Exhibit 3

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PHOSPHORUS REMOVAL TECHNOLOGY SCREENING EVALUATION
KEENE, NH WWTP

May 13, 2006

Executive Summary

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1. A total of eleven phosphorus removal technologies were evaluated as being applicable to Keene. Four (#2,#3,#4, and #5 on Table 2.1) meet the 1.0 mg/l cold weather permit for total phosphorus, Two (#6 and #7) will meet a 0.36 mg/l mass loading limit, and Four (#8, #9, #10 and #11) will meet a warm weather limit of .2 mg/l.
2. All process technologies would be adaptable to the Keene WWTP site and process flow train footprint.
3. Technology #2 (primary chemical precipitation process) appears to be most cost effective to achieve cold weather limits. However, technology #1 (EBPR) may be more desirable because of the lack of chemical usage. The #10 (Tertiary ballasted floc) technology could be the most cost effective to meet the warm weather limits.
4. If mass loading limits are approved, than a limit of 0.36 mg/l for warm weather conditions with 3.3 to 3.6 MGD effluent flows could change the best suited technology to #6 or #7, depending on the cost and operational management preference in regards to chemical usage.
5. The cost differential between meeting 0.36 mg/l and 0.2 mg/l is $2,720,000 based on the average capital cost of technologies #6 and #7 and the average capital cost of technologies #8 through #11.
6. Stantec recommend's that the City negotiate with the EPA for mass loading limits and further evaluate the applied capital and O&M costs for process technologies #6 and #7.
7. Chemicals, power, labor, and other annual O&M costs could greatly impact the cost effectiveness of any of the final applicable technologies.

1.0 Chapter 1 - General

The City of Keene, Department of Public Works, retained the services of Stantec to develop this stand alone document that provides a technology screening evaluation for different phosphorus removal technologies. This evaluation provides the City with additional information to support their comments to the EPA in response to the draft NPDES permit with respect to proposed phosphorus limits for the Wastewater Treatment Facility effluent discharge. In developing this document, Stantec reviewed the draft NPDES permit and supporting fact sheet with respect to the Phosphorus (PO_4) limits, reviewed Keene's WWTP operating conditions and typical wastewater characteristics, and performed a screening of eleven technologies.

This document also makes a final recommendation as to the technology(s) that are best suited for the City of Keene to meet proposed phosphorus limitations of 1 mg/l during cold weather months and .2 mg/l during warm weather months. This document also comments on the process technologies that would be suitable to achieve a lesser effluent phosphorus limitation of .36 mg/l of total phosphorus should the City of Keene be granted mass based limits.

Opinions of capital costs for the unit process technologies include appurtenant equipment and are all based on similar sized facilities for comparative purposes. The costs have not been adapted to reflect its actual installation at the Keene WWTP.

2.0 Chapter 2 – Summary of Technologies

2.1 TECHNOLOGIES SUMMARIES

The principal treatment process technologies in use today for phosphorus removal have been selected for this evaluation and are discussed below. Some generalities are made, and treatment performance predicted. In order to develop more absolute determinations with respect to the processes' application to the Keene Wastewater Treatment Facility, any process would need to be pilot tested under the actual wastewater constituent conditions. Table 2.1 summarizes the processes described below.

2.1.1 ENHANCED BIOLOGICAL PHOSPHORUS REMOVAL (EBPR) (#1)

This process involves the creation within the activated sludge process of an environment to optimize the biological uptake of phosphorus within the cell structure. This is readily accomplished by the creation or construction of an anaerobic zone at the beginning of the aeration system, where mixed liquor is returned. This process is well established with many case studies cited in the literature. It offers advantages in that it may be possible to construct an anaerobic cell within the existing aeration tank structure. Research indicates that there is possibly a slight increase in sludge production. Other studies suggest that overall sludge production and chemical costs are reduced, resulting in a net savings on a life cycle cost basis. It has been demonstrated to reduce phosphorus to levels of 0.8 to 1.2 mg/l; however, this process by itself cannot meet the proposed effluent limitations, for seasonal warm weather, or summer requirements, but may be able to meet seasonal cold weather, or winter requirements.

2.1.2 PRIMARY CHEMICAL PRECIPITATION (#2)

This process considers the application of metal salts to precipitate phosphorus within the primary clarifiers. The capital costs are very low, and the addition of chemical coagulants to the primary process has been reported to enhance clarifier performance and remove organic solids. This process would result in an increase in sludge production. Final effluent phosphorus levels are reported in the range from 0.6 – 1.0 mg/l. A disadvantage of this process is the potential higher chemical use, as well as the potential of over removing phosphorus essential to the downstream activated sludge process. This process also does not have the ability on its own to meet any of the proposed effluent criteria.

2.1.3 SECONDARY CHEMICAL PRECIPITATION (#3)

This process considers the application of metal salts to precipitate phosphorus within the secondary clarifiers. The capital costs are also very low but slightly higher than the primary location. A further advantage with the secondary location is the continued recirculation of coagulant with the Return Activated Sludge (RAS). This results in lower dosage rates in practice than what static jar testing would indicate. The ability to accommodate biological phosphorus uptake is also less impacted from addition with the secondary process. This process also results in a small increase in sludge production. Effluent phosphorus levels are reported in the range from 0.5 – 0.9 mg/l. A disadvantage of this process is the potential high chemical use. This process also does not have the ability on its own to reliably meet any of the proposed final effluent criteria, although in practice, an effluent level of less than 0.6 mg/l is frequently achieved.

2.1.4 MULTI-POINT CHEMICAL PRECIPITATION (#4)

This process combines both primary and secondary application points, and has an advantage in varying dosage rates as the process demands. Effluent phosphorus levels are reported in the range from 0.4 – 0.8 mg/l, dependant upon the amount of chemical use. A disadvantage of this process is the potential for higher chemical use. This process also does not have the ability to reliably meet any of the proposed effluent criteria, although in practice, an effluent level of less than 0.5 mg/l is frequently achieved. A key issue with all options that rely on chemical precipitation is the need to control effluent solids. As the chemical dosage increases, the greater percentage of phosphorus will be concentrated in the effluent solids.

2.1.5 EBPR W/ CHEMICAL ADDITION (#5)

In order to optimize the biological uptake of phosphorus with chemical addition as previously described. The system would consist of new tankage upstream of the existing aeration tanks to provide volume for an anoxic zone. Nitrate-rich mixed liquor is recycled from the aeration tank to the anoxic tank, where the collection of organic materials in the influent can serve as hydrogen donors for the dentrification of the nitrates. As a result, part of the organic matter is consumed and nitrate is converted to nitrogen gas, with release to the atmosphere. The mixed liquor is then aerated in the aeration tank, so that the remaining organic matter and ammonia are oxidized. Phosphorus removal is also achieved.

This process has been demonstrated to reduce phosphorus to levels of 0.3 to 0.6 mg/l; however, this process may not be considered to reliably reduce concentration levels to under 0.5 mg/l if effluent solids exceed 10 mg/l. Because the permit is seasonally based, this process could be further investigated to better define predicted performance.

2.1.6 EBPR W/ CHEMICAL ADDITION AND FILTRATION (#6)

This option combines the process to optimize the biological uptake of phosphorus with chemical addition as previously described, with the addition of a polishing filtration step. The filtration equipment has several options, including disk filters and variations of sand filters. This process is also well established with many case studies. For the purposes of this evaluation, disc filters have been assumed for use with the technology. Wastewater flows into the inside of the filter discs from the center drum. Solids are retained within the filter discs while the clean water flows out and into the collection tank. During normal operation, the discs remain static until the water level in the inlet channel rises to a specific point. When this occurs, backwash is initiated. The filtered effluent provided the source of the backwash. There is a larger increase in sludge production, as the effluent suspended solids are now reduced to less that 5mg/l. This process has been demonstrated to reduce phosphorus to levels of 0.1 to 0.3 mg/l.

2.1.7 MULTI POINT CHEMICAL ADDITION WITH FILTRATION (#7)

This option combines the chemical addition as previously described, with the addition of a polishing filtration step. As discussed, the filtration equipment has several options, including disk filters and variations of sand filters. Filtration equipment varies with performance and head loss requirements, and should be piloted prior to selection. This process is also well established with many case studies. There is a larger increase in sludge production, as the effluent suspended solids are now reduced to less that 5mg/l, and with out the EBPR process, chemical costs are likely higher. This process has also been demonstrated to reduce phosphorus to levels of 0.1 to 0.3 mg/l. For the purposes of this evaluation, disc filters have been assumed for use with the technology. Wastewater flows into the inside of the filter discs from the center drum. Solids are retained within the filter discs while the clean water flows out and into the collection tank. During normal operation, the discs remain static until the water level in the inlet channel rises to a specific point. When this occurs, backwash is initiated. The filtered effluent provided the source of the backwash. There is a larger increase in sludge production, as the effluent suspended solids are now reduced to less that 5mg/l. This process has been demonstrated to reduce phosphorus to levels of 0.1 to 0.3 mg/l.

2.1.8 TERTIARY CLARIFICATION WITH FILTRATION (#8)

This process uses a tertiary solids contact clarifier as a separate phosphorus precipitation step. It produces a chemical sludge which can optimize chemical use, by not allowing the reintroduction of phosphorus in the sludge return streams. This option than includes the addition of a polishing filtration step. As discussed, the filtration equipment has several options, including disk filters and variations of sand filters. This process is also well established with many case studies. There is a larger increase in sludge production, as the effluent suspended solids are now reduced to less that 5mg/l, and a chemical sludge is produced. Chemical costs are likely higher, as polymer addition may be essential to the creation of a settleable floc. This process has been demonstrated to reduce phosphorus to levels of 0.03 to .1 mg/l.

If dual stage sand filters are used, the DynaSand D2 process by Parkson is an option that requires the use of a chemical dosing system, flash mixing, two-stage filtration, and reject treatment and recycle using a Lamella Gravity Settler. The phosphorus-laden secondary effluent enters the flash-mixing tank where a coagulant (alum or ferric chloride are typical chemicals of choice) is added. Both coagulants are effective at reacting and precipitating phosphorus. A provision for polymer dosing is also provided to augment the solids removal potential in the filters. This chemically treated secondary effluent is introduced into the first-stage deep-bed DynaSand filter where the precipitated phosphorus is removed. The filtrate from this first-stage filter is further polished in the second-stage standard-bed DynaSand filter. The expected filtered effluent total phosphorus level leaving the D2 process is 0.03 mg/L provided that secondary effluent total phosphorus does not exceed 1.5 mg/L.

2.1.9 MEMBRANE BIOLOGICAL REACTOR (MBR) W/ CHEMICAL PRECIPITATION (#9)

This alternative would convert the present process to an MBR. The MBR consists of a suspended growth biological reactor integrated with a membrane system. Essentially, the membrane replaces the solids separation function of secondary clarifiers and tertiary filters. An MBR operates at a high mixed liquor concentration in the range of 10,000 to 12,000 mg/l. Chemical addition is required to remove soluble phosphorus. Effluent phosphorus levels are reported in the range from 0.01 – 0.1 mg/l, dependant upon the amount of chemical use. A disadvantage of this process is the potential for higher sludge production and energy cost. This process is an emerging technology, and requires a major capital investment. As an alternative, it exceeds the permit objective and should not be considered for meeting phosphorus objectives alone.

2.1.10 TERTIARY BALLASTED FLOC (#10)

This process is similar to the tertiary solids contact clarifier as a separate phosphorus precipitation step. Here, a ballasted chemical sludge is used to assist with floc formation. The heavier ballasted floc settles more rapidly than a conventional clarifier, allowing for a smaller unit. The ballast material is then recovered and reused. Examples of this process are proprietary equipment such as the Actiflo® Process and the CoMag®. This option does not require the addition of a polishing filtration step. This process is new, with few installations. Piloting is necessary to determine the true economics and viability. This process has been demonstrated to reduce phosphorus to levels of 0.01 to 0.1 mg/l. As a proprietary process, the capital cost is high. The CoMag® process has been used for the basis of the recommendations for this report.

CoMag is a magneto-chemical process that uses magnetically enhanced coagulation to enmesh finely divided magnetite into the metal hydroxide floc particles which bind precipitated phosphorus and other pollutants. The dense "magnetic seed" substantially increases the settling rate so that the clarifier can be very small. The magnetite seed is magnetically recovered from the sludge and recycled back to the process.

CoMag recommends that multi-point coagulant addition be practiced whenever chemical precipitation is practiced to achieve the effluent total phosphorus limits. This will enhance performance and result in less coagulant consumption. Secondary effluent that has already had coagulant applied (1st stage of multi-point treatment) is delivered to the CoMag process by a secondary effluent pump station at the chlorine contact tank. The chemical addition system would include:

- Flow-paced chemical addition system.
- Programmable logic controller (PLC) for coagulant addition, sludge recycle and sludge wasting.
- Duplex metering pump system to inject the aluminum sulfate (alum) coagulant into the wet well of the secondary clarifier pumping station.
- Duplex metering pump system to adjust pH using caustic soda.

The treated wastewater flows through the lift pump, more than 100 feet of pipe, and several pipe elbows. It is expected that this will result in sufficient mixing of the alum and caustic such that no in-line static mixer will be required prior to the reaction tanks. The flow through the CoMag system after the reaction tank is by gravity.

The 2nd stage coagulation and flocculation occur in reaction tanks equipped with variable speed mixers. Reaction time (HRT) in these tanks is relatively short because the use of finely screened magnetite in the CoMag process does not require the development of large well defined flocs, as would be necessary for conventional coagulation processes.

The wastewater flows by gravity to the magnetite tanks where the magnetite powder and polymer are mixed. Polymer dose of 1 to 2 mg/l is added to further develop and consolidate the floc particles around the magnetite.

The magnetite concentration in the magnetite tanks serves two major functions:

- Magnetite with a specific gravity of 5.2 greatly increases the settleability metal hydroxide floc.
- Magnetite in the sludge is processed over a magnetic drum where it is recovered and recycled back to one of the magnetite tanks.

The magnetite-laden floc flows from the reaction tanks to two clarifiers that operate in parallel.

Settled sludge is drawn through a recycle/waste pump located beneath each clarifier. Approximately 80 percent of the solids underflow is recirculated back to the magnetite contact tank to improve the flocculation by increasing the mass of solids in contact with the phosphorus precipitate and recycling the coagulant. The remainder of the settled sludge (20 percent) is diverted to an in-line sludge shear and magnetite recovery system using a magnetic drum separator that captures the magnetite and recycles it back to the process. The phosphorus sludge flows to the sludge thickening system for further processing and off-site disposal.

The CoMag system provides for automated process control by using a PLC to continuously monitor the instrument signals and, based on the programmed control logic and set points, adjust the chemical feed rates, sludge pumps, and make other process changes. The operator will control the process through a local control panel and monitor the status of the process, and/or adjust the control set points.

2.1.11 TERTIARY MEMBRANE W/ CHEMICAL PRECIPITATION (#11)

This process would add a tertiary membrane Microfiltration unit to treat the secondary effluent prior to disinfection. Essentially, the membrane replaces more conventional tertiary filters. Chemical addition is also required to remove soluble phosphorus. Effluent phosphorus levels are reported in the lowest range of from 0.01 – 0.05 mg/l, dependant upon the amount of chemical use, and represent the lowest practical of present technology. A disadvantage of this process is high capital and energy cost. This process is an emerging technology, and requires a major capital investment. As an alternative, it exceeds the permit objective and should not be considered for meeting phosphorus objectives alone. The Zenon Zeeweed® process has been used for a basis for capital costs.

Table 2.1 and Figure 2.1 represent a broad brush review of technologies used for phosphorus removal. This look at the full spectrum is needed as the proposed permit limitations indicate a seasonal approach to effluent phosphorus.

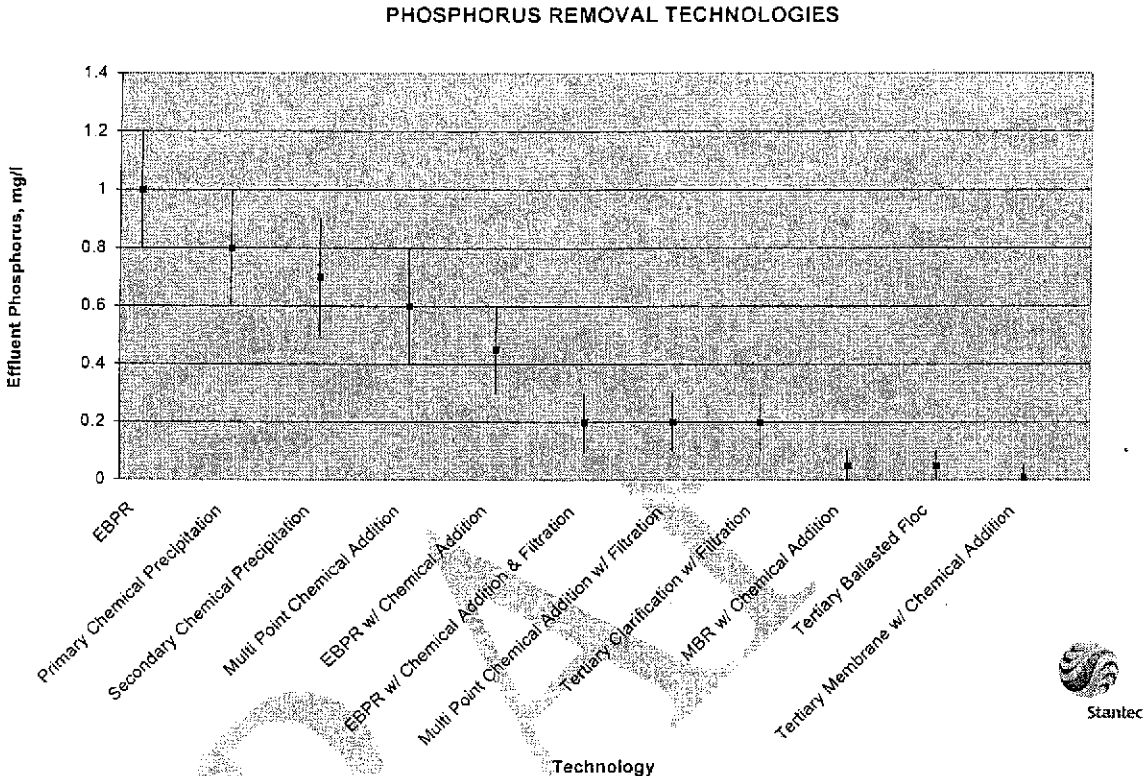

Figure 2.1

2.2 SUMMARY/RECOMMENDATIONS

According to the permit fact sheet, a warm weather limit of 0.2 mg/l total phosphorus and a cold weather limit of 1 mg/l are proposed for the City of Keene in the draft NPDES Permit. This finding is based on a conclusion that examined the impact a discharge of 6.0 MGD would have on the Ashuelot River. The draft permit proposes a specific concentration limitation for phosphorus. In our opinion, the more appropriate limitation should be based on a mass discharge. This is especially important as the technology necessary to achieve limits of less than 0.2 mg/l involve more costly tertiary filtration or ballasted flocculation processes. A mass limit based on 0.2 mg/l at 6.0 MGD allows for a discharge of 10 lbs TP per day. A limit based on 0.5 mg/l at 6.0 MGD allows for a discharge of 25 lbs TP per day. At the present actual average daily effluent flow of 3.3 MGD (per EPA Fact Sheet), a mass limit of 10 lbs/day results in a required effluent concentration of 0.36 mg/l, while 25 lbs/day represents a concentration of 0.9 mg/l. These can be achieved by less costly technologies, such as technology #6 (EBPR with chemical addition and disc filtration) and technology #7 (multipoint chemical addition with disc filtration).

Stantec recommends that the City petition the EPA for a mass limit for effluent total phosphorus and further refine the costs for adapting the technologies to be directly applicable to construction of the facilities at the Keene WWTP.

2.3 BENCHMARK COMPARISONS WITH OTHER FACILITIES

In 2005, the City of Burlington, Vermont effluent phosphorus averaged 0.42 mg/l with a high of 0.54 mg/l and a low of 0.34 mg/l. The City uses supplemental alum addition to keep effluent concentrations this low. According to Steve Roy, City Process Engineer, "Based upon some previous analysis, BNR reduces total P from 5-6 mg/l to around 1-1.5 mg/l and then we finish it with a coagulant. For example, we used an average of 17 mg/l alum in December."

The Town of Maynard, MA discharges to an impoundment in the Assabet River and is currently proceeding with final planning of a phosphorus removal and total plant upgrade to its existing secondary treatment facility. They will be required NPDES permit to achieve .1 mg/l of total phosphorus effluent discharge. They have chosen to proceed with eventual pilot testing of the tertiary ballasted floc (CoMag), technology #10, to achieve an effluent limitation of .1 mg/l. They have also studied extensively tertiary clarification with chemical precipitation and two stage filtration, Technology #8. They considered this process to be comparative in reliability and cost.

PHOSPHORUS REMOVAL TECHNOLOGIES SUMMARY

TABLE 2.1

Process/ Technology # Name	Process/Tech Description	Facilities/Chemicals Required	Effluent Phos. Limits achievable	Performance History/ Number of Installations	Process/ Biosolids Impacts	Estimated Construction Costs [1]	Ability to PO_4 Limits of: 1.0	.36	.2
1. EBPR (AO)	Enhanced Biological Phosphorus Removal (EBPR)	• Construction/Creation of Anaerobic zone at beginning of the activated sludge process • no chemicals required	0.8 – 1.2 mg/l	Established technology, growing number of installations	Slight increase in sludge production	$2,500,000	X		
2. Primary Chemical Precipitation	Metal Salt addition upstream of Primary Clarifiers	• Chemical Storage and Feeding Equipment • Building Addition • Primary clarifier improvements • Sludge pumping improvements	0.6 – 1.0 mg/l	Well established technology, numerous installations	Moderate increase in sludge production	$655,000	X		
3. Secondary Chemical Precipitation	Metal Salt addition upstream of Secondary Clarifiers	• Chemical Storage and Feeding Equipment Required	0.5 – 0.9 mg/l	Well established technology, numerous installations	Small increase in sludge production	$1,130,000	X		
4. Multi Point Chemical Addition	Metal Salt addition upstream of both Primary Clarifiers and Secondary Clarifiers	• Chemical Storage and Feeding Equipment Required • Building Addition • Primary clarifier improvements • Sludge pumping improvements	0.4 – 0.8 mg/l	Well established technology, numerous installations	Larger increase in sludge production	$1,600,000	X		
5. EBPR w/ Chemical Addition	EBPR with secondary Chemical Addition	• Construction/Creation of Anaerobic zone at beginning of the activated sludge process • Chemical Storage and Feed Equipment • Sludge pumping improvements	0.3 – 0.6 mg/l	Established technology, many installations	Larger increase in sludge production	$3,630,000	X		
6. EBPR w/ Chemical Addition & Filtration	EBPR with secondary Chemical Addition and Tertiary disc Filtration	• Construction/Creation of Anaerobic zone • Chemical Storage and Feed Equipment • Effluent Disc Filters required • New Building	0.1 – 0.3 mg/l	Established technology, many installations	Larger increase in sludge production	$6,630,000		X	
7. Multi Point Chemical Addition w/ Filtration	Multi Point Chemical Addition and Tertiary Filtration	• Chemical Storage and Feed Equipment • Effluent disc Filters required • New Building	0.1 – 0.3 mg/l	Established technology, many installations	Large increase in sludge production	$4,600,000		X	
8. Tertiary Clarification w/ two stage Filtration	Tertiary Solids Contact Clarifiers for Chemical Precipitation, followed by two stage Filtration	• Construction of Tertiary Solids Contact Clarifiers • Effluent Filters required • New Building	0.03 – 0.1 mg/l	Established wastewater treatment technology, with many wastewater installations	Moderate increase in sludge production	$7,455,000			X
9. MBR w/ Chemical Addition	Membrane Biological Reactor w/ Multi Point Chemical Addition	• Construction of Membrane Biological Reactor • Chemical Storage and Feeding Equipment	0.01 – 0.1 mg/l	Emerging technology, many installations	Large increase in sludge production	$10,500,000			X
10. Tertiary Ballasted Floc	Ballasted Clarification Process	• CoMag® (Magnetite Weighted) or Actiflo® (Sand Weighted) proprietary process equipment • Chemical Feed Systems	0.01 – 0.1 mg/l	New and Emerging technology being piloted, no installations for CoMag, few for Actiflo	Potentially small increase in sludge production	$6,530,000			X
11. Tertiary Membrane w/ Chemical Addition	Multi Point Chemical Addition followed by Tertiary Membrane Microfiltration	• Construction of in-tank Membrane Microfiltration equip. • Chemical Storage and Feed Equipment • Sludge pumping improvements	0.01 – 0.05 mg/l	New and Emerging technology being piloted, few installations	Potentially large increase in sludge production	$8,855,000			X

Notes:
1) Capital Costs are for PO_4 Unit process equipment and appurtenant tankage and equipment only for similar sized facilities. Costs have not been adapted to the Keene WWTP

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TABLE 2.1

3.0 Chapter 3 – RECOMMENDED TREATMENT TECHNOLOGY

Table 3.1 provides a rating matrix of all technologies discussed in this evaluation. This matrix ranks technologies for the three treatment ranges and should be used in conjunction with Table 2.1, with its estimated construction costs and consideration for O&M Costs and operational preference regarding chemical usage to determine the preferred technologies.

Stantec recommends the Enhanced Biological Phosphorus Removal Process (#1) for use during winter weather permit limitations and either the addition of chemicals and filtration to this option (#8) or installation of the CoMag (Tertiary Ballasted Floc - #10) system for the .2 mg/l summer limitation.

PHOSPHORUS REMOVAL TECHNOLOGIES SCREENING RATING MATRIX
TABLE 3.1

	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11
	EBPR	Primary Chemical Precipitation	Secondary Chemical Precipitation	Multi Point Chemical Addition	EBPR w/ Chemical Addition	EBPR w/ Chemical Addition & Filtration	Multi Point Chemical Addition w/ Filtration	Tertiary Clarification w/ Filtration	MBR w/ Chemical Addition	Tertiary Ballasted Floc	Tertiary Membrane w/ Chemical Addition
Amount of Chemicals used	5	3	3	2	3	2	2	2	2	2	2
Site Requirements	5	4	4	4	4	2	1	1	1	1	1
Process Reliability	2	3	4	3	3	4	4	3	3	2	1
Biosolids Impacts	4	4	4	3	3	2	2	3	2	4	2
Capital Costs	2	3	3	3	3	2	3	2	1	3	2
O&M Costs	4	4	3	3	3	3	2	3	2	3	2
Total	**22**	21	21	18	19	**15**	14	14	11	**15**	10

Notes: The primary areas of concern in selecting and evaluating phosphorus removal technologies are the process's history of performance and process reliability, operational and biosolids impacts, capital and O&M costs. The "Phosphorus Removal Technologies Evaluation Summary" presents a numerical ranking of the alternatives based on these criteria. A rank of from 1 to 5 is given to each alternative for each criteria, with "5" being assigned to the alternative which best meets the needs of the City. As a result, the alternative with the highest overall ranking is the preferred option. This Matrix rates technologies without consideration for the process's ability to achieve discharge limits. This matrix should be used in conjunction with Table 2.1 determine the best technology for each treatment range.

Meets 1.0 mg/l
Meets .36 mg/l
Meets .2 mg/l

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