APPENDIX A

NORTH READING MIDDLE & HIGH SCHOOL PROPOSED
WASTEWATER TREATMENT PLANT ENGINEERING REPORT

NORTH READING PUBLIC SCHOOLS

NORTH READING MIDDLE AND HIGH SCHOOL WASTEWATER TREATMENT FACILITY

CONTRACT OPERATION AND MAINTENANCE SERVICES

REQUEST FOR PROPOSAL

FEBRUARY 14, 2020

RFP No. 20 - 02

NORTH READING MIDDLE & HIGH SCHOOL
PROPOSED WASTEWATER TREATMENT PLANT
ENGINEERING REPORT

INTRODUCTION

The existing North Reading Middle & High Schools (NRMH) was built approximately 50 years ago and are located on the same 42.5 acre site with the following addresses:

North Reading High School	189 Park Street
North Reading Middle School	189 Park Street

HISTORY

The existing NRMH complex wastewater disposal consists of two separate septic disposal systems on approximately a 42.5 acre school site. The Middle School Septic System is approximately 47 years old and the High School System is approximately 56 years old. The Commonwealth of Massachusetts Department of Environmental Protection (DEP) Title V 310 CMR 15.00 requires that for projects generating in excess of 10,000 gallons of sewage flow per day that a Ground Water Discharge Permit (GWDP) be obtained. In order to meet the effluent ground water discharge standards a wastewater treatment facility will be required for this site.

ENGINEERING DATA

Martinage Engineering Associates, Inc. (MEA) working with HML Associates, Hingham, MA, the project hydrogeologic consultant, determined the suitability of the site to receive the project design flow for the new NRMH. A completed hydrogeologic has previously been submitted to your department under BRP WP 83 (Transmittal # X253126). In summary, suitable soils with excellent percolation rates have been found and official testing witnessed by Mr. Criss Stephens of your department has been completed. The proposed school site is not within a nitrogen sensitive area or classified as within a Zone II Water Supply Protection Zone.

MEA previously submitted engineering data relative to actual water use at the existing NRMH. Copies of this data as well as a copy of an email from your office dated June 20, 2012 are enclosed. The email summarizes DEP's review and concurs with our opinion that based on the information presented by MEA that the use of 10-gallons/person/day as design flow for the proposed NRMH project is appropriate and consistent with current water use records as well as other similar school data presented

by MEA. The June 20, 2012 email also concurs that for a design population of 1,750 students and staff that a design flow of 17,500 gpd should be used as the basis of design. This request for variance for school flow is allowed per Title V 310 CMR 15.416.

The proposed wastewater treatment plant will be designed with the following influent and effluent parameters. (Based on similar school effluent studies by our firm).

Influent

Flow 17,500 GPD
BOD_5 450 mg/l
TSS 350 mg/l
TKN 160 mg/l

Effluent

BOD 30 mg/l
TSS 30 mg/l
TN 10 mg/l
Fecal 200 colonies/100*

*MEA respectfully requests that an effluent limit for fecal coliform not be included in the final GWDP, unless DEP review of the downstream environmental receptors or site specific conditions require a permit level for fecal coliform.

PROPOSED LEACH AREA AND PROPOSED 50% RESERVE AREA

The size of the proposed final leaching area is based on the hydrological study prepared by HML with a loading rate of treated effluent at 3 gals/sq.ft./day. The reserve area proposed for the site has been sized for 50% of the proposed design flow. We request that DEP allow the 50% reduction in the reserve area due to site constraints. The permittee is proposing a Membrane Biological Reactor (MBR) treatment system which will achieve high levels of solids removal from the wastewater and provide an extended life to the active final leach area. In addition, the final leach area has been designed as two separate leach areas of 3,000 square feet each independent of each other. The separate distribution network will allow ½ of the total field (3000 sq ft) to be taken off line for repair etc, if necessary, while the other ½ remains on line.

EXISTING INFLUENT DESIGN PARAMETERS

The following designed criterion is based on a previous letter report by our firm as previously noted. Based on the organic analysis of raw waste from five (5) similar High School WWTPs, we determined the following is the realistic expected organic load for the proposed school facility.

BOD_5 = 450 mg/l
TSS = 350 mg/l
TKN = 160 mg/l

The proposed treatment facility final disposal area (SAS) will be located at the site which is outside any designated Zone II Water Supply Protection Zone. The proposed WWTP using MBR Technology will be designed to produce an effluent quality not to exceed the following:

BOD_5 = 30 mg/l
TSS = 30 mg/l
NITRATE = 10 mg/l
TOTAL NITROGEN (NO_2 + NO_3 + TKN) = 10 mg/l
FECAL COLIFORM = 200 colonies/100 *
OIL & GREASE = 15 mg/l

- If required by DEP after review of project hydrogeology study

PROPOSED TREATMENT OVERVIEW

Our firm reviewed possible methods of treatment and has elected to use the MBR Process. This process will include Primary Settling, Flow Equalization, Aerobic Stage, Anoxic Stages, Membrane Stage, UV Disinfection, and Dosing Tank to Cultec below grade chambers (or approved equal) and final leach area below grade distribution system.

PROPOSED TREATMENT PROCESS

PRIMARY TREATMENT/ FLOW EQUALIZATION

Wastewater from the new NRMH complex will enter one of two 9,000 gallon trash traps. The trash traps will be precast concrete tanks installed below grade. The purpose of the trash traps is to remove a portion of fats, oil and grease (FOG) and heavy solids prior to the wastewater entering the Flow Equalization Tank (EQ tank). Flow from the

trash traps to the EQ tank will be via gravity. A 19,000 gallon precast concrete EQ tank will be installed below grade (9,276 gallon working volume). The EQ tank will be utilized to dampen the flow variations throughout the day in order to feed a relatively constant flow to the treatment process. The trash traps and EQ will have Odor Control to an activated Carbon Motorized Odor Control system. The EQ tank will contain two (one operating/one standby) submersible pumps. The pumps will be controlled by variable speed drives and the flow from the pumps will be monitored by a magnetic flow meter. In this fashion the pump output can be controlled to a specified flow rate regardless of the liquid height in the EQ tank. This flexibility will allow the operator to set the flow into the treatment process for better process control. An ultra-sonic level sensor will be installed in the EQ tank to monitor the liquid level for pump protection and high level alarming. Flow from the EQ pumps will pass through a rotary drum screen. The screening system will remove non-soluble BOD and inorganic solids greater than 2 mm. The screen system will include conveyor/compactor and automatic bagging system to capture the solids. Screened sewage will then flow to a 5,000 gallon Pre Anoxic Tank. A level sensor will be installed in the Pre Anoxic Tank to control the flow forward from the FET pumps.

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MECHANICAL BAR SCREEN

Wastewater will be pumped at a controlled forward flow rate from the FET through an automated mechanical bar screen assembly prior to flow to the biological treatment reactors. The mechanical bar screen will contain 2 millimeter openings with raking mechanism to remove collected solids to a collection basket.

PRE ANOXIC STAGE

Wastewater will be fed to a 5,000 gallon Pre Anoxic tank from the bar screen. This tank will be a below floor grade precast concrete tank within the building. The anoxic zone is required in order to achieve nitrogen removal. Nitrogen removal is accomplished in the anoxic zone by the conversion of nitrates to nitrogen gas (which purges to atmosphere). Although the anoxic zone is maintained with zero dissolved oxygen it does contain oxygen in the form of nitrates contained in the mixed liquor that is recycled from the membrane skid. The carbon source required for biological Denitrification is provided by the influent wastewater and a supplemental carbon feed system. Oxygen required for the oxidation of BOD by the microorganisms is supplied by the oxygen that is chemically bound to the nitrate ion resulting in the reduction of nitrates to nitrogen gas. The design will utilize the mixing pumps to mix the contents of the anoxic tanks. In order to assure the microorganisms have an adequate food source a supplemental carbon feed system will be installed. An ORP controller will be utilized to monitor the oxidation reduction potential in the anoxic tank which will determine the rate of additional carbon that needs

to be fed to the anoxic tank. The supplemental carbon system is fully automatic. A non-hazardous chemical called Micro-C or Sucrose will be utilized as the additional carbon source.

AERATION STAGE

Mixed liquor will flow by gravity from the Pre Anoxic tank to a 4,400 gallon aeration tank. This tank will be a reinforced below grade precast concrete storage tank within the building. The aeration tank is fitted with a fine bubble aeration system in order to provide oxygen to the microorganisms and to provide complete mixing of the aeration tank contents. Both BOD reduction and nitrification occur in the aeration chamber. Air is provided to the aeration chamber by a positive displacement blower that is controlled by a variable speed drive (VFD). A dissolved oxygen (DO) meter will monitor the dissolved oxygen level within the aeration chamber. The DO meter will provide information to the control system to allow for automatic control of the aeration blower. The speed of the blower will be controlled in order to maintain a set DO level within the chamber. A pH control system will be installed to monitor and control the pH in the aeration tank to optimum levels. Sodium Hydroxide will be utilized to control the pH.

POST TERTIARY ANOXIC REACTOR

A 2,500 gallon precast concrete tank below floor grade similar to the pre anoxic storage described above will provide Denitrification of any remaining Nitrate-N that is contained in the aerobic reactor effluent.

MEMBRANE STAGE

Following biological treatment in the anoxic/aeration tanks, the treated wastewater must be separated from the biomass (activated sludge). This will be achieved by a pressurized cross-flow low energy membrane separation process. The activated sludge in the concentrate stream will be returned to the Aeration Tank.

The proposed Pentair X-Flow Airlift Bio Pulse Membrane will be external tubular membrane system. The Membrane will be configured in the vertical position above the WWTP floor for ease of maintenance. The bank of membranes will be provided with a membrane feed pump to provide the necessary cross-flow velocity through the membrane modules. The feed pumps are ‘fed’ from below floor grade Post Anoxic tank.

PERMEATE TANK

This tank will be a reinforced above grade HDPE 2,000 gallon storage tank within the building. The purpose of the Permeate Tank is storage of water for backwash of the Membrane with the overflow discharge to the outside below grade Dosing Tank.

TURBIDITY MONITORING

A slip stream from the permeate pump discharge will pass through a turbidity meter prior to the permeate /backwash tank fill connection. The turbidity meter will monitor the clarity of the effluent in order to alert the operator in the unlikely event of a membrane failure. Should the turbidity increase above an acceptable level the system will be faulted and an alarm activated.

UV DISINFECTION

A UV disinfection system will be installed on the discharge of the Membrane Skid Pump. This UV system will be utilized to assure fecal coliform levels meet the permit requirements. A second UV unit with pump will recirculate the stored water in the Permeate Storage Tank to assure that backwash water is disinfected and free of any growths that could foul the membrane. The discharge to the dosing pumps will include a flow meter and pH monitor.

TREATED EFFLUENT DISPOSAL

Effluent will then be directed to a below grade 4,375 gallon working volume Dosing Tank. The effluent storage tank will be a precast concrete tank installed below grade. The tank will contain two effluent dosing pumps. The dosing pumps will pump effluent to final discharge within the new chambered disposal field. The dosing will consist of dosing to two separate leach areas with separate pump and force main. The dosing pumps will be controlled with VFD's to vary the flow discharge rate for distribution to the final fields. The discharge piping to the SAS will be dual 4" diameter ductile iron pipes. The distribution system within the final leach area will consist of 3" and 4" schedule 80 PVC pipe. 20 distribution nozzles per field are proposed to disburse the treated effluent. Each nozzle is designed to dose at a rate of 10 gpm.

STANDBY EMERGENCY POWER

A standby generator will be installed to provide power in the event the treatment plant loses power. The generator will be designed to automatically start upon a power failure and continue to operate until normal power is restored. The generator will be sized to operate the plant at peak capacity. The generator will be located outside the proposed WWTP building.

SAFETY

The WWTP will be equipped with standard safety features such as first aid kit and fire extinguishers. In addition, eye wash and safety shower within the chemical feed area will be provided. OSHA approved chemical storage containment basins will be provided for all stored chemicals.

The construction of the new WWTP to serve the new NRMH will be a positive long range improvement to sewage disposal at this site.

FUTURE POSSIBLE OTHER SEWER CONNECTIONS

During the WWTP design process, the Town of North Reading discussed the possibility of connecting additional public buildings to the proposed NRMH WWTP at sometime in the future. This was discussed during a meeting with DEP on May 13, 2012. The possible future tie in of North Reading buildings included the Batchelder School, Public Safety, Flint Library, Building on the common, Putnam House, Damon Tavern and Senior Housing adjacent to the school site. DEP stated that these additional flows would be considered after the new NRMH is on line and after consistent actual water use is documented. This evaluation would occur in 2016. It was noted at the meeting that any future connections to the WWTP would be only for public buildings and not private. (See Section 1b showing possible public building tie in concept).

OVERALL SITE PLAN

Included with the design package submittal are site drawings showing the proposed sewer collection system for the new NRMH.

Shown on the permit drawings upstream of the WWTP is a sewer stub to allow for the possible future tie in of the North Reading Senior Housing Complex. This possible future tie in would be considered especially feasible to supplement sewage flows to the new High School WWTP during the summer months or periods during the year when school flow is minimal. This tie in would not be made without prior approval by DEP of proposed method of tie in. This proposed tie in would not occur until complete construction of the High School/Middle School as well as a period of recording of actual water from the new school building complex.