expense Costs	$100,900

In addition to evaluating the feasibility of installing this system, the future expansion potential was assessed. The proposed design, as submitted, can accommodate up to 62,500 gpd based on the anticipated influent wastewater strength. As with all the other systems, a significant increase in flow above 40,000 gpd, would require additional flow equalization and final effluent storage tanks as well as additional leaching capacity. However, we do not anticipate requiring modifications to the Ovivo MBR system were an additional 5,000 gpd of wastewater sent to the system.

Aqua Aerobics SBR:

The Aqua SBR proposal is based on providing two (2) SBRs, which are each 10 feet by 16 feet by 20 feet high stainless steel basins with fiberglass covers in the area designated for spill containment. The SBR tanks would be located above ground in the chemical containment area with access grating around perimeter. Access to the tanks for operations and maintenance would most likely be made from the top of final effluent pump chamber, which is exterior to the existing WWTP building. The SBR option would also require a new fiberglass sludge storage tank to replace existing aerated sludge holding tank, as the aerated sludge holding tank would need to be modified to provide additional influent flow equalization. The SBR option would not require modifications to building super-structure, and should allow for the system to be installed while providing the ability to keep the facility in operation during most of the construction.

As part of the proposal, Aqua detailed their anticipated operational costs for utilities, chemicals, etc. The Aqua SBR system does not have high cost consumable items such as membranes to be replaced, so they did not provide us with costs associated with that type of item. Table 3 below details our opinion of probable construction, reserve and operational costs associated with the Aqua Aerobics SBR system. The construction cost includes furnishing, installing and startup of the treatment system, along with estimates for bypass pumping etc. Please see the complete vendor proposal summary table for all the technologies considered attached to this report for a detailed breakdown of the various costs carried in this evaluation.

Table 3
Aqua Aerobics SBR Estimated Probable Costs
Mendham East WWTP – Upgrade Evaluation
Mendham Township, NJ

Line Item	*Estimated Probable Cost*
Construction	$1,555,706
Annual Reserves	$25,500
Annual Operation, Maintenance and Expense Costs	$103,800

In addition to evaluating the feasibility of installing this system, the future expansion potential was assessed. Expansion of the SBR system would involve adding additional basins if the service area were expanded significantly. Based on correspondence with Aqua Aerobics, the tank sizing described herein can accommodate approximately 5,000 gpd of additional flow, based on the anticipated influent wastewater strength. With any significant increase in flow above the incorporated 5,000 gpd, additional SBR basins (approximately 1 basin for 20,000 gpd of flow) would be required in addition to additional flow equalization, final effluent storage tanks and effluent disposal leaching would be necessary.

Amphidrome System:

The Amphidrome proposal is based on the installation of two (2) 15,000 gallon capacity anoxic tanks, an Amphidrome Reactor, an Amphidrome Plus Reactor, an effluent clearwell, and a mud well tank for sludge storage. The Anoxic tanks, Amphidrome Reactor, clearwell, and mudwell would need to be installed on the site, outside the confines of the building. The Amphidrome Plus Reactor tank could conceivably be located within the building in the sump pit for the existing filter. The Amphidrome system does not require significant modifications to the building, however it would require significant site work to install the tanks. The limited available space, in combination with the number of the proposed tanks at a significant depth would be challenging given the site's existing infrastructure and proximity to the WWTP building and effluent disposal system.

As part of the proposal, FR Mahony detailed their anticipated operational costs for utilities, chemicals, etc. Like the Aqua SBR, this system does not have high cost consumable items such as membranes to be replaced, so they did not provide us with costs associated with that type of item. Table 4 below details our opinion of probable construction, reserve and operational costs associated with the Amphidrome system. The construction cost includes furnishing, installing and startup of the system, along with estimates for bypass pumping etc. Please see the complete vendor proposal summary table for all the technologies considered attached to this report for a detailed breakdown of the various costs carried in this evaluation.

Table 4
FR Mahony Amphidrome Estimated Probable Costs
Mendham East WWTP – Upgrade Evaluation
Mendham Township, NJ

Line Item	*Estimated Probable Cost*
Construction	$1,592,720
Annual Reserves	$29,500
Annual Operation, Maintenance and Expense Costs	$107,800

In addition to evaluating the feasibility of installing this system, the future expansion potential was assessed. Expansion of the Amphidrome system would involve adding additional reactors and equalization tanks to the system. Since an increase in flow cannot be accommodated without providing additional tankage, it is our opinion that the system is not easily expandable above current flow and influent loadings. As with the other systems, in addition to more tankage and reactor volume, additional flow equalization, final effluent storage tanks and effluent disposal leaching would be necessary.

2.3 FINANCIAL RATE STRUCTURE ANALYSIS

In considering the overall scope and impact that a possible upgrade to the Mendham East WWTP would have on the rate payers, it is important to review the previous presented costs relative to the current rate structure for funding the capital costs, but also the long term operational and reserve account funding expenses. As part of this evaluation, it is important that the Township and ratepayers understand what additional funding, if any, would be required to complete the possible upgrade of the WWTP.

The existing rate structure appears to be based upon covering operational, maintenance and chemical expenses combined with the USDA loan repayment. Based upon FY 2014 data provided, the Township receives $257,790 in revenue from rate payers. This income is predominantly based upon the $712/bedroom annual sewer use fee that residents pay if they are connected to the system.

To accomplish our analysis, we reviewed the current rate structure and expenses and compared that relative to the proposed changes. As the capital costs for most of the systems were very similar, for purposes of this analysis, we assumed that the cost associated with the upgrade to the WWTP would be $1,600,000. Furthermore, we assumed that a 30 year loan at a fixed interest rate of 3.0% would be secured to fund the project. Based upon the amortization tables attached to this report for the loan as described, the annual outlay of principal and interest for financing the project would be $80,948. For operational and reserve account funding, we assumed that the operational costs would be $102,000/yr. and that the required reserves would be $28,500/yr. Table 5 below provides a summary and total of our estimated anticipated annual expense for a proposed upgrade to the WWTP.

Table 5
Estimated Total Annual WWTP Expenses
Mendham East WWTP – Upgrade Evaluation
Mendham Township, NJ

Line Item	*Annual Expense*
Capital Loan Repayment	$80,948
Reserve Account Funding	$28,500
Operation, Maintenance and Expenses	$102,000
Total Annual Expenses:	$211,448

As noted above, the annual revenue for FY 2014 was $257,790. As this should be a level funded utility fund, we anticipate that this level of funding will be consistent from year to year as long as the homes connected to the system are occupied and their accounts are in good standing. Based upon these estimates, we envision that there would be approximately $46,342 available to offset the current payments to USDA for the recent leaching field replacement project loan. Based upon this analysis, it appears that the current rate structure would be suitable to affect the proposed WWTF upgrades as a stand-alone project. However, as the Township currently makes annual payments of $64,390 to repay the USDA leach field project loan, a financial analysis of the means to cover those payments (in addition to the aforementioned additional estimated capital loan for the replacement of the WWTF) should be completed.

SECTION 3 – OPERATIONAL ASSESSMENT

3.1 OPERATIONAL EFFICIENCY ANALYSIS

As previously noted, the current system employed at the Mendham East WWTP is a physical/chemical treatment process whereby aluminum (Alum) is added to assist in the filtering of biological solids and then Chlorine based chemicals are used to oxidize ammonia into nitrogen gas. Upon completion of the ammonia removal process, dechlorination chemicals are then used to remove any residual chlorine remaining in the effluent. In addition to using large quantities of caustic and expensive chemicals, this process produces high levels of solids that must be stored and shipped offsite for further treatment. As this process was first studied by the EPA in the early 1970s for it effectiveness, it is considered antiquated by modern wastewater treatment standards as it is labor intensive and presents safety hazards to operational staff because of the nature of the chemical used and the quantities in which they must be stored and handled. The chemicals in question, Alum, Chlorine, and Sodium Bisulfite are considered hazardous and must be shipped, stored and used with extreme care to prevent human exposure or spills to the environment.

By contrast, an MBR system, for example, would use very little to no chemicals in the daily processing of wastewater. Typically, a supplemental carbon source as well as additional alkalinity is all that is required. Equipment cleaning chemicals, such as household bleach are also sporadically used to clean the membranes, but typically it can be furnished in gallon containers and stored at the site, similar to cleaning solutions for a house. In an effort to quantify the relative difference that we would anticipate being realized by making the conversion from a physical/chemical treatment process to a biological one, we compared the current costs associated with furnishing the chemicals and then using them in each process.

Based upon data provided by WhiteWater, the Mendham East Plant spends, on average, approximately $65,000/year in chemical costs alone. This does not include the costs associated with the labor involved with handling and using them in a safe manner. In contrast, based upon years of operational experience, WhiteWater has estimated the total chemical costs for an MBR or SBR type system is in the range of $3,000 to $4,000 per year. As one can see, that is approximately a 95% reduction in the costs of chemicals alone. In addition, as the operator would no longer have to work with these chemicals and these newer types of processes are largely automated, the operator will require less time and effort to maintain treatment. This will also be realized in additional cost savings on the overall operations budget. We anticipate that, on average, the operations budget for Mendham East will decrease by approximately 40% upon startup of a new WWTP.

3.2 CHLORINE CHEMICAL ELIMINATION ANALYSIS

Aside from the obvious improvements to the environment that result in not shipping, storing and using chlorine based products during treatment, which can result in chlorine based chemicals entering the groundwater from the WWTP discharge, there is the additional environmental impact of the carbon footprint associated with making the chemicals in the first place that must be considered when performing this analysis. Environmental and health and human impacts

associated with the use of chlorine in and of itself are largely limited to spills, improper dosing, or removal. If these factors are properly managed, this risk, while still present, can be somewhat mitigated, however, the environmental impacts associated with the generation, shipping and use as it relates to Mendham's Carbon Footprint cannot be overlooked.

It has been estimated that in totality, to use chlorine based chemicals for wastewater treatment, approximately 100 tons of CO_2 emissions per year are created when disinfecting 1 million gallons per day of treated effluent. To achieve disinfection of treated effluent, typical doses of chlorine are typically 5 mg/L. For wastewater applications, this correlates to approximately 20 tons/yr. per mg of chlorine used. However, as the Mendham East WWTP uses breakpoint chlorination for ammonia-nitrogen removal, not disinfection, the dosing of chlorine is much higher. Per WhiteWater, the average chlorine dose at the Mendham East Plant is approximately 45 mg/L. Based on the above ratio, approximately 900 tons/yr./1MGD of carbon emissions are generated by using chlorine at the Mendham East WWTP.

Based upon these dose concentrations and the average daily flows at the WWTP, we were able to estimate the impact using that amount of chlorine has on greenhouse gas emissions. As the Mendham East WWTP is sized to treat 40,000 gpd, but averages 25,000 gpd of actual flow, the equivalent carbon footprint, (at 900 tons/yr./1MGD) is approximately 22.5 tons per year. In essence, the use of chlorine based chemicals at the Mendham East WWTP results in the generation of 45,000 pounds per year of greenhouse gas emissions. As previously noted, by converting this system to a biological based process, we could reduce the overall chlorine use to a few gallons per year for membrane cleaning or no chlorine used for an SBR or Amphidrome system. In essence, the conversion would essentially eliminate the chlorine chemical carbon foot print of this facility and result in a significant net positive environmental impact.

In addition to the favorable impacts to CO_2 emissions that would be realized if the WWTP were upgraded, it is important to note that the discussed biological systems (MBRs in particular) produce a much higher quality effluent, particularly as it relates to suspended solids and organic pollutants. These systems are designed such that the organic and solids removals will occur even without the operator running the system to achieve high levels of treatment. This is important to consider because these pollutants are just that, pollutants, and they can, over long periods of time, have a detrimental effect on the permeability of the effluent disposal fields and on underlying groundwater quality. Replacement of this system with an advanced treatment system will have an immediate effect of improving groundwater quality at the discharge site. It will also prolong the life of the effluent disposal field, which as noted, has already been replaced once due to solids overloading from the existing treatment system.

Lastly, it is important to note that the use of caustic chemicals in the WWTP has had a deleterious effect on the building, ventilation, electrical and plumbing systems, as anything that can be corroded by the residual chlorine vapors has been corroded in the WWTP. Replacing the system with a biological process would essentially eliminate a source of the corrosion and thereby be beneficial in extending the useful life of the building and building systems going forward. This will also have a positive net beneficially effect on both capital costs, but also the need to remove and dispose of the corroded systems in the future will be greatly reduced, thereby reducing the solid waste impacts in landfills.

3.3 COMPARATIVE EQUIPMENT IMPLEMENTATION ANALYSIS DURING CONSTRUCTION

A key component of this analysis was to determine the feasibility of constructing a new facility while maintaining and operating the existing one. As noted in our equipment assessment evaluation, each system is slightly different in its configuration and the manufacturers approach on how to integrate the new technology within the existing WWTP. However, generally, the common thread between all systems is that a significant portion of the construction can either be done at the site adjacent to existing structures, or at the manufacturer's facility such that the almost finished product can be shipped directly to the site. In either case, the amount of down time that will be required can be minimized such that we anticipate requiring between 14 and 21 days of time where pumping an hauling of sewage for offsite treatment will be required. This will vary depending on the system chosen.

For example, with the Ovivo MBR, we anticipate that the building modifications and much of the piping and electrical work can be done while the existing plant is still on line but that once the unit is shipped and ready for delivery, the existing system would need to be taken offline, demolished and the area prepped to receive the new MBR tank. In contrast the SBR system would mostly be constructed completely outside adjacent to the facility and would require a minimal shutdown of the facility to make electrical and process piping connections. The difference with that system is that it will almost entirely be constructed at the site, whereas most of the assembly of the Ovivo (and GE for that matter) system would be done in the factory and less work at the site would be required.

It is important to note that we have estimated the level of effort required for each system relative to the time it would take to make the conversion and have the new system running. Using that estimated time, we developed an anticipated cost relative to bypass pumping/hauling and have included that in the overall project construction cost. Detail of that cost is included in the system proposal summary sheet included with this report.

Upon a decision by the Township to move forward with the upgrade of the plant and upon selection of a preferred equipment and manufacturer, a more specific and detailed plan for maintaining wastewater services to the residents during construction will be formalized. We expect that plan to include input from the NJ DEP, the appropriate Township Committees, as well as the manufacturer and WhiteWater, the contract operator of the facility.

SECTION 4 – CONCLUSIONS/RECOMMENDATIONS

Based upon our analysis summarized and presented herein, we offer the following conclusions and recommendations for proceeding with the project. As noted, there are several viable and high quality biological treatment system options available to Mendham for upgrading the East WWTP. These systems vary in technology, configuration, equipment cost and ease of installation. However, as noted, each system has advantages and disadvantages such that they typically offset each other relative to overall costs. Specifically, while the Aqua SBR has the lowest equipment costs, they require very large tanks to be fabricated and installed outdoors at the site, which ends up offsetting the cost savings realized on the equipment.

Furthermore, the overall operational costs associated with each type of technology are similar as well. One advantage that there is in completing an upgrade of the WWTP is in that the existing system is in poor condition, due in large part to the corrosive nature of the treatment chemicals used, and that the large capital outlay that will be required to make improvements will be immediately offset by the large reduction in chemical and operations/maintenance costs. As noted, we anticipate the overall operations budget to be reduced by approximately 40% when a new system is put online.

In addition, use of a new system, particularly the MBR types, will produce a far superior effluent quality than the existing WWTP produces. While this will have the effect of improving the groundwater quality relative to environment, it will also reduce the solids and organic load into the leaching field, which should effectively prolong its useful life, thereby reducing future capital expenditures related to leaching field replacements.

While the various technologies and systems are very similar from a capital and operations cost perspective, we believe that the excess capacity and the compact nature of the MBR systems set them apart. It is important to reiterate that most of the construction of those systems will be done at the factory, in a controlled environment, shipped to the site tested and ready to be installed. This fact also lends itself to these systems being better from a cost control perspective as less “at the site” construction will be necessary. This also means that the construction at the site, and disturbances associated with that would be minimized to the largest extent practical with these systems. The selection of an MBR would also allow a large portion of the site construction, building modifications, electrical and building utility upgrades to be completed while the existing system is still in operation, thereby reducing the impacts of the conversion to the system users.

Based upon the information summarized in this report our estimates of cost, the fact that it appears an MBR system can be furnished, installed and operated within the current rate structure for the Mendham East WWTP and the fact that the MBR systems provide excess treatment capabilities without modifications required and the highest quality treatment effluent, we recommend that the Township move forward with implementing the replacement of the Mendham East WWTP with a MBR based WWTP, provided that the budgetary gap related to repayment of the leaching field replacement project loan can be adequately addressed.

Amortization Calculator

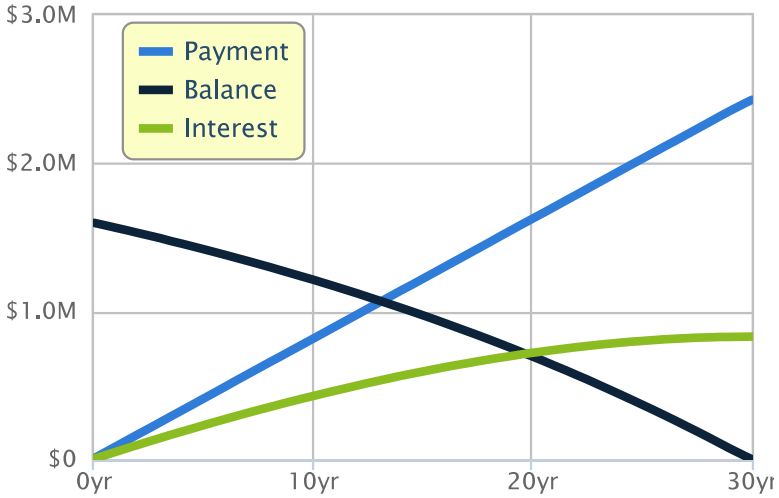
Loan Amount	$ 1600000	
Loan Term	30	years
Interest Rate (APR)	3	%

Calculate

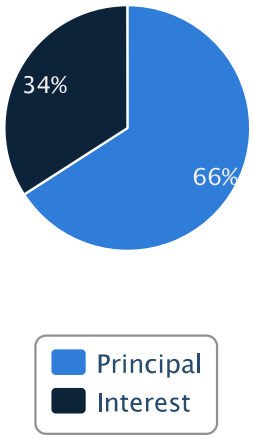
Monthly Pay: $6,745.66

Total of 360 Loan Payments	$2,428,439.23
Total Interest	$828,439.23

Loan Amortization Graph



Payment Breakdown



Annual Amortization Schedule

Annual Schedule | Monthly Schedule

	Beginning Balance	Interest	Principal	Ending Balance
1	$1,600,000.00	$47,543.17	$33,404.75	$1,566,595.19
2	$1,566,595.19	$46,527.14	$34,420.78	$1,532,174.35
3	$1,532,174.35	$45,480.19	$35,467.73	$1,496,706.56
4	$1,496,706.56	$44,401.41	$36,546.51	$1,460,159.99
5	$1,460,159.99	$43,289.80	$37,658.12	$1,422,501.81
6	$1,422,501.81	$42,144.39	$38,803.53	$1,383,698.23
7	$1,383,698.23	$40,964.15	$39,983.77	$1,343,714.40
8	$1,343,714.40	$39,748.00	$41,199.92	$1,302,514.42
9	$1,302,514.42	$38,494.86	$42,453.06	$1,260,061.31
10	$1,260,061.31	$37,203.59	$43,744.33	$1,216,316.94
11	$1,216,316.94	$35,873.07	$45,074.85	$1,171,242.05
12	$1,171,242.05	$34,502.09	$46,445.83	$1,124,796.16
13	$1,124,796.16	$33,089.39	$47,858.53	$1,076,937.57
14	$1,076,937.57	$31,633.71	$49,314.21	$1,027,623.32
15	$1,027,623.32	$30,133.81	$50,814.11	$976,809.13
16	$976,809.13	$28,588.20	$52,359.72	$924,449.38
17	$924,449.38	$26,995.63	$53,952.29	$870,497.06
18	$870,497.06	$25,354.65	$55,593.27	$814,903.72
19	$814,903.72	$23,663.72	$57,284.20	$757,619.46

20	$757,619.46	$21,921.36	$59,026.56	$698,592.85
21	$698,592.85	$20,125.99	$60,821.93	$637,770.88
22	$637,770.88	$18,276.05	$62,671.87	$575,098.95
23	$575,098.95	$16,369.84	$64,578.08	$510,520.80
24	$510,520.80	$14,405.61	$66,542.31	$443,978.44
25	$443,978.44	$12,381.68	$68,566.24	$375,412.14
26	$375,412.14	$10,296.17	$70,651.75	$304,760.32
27	$304,760.32	$8,147.20	$72,800.72	$231,959.56
28	$231,959.56	$5,932.90	$75,015.02	$156,944.49
29	$156,944.49	$3,651.25	$77,296.67	$79,647.77
30	$79,647.77	$1,300.21	$79,647.71	$0.00

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