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APPLIED GEOLOGY, INC.
ENVIRONMENTAL CONSULTANTS

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LINCOLN APPLIED GEOLOGY, INC.

May 6, 2020

Ms Jamie Teague, Business Administrator
Dresden School District/SAU7O
44 Lebanon St., Suite 2
Hanover, NH 03775

RE: Marion Cross School, Wastewater Disposal System – Hydrogeologic Evaluation of a Failed Wastewater Disposal System and the Overall Norwich Town Green

Dear Ms Teague:

When what are described as colored surface discharges began appearing on the ice and snow covered surface of the Town Green (the Green) west of the Marion Cross School's (MCS) four (4) disposal areas, there was of course, a concern that they were failing or had failed. Pathways Consulting, LLC (PC) conducted a reconnaissance on January 26, 2018 to take photographs to locate, characterize and collect representative samples of four (4) of them for fecal coliform analysis. The February 2, 2019 PC letter report, the Figure 1 Sampling Diagram, seventeen (17) photographs and the fecal coliform laboratory results are attached as Attachment A. The letter report clearly shows the wide spread presence of colored surface discharges on the Green west of the 4 disposal areas, as well as their appearance. Four frozen samples were collected for analysis, the results of which suggested very low level fecal coliform presence. There is enough evidence of fecal impact to understand that the surface discharges form seasonally, driven by the dynamics of the current system. The facts that were defined are that the colored surface discharges only appear during periods of very cold weather enhanced by snow and ice conditions and they appear north and west of the 4 disposal areas. Based on the definition of a failed wastewater system in the current State wastewater regulations, systems that have recurring, continuing, or seasonal failures are considered to be failed systems. In this regard, the Marion Cross School wastewater disposal system is a failed system.

In response to their findings, the reoccurrence of the problem in 2019 and concerns of widespread disposal system failure, Lincoln Applied Geology, Inc. (LAG) in concert with PC was contracted by Norwich School District to conduct a four (4) task Hydrogeologic Analysis to define the nature and cause of the problem, as well as a possible solution. The four tasks include:

Task 1 – A site and soil evaluation was conducted in the current disposal area and the Green using reconnaissance and test pit methods. Several pits were precisely placed to evaluate if and why the existing disposal areas are failed given that they are located in a permeable sand deposit. The other test pits were be placed in the Green to define conditions that could cause seasonal failures, as well as to define potential solutions to the problem beyond the limits of the current disposal area.

Task 2 – Three (3) borings (with continuous macrocore samples) were placed and converted to monitoring wells finished off below grade to be used for hydraulic conductivity testing and water table monitoring. This included oversight by a geologist/hydrogeologist, the boring contractor (T&K Drilling) and all required materials.

Task 3- Hydraulic conductivity tests on the 3 monitoring wells were conducted to define the ability of the sand deposit to transmit effluent from the disposal areas.

Task 4- The analysis of the overall database was conducted to define the cause of the colored surface discharges, to define a basis of design for handling +/- 5000 gallons per day (gpd) and to define solutions for remediating the process causing the colored surface discharges.

As a result of a summary meeting on November 11, 2019 with the State of Vermont Regional Engineer, Terry Shearer; Pathways Consulting, LLC; Ms Jamie Teague, Business Administrator for Dresden School District/SAU70 and Tom Candon, School Board Chair of Norwich School District, the tasks were expanded to include Task 5- Altering disposal system operations as soon as possible and groundwater system monitoring (which was authorized in early March 2020).

Preliminary to conducting the analysis, a comprehensive review of the soil and hydrogeologic evaluation that was conducted by Wagner, Heindel and Noyes(WHN) to provide a basis of design for the current 10,000 gpd system that was designed, permitted and installed in 1988 – 1989 timeframe was reviewed. The 10,000 gpd system design was also reviewed to define the specific details of the distribution system along with its adequacy and functionality in terms of defining how the distribution system may have contributed to the appearance of the colored surface discharges. This review was ultimately conducted to define potential ways of remediating the system (if possible) to prevent the seasonal formation of the colored surface discharges.

A series of seven (7) test holes shown on Figure 1 were excavated and evaluated by Tim McCormick of PC and Stephen Revell, CPG of LAG on June 13, 2019 with Terry Shearer, State Regional Engineer in attendance. Formal descriptions were compiled by Tim McCormick, Soil Scientist which are presented in Attachment C. The test hole locations are shown on the attached Figure 1 – Existing Conditions Wastewater Plan prepared by PC. Four test holes (TH-1 through TH-4) were placed adjacent to each of the 4- 4200 sq. ft. disposal fields to define soil conditions and evidence of failure or proper function. Three additional test pits were excavated and evaluated on the western half of the Green (TH-5, 6 and 7) to define native soil conditions and water table limitations beneath the overall Green.

The test holes placed adjacent to each disposal area identified clean disposal area stone and no evidence of clogging or the presence of black organic deposits that would suggest malfunction or failure. Following their placement, the effluent pump was activated to evaluate distribution to all four disposal areas and they all passed with flying colors. The native soils beneath each disposal area were evaluated and fine to coarse sands and some loamy fine sands were identified with no indication of a water table noted to a depth of at least 48 to 65”. The soil descriptions defined by WHN in 1988 were generally confirmed.

The native soil profiles beneath the overall Green were defined as sandy loams to loamy sands over gravelly coarse sands with no real evidence of a water table to a depth of 72”. Evidence of a seasonal high water table and saturation were noted at a depth of 72 to 84”. This mimiced the depth to water table indicators noted by WHN in 1988. The overall soil data indicated the presence of permeable sands which were thought to be capable of handling either 10,000 gpd in 1988 or +/- 5000 gpd in 2019 generated by MCS.

To define the soil characteristics at depth, 3 borings/ monitoring wells shown on Figure 1 were installed and evaluated to a depth of 12 to 15’, directly adjacent to test holes 1, 3 and 4. The boring/ monitoring well descriptions are included in Attachment C. They indicated the presence of fine to coarse sands with minor gravel to a depth of 11 to 12’, underlain by fine sand to silt. They were found to be saturated at a depth of 6 to 7’’. The boring/monitoring well descriptions indicate the presence of permeable well drained sands which preliminarily appeared capable of handling the current wastewater flows (+/- 5000 gpd) from MCS. The boring/ monitoring wells were also placed to define the water table and direction of groundwater flow in the area of the 4 disposal areas, as well as to allow the hydraulic conductivity/ permeability of the native sand deposits to be defined.

Saturated hydraulic conductivity tests were conducted on July 30, 2019 in the 3 monitoring wells and analyzed using Hvorslev’s Method. Prior to the testing, the depth to water table was defined between 7.3’ and 8.2’ below ground surface. Utilizing the monitoring well elevations shown on the Figure 1 Existing

Conditions Wastewater Plan, groundwater elevations were calculated. As shown, they are 514.56'(MW-1), 514.90'(MW-2) and 515.59'(MW-3). A single groundwater contour (515') is shown which describes general groundwater flow to the south – southeast at a low (not flat) groundwater gradient of 0.0068 feet/feet which discharges into one or more tributaries of the Connecticut River. Depending on groundwater conditions at different times of the year, as well as cold weather related perturbations, I believe that flow components could be radial to the west, southwest, south and southeast. The results of the hydraulic conductivity analysis are contained in Attachment D. Three tests were conducted with hydraulic conductivities ranging from 40.48 ft./day to 40.94 ft./day to 42.70 ft./day. They are somewhat higher than the results generated by WHN. The average value is 41.37 feet/day which was used in the Site Specific Effluent Mounding Analysis utilizing Darcy's Law. This is an overall effects analysis which relates to all 4 disposal areas operating simultaneously. The results of this analysis indicate that a 8.48' effluent mound would develop beneath the disposal area in response to a maximum potential daily flow of 5000 gpd. It is important to note that the way the current system was operated through December 2019 with very limited alternation of the disposal areas, the mounding could be higher. As Attachment D shows, the Darcy's Law analysis was also conducted with literature values of 50 feet/day and 100 feet/day because 41.37 feet/day did not seem high enough for the underlying sands. The results indicate an effluent mound 7' and 3.5' will form.

An attempt at calibrating the Darcy's Law model using the Hantush model was made using 41.37 feet/day, 50 feet/day and 100 feet/day. The results indicate effluent mounds of 2.14', 1.86' and 1.08' would form. The use of the model suggests that the mounding associated with the simultaneous use of the disposal fields will be much less than that calculated using Darcy's Law, so the use of Hantush to calibrate Darcy's Law is not considered to be applicable because there is not flow in all directions throughout the year. The use of the Hantush Model does confirm to the greatest degree the analysis conducted by WHN in 1988 which showed a 1.5' mound resulting beneath the 2- 2500 gpd beds of each 5000 gpd system. To continue with the attempt to calibrate the current Darcy's Law model, the WHN data was used to calculate a groundwater gradient (in 1988) of 0.0042 feet/feet. This gradient was used to calculate mounding of 13.7', 11.4'and 5.68'. Although the effluent mounding was greater using WHN data, the results compare favorably with the effluent mounding calculated in 2020. This calibration/comparison indicates that if an active groundwater gradient in a specific direction can be calculated from groundwater elevation data, Darcy's Law should be used because the Hantush Model is based on effluent flow in 4 directions from the disposal field. In short, modeling using Hantush significantly underestimates effluent mounding associated with a sloping one dimensional groundwater flow system.

Based on the effluent mounding results generated from Darcy's Law, it is difficult to understand why the four disposal areas are not failing all the time. It is my belief that as the effluent mound grows effluent flow goes from being one dimensional to the south-southeast to being multi-dimensional to the southeast-south-southwest-west-northwest. This results in the zone of effluent transmission expanding to the point that results in effluent mounding being much less than that calculated in Attachment D. This answers the question about the impact of effluent from the disposal areas remaining subsurface most of the year but it doesn't explain what takes place during very cold periods of the year.

In order to define the process by which the cold weather colored surface discharges form, the way the disposal system is currently operated and related earth processes must be taken into account. In this regard, during cold (below freezing consistently) weather, the roads and walkways bounding 4 sides of the Green freeze to variable depths normally approximating 6' with all other ground surfaces freezing to variable depths depending on their use which includes the playground use, other Green uses, the ice rink use, and the disposal area use. In this regard, there is a variable layer of frost and ice/snow cover over the complete area of the Green which includes the disposal areas. This sets up the cold weather existence of a box bounded by four sides of frozen soil to a depth of 6' with a variable thickness of frozen ground on the top and a water table on the bottom. The presence of the frozen soil box, the correctly calculated effluent mounding, the distribution system design and the current operation of the system results in excessive distribution to a limited area (flooding) causing excessive effluent mounding and causing effluent and comingled groundwater to be compressed between the water table, the frozen ground on three sides and the variable thickness of frost and snow/ ice ground cover. This results in the migration of effluent to the north and west, the least impacted area of the frozen box. In short, the colored surface discharges form at random locations based on random westerly and northerly paths of least resistance to the surface. It is a bit difficult to comprehend but it is real. This relates to understanding that the historic system operations revolved around a 850 gpm pump which doses 2500 gallons to 2 of the 4 disposal fields (at a time) in 3 minutes. In other words the 2 disposal fields are being flooded and in winter weather the related effluent is compressed by ice and the underlying effluent related mounded water table resulting in the colored surface discharges expressing themselves at ground surface. Even without the Girard Way frozen side of the box blocking the south flowing groundwater system, a review of the St. Barnabas Church soil and groundwater data indicates restrictive conditions downgradient of the school with both a very shallow water table and a very flat groundwater gradient.

Task 5 was initiated after the November 11, 2019 summary meeting by reducing the total flow during each pumping event and opening valves to allow effluent to be distributed simultaneously to all four disposal areas at the same time. As cold weather set in, the system showed no signs of failure or the formation of the colored surface discharges to the west of it. Unfortunately, when consistently very cold conditions set in and ice and snow began covering the overall Green, the colored surface discharges again began to form. In response, at the end of February, LAG was asked to install pressure transducers to continuously monitor the water table during the simultaneous operation of all 4 disposal areas.

The transducers were installed in monitoring wells MW-1 and MW-3(shown on Figure 1) located on the west side of the overall disposal area on March 9, 2020 during what looked to be the meltdown of the snow and ice conditions on the surface of the Green and probably the frozen soil sides of the box. During the first week of monitoring, the school was in operation but after that the school was shut down for the mid-winter break and then was closed due to Covid-19. The school has remained closed to date. Because the school was shutdown, the transducers were removed on March 31, 2020 to evaluate water table impacts during the one week of school operation.

The graphical results of groundwater monitoring are presented in Attachment E as Figures 1 through 6. A water table data set was collected when the transducers were removed in order to define the groundwater flow direction and the groundwater gradient. To the greatest degree, they were the same as that shown on the Figure 1 Existing Conditions Wastewater Plan, with groundwater flow to the south at a gradient of 0.0068 feet/feet. Monitoring Figure 1 and 3 describe groundwater conditions between March 9 and March 31 in MW-1 (located on the Girard Way side of the disposal area) and MW-2 (located on the ballfield side of the system). The peaks represent system pumping events with the school in operation during the first week and without the school in operation during the remaining period although normal maintenance was being conducted and possibly staff related activities were being conducted in response to Covid-19. Since the disposal areas were installed at an approximate depth of 2.5', the minimum separation of the groundwater system from the bottom of the disposal areas can be calculated. Relative to MW-1, the minimum calculated separation was 3.71'. For MW-3, the minimum separation was 3.54'. The required minimum separation from the groundwater system is 3'. The monitored separation is concerning given only one week of the school operating and the fact that the seasonally high groundwater period had not been completely reached.

Monitoring Figures 2 and 4 describe groundwater conditions between March 9 and March 14 when the school was in operation. These graphs (Monitoring Figures 2 and 4) show nothing different than Monitoring Figures 1 and 3, they just allow a focus on the groundwater conditions when the school was operating. Based on the fact that the monitoring was conducted just after frost left the ground and now the school is no longer operating, the monitoring was suspended because the necessary data was already collected and the collection of additional data would not show anything more that would aid the evaluation.

In summary, the five task hydrogeologic evaluation describes the presence of well drained sands with a high enough permeability to transmit effluent and groundwater but with very difficult one dimensional flow to the south at a low gradient of 0.0068 ft/ft. When modeled properly using Darcy's Law, effluent mounding can be shown to be prohibitively high and in direct conflict with State wastewater regulations. While the groundwater flow system expands in width due to radial flow in a southeast-south-southwest-west-northwest direction to dissipate the effluent mounding during most of the year, it cannot be expanded at all when frozen ground conditions are present. In this regard, comingled groundwater and effluent flows to the north and west, the least impacted area in the frozen box. What this suggests is that the disposal areas may be sized large enough to accept 5000 gpd in warmer conditions but during very cold weather when the frozen soil box is present there is nowhere for the effluent to go but up to the surface on the north and west side of the Green. Based on the results of the evaluation, it is my professional opinion that regardless of the size, dimension or orientation of an up to 5000 gpd system, the presence of the frozen ground barriers will not allow a system of this size to function properly year-round.

If you have any questions, please don't hesitate to call me at 802-453-4384 or email me at srevell@lagvt.com

Very truly yours,
**Lincoln Applied Geology, Inc.**

Stephen Revell, CPG
Senior Hydrogeologist

SR/KC
Cc Jeff Goodrich
Tom Candon
Tony Daigle

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## EXISTING SYSTEM

500 STUDENTS WITH KITCHEN=10,000 GPD

$\frac{10{,}000\ GPD}{1.2\ GAL./FT^2}$ 8,333 $FT^2$

DUAL ALTERNATING SYSTEMS
4-4,200 $FT^2$ BEDS

NOTE:
WASTEWATER SYSTEM INFORMATION SHOWN ON PLAN OBTAINED FROM PLAN ENTITLED "SEWAGE DISPOSAL SYSTEM DESIGN FOR MARION CROSS SCHOOL, NORWICH, VERMONT", BY K.A. LECLAIR ASSOC. INC., DATED JUNE 30, 1988. PROJECT NO. 112987A.

TEST HOLE, MONITORING WELL, AND YARD DRAIN LOCATIONS SURVEYED BY PATHWAYS CONSULTING, LLC AUGUST 21, 2019.

0 50 100
IN FEET

REV: 08/21/19


**Pathways Consulting, LLC**
240 Mechanic Street, Suite 100
Lebanon, New Hampshire 03766
(603) 448-2200 FAX: (603) 448-1221


EXISTING CONDITIONS WASTEWATER PLAN

# MARION CROSS SCHOOL

22 CHURCH STREET – NORWICH, VERMONT

| | |
|---|---|
| SCALE: AS SHOWN | FIGURE 1 |
| DESIGNED BY: | |
| DRAWN BY: CRM | |
| CHECKED BY: | |
| DATE: 04/05/19 | |
| PROJ. NO. 11647 | |

# Attachment A

# Marion Cross School Hydrogeologic Analysis

# 1/26/18 Wastewater Sampling Report

# By Pathways Consulting, LLC

**PATHWAYS CONSULTING, LLC**
Planning • Civil & Environmental Engineering • Surveying • Construction Assistance
240 Mechanic Street • Suite 100
Lebanon, New Hampshire 03766
(603) 448-2200 • Fax: (603) 448-1221

February 2, 2018

Anthony Daigle, Director of Facilities
School Administrative Unit #70
41 Lebanon Street, #2
Hanover, New Hampshire 03755

RE: WASTEWATER SAMPLING REPORT, MARION CROSS SCHOOL, 22 CHURCH STREET, NORWICH, VERMONT (Project No. 11647)

Dear Mr. Daigle:

Please find enclosed the monitoring data from wastewater sampling that I conducted at the Marion Cross School on January 29, 2018 at the approximate four locations shown on Figure 1, which is attached. Figure 1 also presents January 26, 2018 approximate photo locations on the attached photo log. Endyne Inc., located in Lebanon, New Hampshire, analyzed the samples.

Sampling point PT- 4 tested positive for fecal coliform bacteria by the multiple tube fermentation technique (SM20 9221E) at a concentration of 2 MPN/g, which is a concentration level at the lowest laboratory detection limit. MPN, or Most Probable Number, is a quantification of bacterial density in a sample and is representative of a bacteria colony. In other words, the mixture of soil and ice sampled at PT-4 had the potential to harbor two fecal coliform colonies per gram of ice/soil mixture.

Sampling points PT-1 and PT-2 were taken from the presumed location of the leachfields, and what appeared to me to be the most heavily contaminated area of the playground. PT-1 and PT-2 sampling locations required significant ice chipping in order to collect surface water samples. These samples were negative for fecal coliform bacteria.

All wastewater samples provided to Endyne were partially frozen and required overnight thawing before the fermentation process could begin, which consequently caused the samples to exceed "hold time" and may have affected the lab results (i.e., the less frozen PT-1 and PT-2 samples would have been more dramatically affected by the thaw time than the more frozen PT-3 and PT-4 samples).

Please feel free to contact us if you have any questions regarding this report.

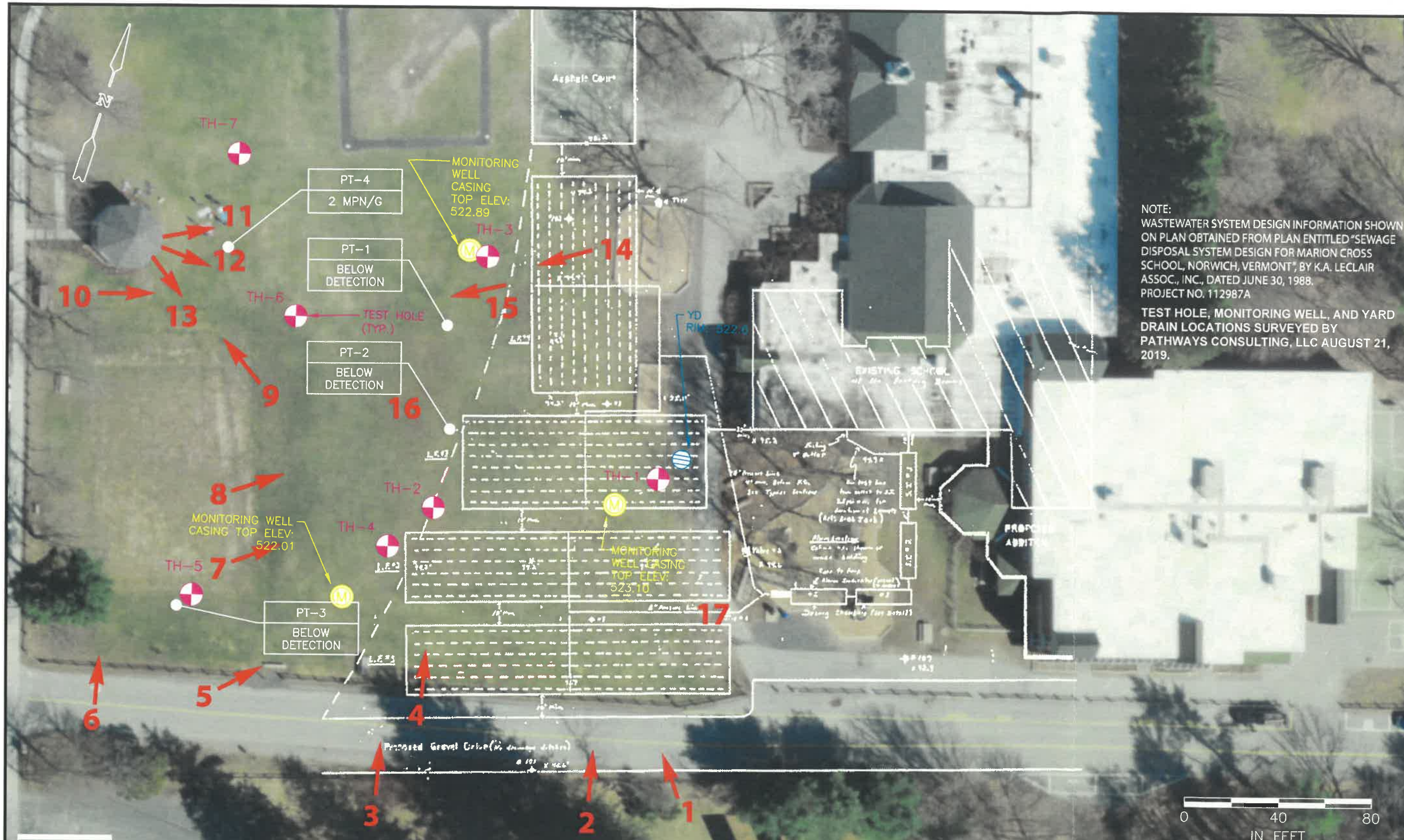
Sincerely,

PATHWAYS CONSULTING, LLC

Thomas H. Philbin
Environmental Engineer

THP:sef
Enclosures

11647.MCSWWSamplingRpt.20180202.thp




**Pathways Consulting, LLC**
240 Mechanic Street, Suite 100
Lebanon, New Hampshire 03766
(603) 448-2200 FAX: (603) 448-1221

SAMPLING DIAGRAM FOR

# MARION CROSS SCHOOL

ROUTE 5 – NORWICH, VERMONT

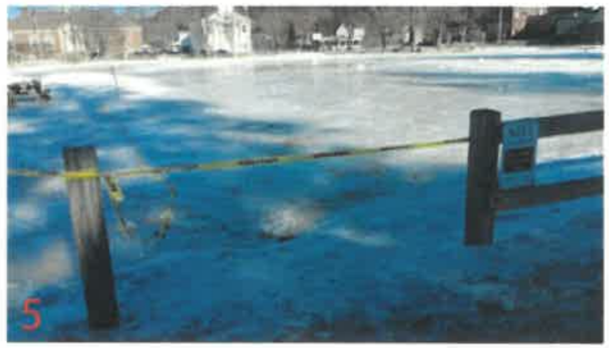
| | |
|---|---|
| SCALE: AS SHOWN | FIGURE 1 |
| DESIGNED BY: | |
| DRAWN BY: CRM | |
| CHECKED BY: JSG | |
| DATE: 02/02/18 | |
| PROJ. NO. 11647 | |


1


2


3


4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01-26-18 PHOTOLOG


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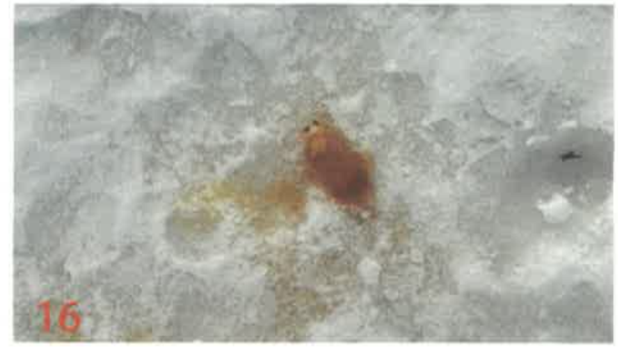
16


17

ENDYNE Inc.
Environmental Laboratories

# Laboratory Report

| | |
|---|---|
| Pathways Consulting, LLC | 090570 |
| 240 Mechanic Street | |
| Suite 100 | |
| Lebanon, NH 03766 | |

PROJECT: Pathways Fecal Coliform
WORK ORDER: **1801-02074**
DATE RECEIVED: January 29, 2018
DATE REPORTED: February 01, 2018
SAMPLER: Thomas Philbin

Enclosed please find the results of the analyses performed for the samples referenced on the attached chain of custody located at the end of this report.

The column labeled Lab/Tech in the accompanying report denotes the laboratory facility where the testing was performed and the technician who conducted the assay. A "W" designates the Williston, VT lab under NELAC certification ELAP 11263; "R" designates the Lebanon, NH facility under certification NH 2037 and "N" the Plattsburgh, NY lab under certification ELAP 11892. "Sub" indicates the testing was performed by a subcontracted laboratory. The accreditation status of the subcontracted lab is referenced in the corresponding NELAC and Qual fields.

This NELAC column also denotes the accreditation status of each laboratory for each reported parameter. "A" indicates the referenced laboratory is NELAC accredited for the parameter reported. "N" indicates the laboratory is not accredited. "U" indicates that NELAC does not offer accreditation for that parameter in that specific matrix. Test results denoted with an "A" meet all National Environmental Laboratory Accreditation Program requirements except where denoted by pertinent data qualifiers.

Endyne, Inc. warrants, to the best of its knowledge and belief, the accuracy of the analytical test results contained in this report, but makes no other warranty, expressed or implied, especially no warranties of merchantability or fitness for a particular purpose.

Reviewed by:

Alexander J Rakotz
Laboratory Director Lebanon, NH

**Laboratory Report** DATE REPORTED: 02/01/2018

CLIENT: Pathways Consulting, LLC WORK ORDER: **1801-02074**
PROJECT: Pathways Fecal Coliform DATE RECEIVED: 01/29/2018

**001** Site: Pt. 1 Date Sampled: 1/29/18 Time: 13:33

| Parameter | Result | Units | Method | Analysis Date/Time | | Lab/Tech | NELAC | Qual. |
|---|---|---|---|---|---|---|---|---|
| Fecal Coliform | < 2 | MPN/g wet | SM20 9221E | 1/30/18 | 14:12 | R SMY | U | AN1 |

**002** Site: Pt. 2 Date Sampled: 1/29/18 Time: 13:45

| Parameter | Result | Units | Method | Analysis Date/Time | | Lab/Tech | NELAC | Qual. |
|---|---|---|---|---|---|---|---|---|
| Fecal Coliform | < 2 | MPN/g wet | SM20 9221E | 1/30/18 | 14:12 | R SMY | U | AN1 |

**003** Site: Pt. 3 Date Sampled: 1/29/18 Time: 13:56

| Parameter | Result | Units | Method | Analysis Date/Time | | Lab/Tech | NELAC | Qual. |
|---|---|---|---|---|---|---|---|---|
| Fecal Coliform | < 2 | MPN/g wet | SM20 9221E | 1/30/18 | 14:12 | R SMY | U | AN1 |

**004** Site: Pt. 4 Date Sampled: 1/29/18 Time: 14:00

| Parameter | Result | Units | Method | Analysis Date/Time | | Lab/Tech | NELAC | Qual. |
|---|---|---|---|---|---|---|---|---|
| Fecal Coliform | 2 | MPN/g wet | SM20 9221E | 1/30/18 | 14:12 | R SMY | U | AN1 |

## Report Summary of Qualifiers and Notes

AN1: Samples received partially frozen. Samples were thawed and run past method specified holding time. Results may be affected by sample conditions.

Endyne, Inc.
56 ETNA ROAD
LEBANON, NH 03766-1446
Phone: 603-678-4891 Fax 603-678-4893
Email: arakotz@endynelabs.com

**LAB USE:**
Sample Logged In By: ______
Anomaly Sheet: Y____ N____
Temperature Check: 1.1

Client: Pathways consulting
Address:

Contact:
Email: Tom.Philbin@Pathwaysconsult.com
Phone No:
Fax No:

**LAB USE:**
Customer Nos:
Project or WSID#:
Job Template:

**CHAIN OF CUSTODY**

| | Date | Time | Print Name Here:* | Date | Time |
|---|---|---|---|---|---|
| Sampled by:* Thomas Philbin | | | Accepted by: | | |
| Relinquished by: [signature] | 1/29/18 | 2:50 pm | Received by Endyne: [signature] SEB | 1/29/18 | 14:53 |
| Relinquished by: | | | | | |

| Sample No: | Sample Location | Sample Date | Sample Time | Matrix | Preservative | Container Material | Container Volume | Containers per Sample | Parameters |
|---|---|---|---|---|---|---|---|---|---|
| -001 | Pt. 1 | 1/29/18 | 1:33 p.m. | | | | | | Fecal coliform |
| | Pt. 2 | 1/29/18 | 1:45 | | | | | | ↓ |
| | Pt. 3 | 1/29/18 | 1:56 | | | | | | ↓ |
| | Pt 4 | 1/29/18 | 2:00 | | | | | | ↓ |

Rec'd Partially Frozen.
To be thawed + Run past holding time - AJK 1/29/18
THP

Please return samples within

1801-02074

1801-02074
Pathways Consulting, LLC
Pathways Fecal Coliform

ENDYNE Work Order:

Attachment B

# Marion Cross School

6/13/19 Test Hole Information

By Tim McCormick, Soil Scientist

Pathways Consulting, LLC

MARION CROSS TEST HOLES PROJECT NUMBER 11647

TEST HOLE INFORMATION (EVALUATED ON 06/13/19)

TEST HOLE #1

| | |
|---|---|
| 0-18" | VERY DARK GRAYISH BROWN 10YR 3/2; LOAMY SAND; FRIABLE; GRANULAR TO SUB-ANGULAR BLOCKY (FILL MATERIAL) |
| 18-30" | 1 ½" STONE AND PIPE LEACH FIELD, WITH FILTER FABRIC |
| 30"-33" | BROWN 10YR 5/3, AND GRAYISH BROWN 2.5Y 5/2 FINE SANDY LOAM; FRIABLE; MASSIVE |
| 33– 48" | VERY DARK GRAYISH BROWN 2.5Y 3/2 MEDIUM TO COARSE SAND; LOOSE; SINGLE GRAIN. NO REDOXIMORPHIC FEATURES, NWTD, NLTD |

TEST HOLE #2

| | |
|---|---|
| 0-18" | VERY DARK GRAYISH BROWN 10YR 3/2; LOAMY SAND; FRIABLE, FIRM IN PLACES; WEAK PLATY (FILL MATERIAL) |
| 18-26" | DARK BROWN 10YR 3/3; LOAMY SAND; FRIABLE; MASSIVE (FILL MATERIAL). |
| 26"-38" | 1 ½" STONE AND LEACH FIELD WITH FILTER FABRIC |
| 38– 40" | DARK BROWN 7.5YR 3/2; LOAMY SAND; FRIABLE; MASSIVE. |
| 40- 52" | VERY DARK GRAYISH BROWN 2.5Y 3/2; MEDIUM SAND; LOOSE; SINGLE GRAIN. |
| 52-60" | DARK GRAYISH BROWN 2.5Y 4/2; LOAMY VERY FINE SAND; FRIABLE; MASSIVE (REDOXIMORPHIC FEATURES IN THIS LAYER DUE TO THE CHANGE IN TEXTURE). |
| 60-65" | DARK OLIVE BROWN 2.5Y 3/3; MEDIUM SAND; LOOSE; SINGLE GRAIN |

TEST HOLE #3

| | |
|---|---|
| 0-12" | VERY DARK GRAYISH BROWN 10YR 3/2; LOAMY SAND; FRIABLE, GRANULAR (FILL MATERIAL) |

12-26" DARK YELLOWISH BROWN, 10YR 3/3 LOAMY SAND; FRIABLE; MASSIVE (FILL MATERIAL). NOTE, LEACH FIELD AT THE SIDE OF THIS HOLE. STONE WAS CLEAN.

26"-28" DARK GRAYISH BROWN 2.5Y 4/2; LOAMY SAND; FRIABLE, FIRM IN PLACES, MASSIVE

28- 54" VERY DARK BROWN 2.5Y 3/2; MEDIUM SAND; LOOSE; SINGLE GRAIN

TEST HOLE #4

0-12" VERY DARK GRAYISH BROWN 10YR 3/2; LOAMY SAND; FRIABLE, GRANULAR (FILL MATERIAL)

12-18" DARK GRAYISH BROWN, 10YR 4/2 AND DARK BROWN 10YR 3/3; MIX OF LOAMY SAND AND FINE SANDY LOAM; FRIABLE; MASSIVE (FILL MATERIAL).

18"-28" 1 ½" STONE AND LEACH FIELD WITH FILTER FABRIC

28- 32" DARK GRAYISH BROWN 2.5Y 4/2; LOAMY FINE SAND; FRIABLE; MASSIVE.

32- 48" ALTERNATING LAYERS OF DARK OLIVE BROWN 2.5Y 3/3; AND DARK GRAYISH BROWN 2.5Y 4/2 FINE SANDS AND MEDIUM SAND; LOOSE AND SINGLE GRAIN TO FRIABLE AND MASSIVE

TEST HOLE #5

0-6" VERY DARK GRAYISH BROWN 10YR 3/2; LOAMY SAND; FRIABLE, GRANULAR

6-12" OLIVE BROWN 10YR 3/3; MEDIUM SAND; LOOSE; SINGLE GRAIN;

12”-28” DARK BROWN 10YR 3/3; GRAVELLY LOAMY SAND; FRIABLE; MASSIVE

28– 72” VERY DARK BROWN 2.5Y 3/2 AND DARK GRAYISH BROWN 2.5Y 4/2; ALTERNATING LAYERS OF MEDIUM SAND AND GRAVELLY COARSE SAND; LOOSE; SINGLE GRAIN, REDOXIMORPHIC FEATURES 5.5 FEET FROM THE SURFACE.

72- 84” DARK GRAY BROWN 2.5Y 4/1; MEDIUM TO COARSE SAND; LOOSE; SINGLE GRAIN. (SATURATED)

TEST HOLE #6

0-6" VERY DARK GRAYISH BROWN 10YR 3/2; LOAMY SAND; FRIABLE, GRANULAR (FILL MATERIAL)

6-16” BROWN, 10YR 4/3; LOAMY SAND; FRIABLE; MASSIVE

16”-36” VERY DARK GRAYISH BROWN 10YR 3/2; GRAVELLY COARSE SAND; LOOSE; SINGLE GRAIN

36– 60” ALTERNATE LAYERS OF VERY DARK GRAYISH BROWN 2.5Y 4/2 AND BROWN 10YR 4/3; COARSE TO FINE SANDS; LOOSE; SINGLE GRAIN

60- 96” DARK GRAYISH BROWN 2.5Y 4/2; GRAVELLY COARSE SAND; LOOSE; SINGLE GRAIN. (Mn staining up to 78 inches from the surface).

NOTE: THERE WAS BUILDING DEBRIS (CHARCOAL AND DECAYED BRICK DOWN TO A DEPTH OF 48 INCHES ON THE EAST SIDE OF THIS HOLE).

TEST HOLE #7

0-7" VERY DARK GRAYISH BROWN 10YR 3/2; VERY FINE SANDY LOAM; FRIABLE, GRANULAR

7-21” DARK BROWN 7.5YR 3/3 GRAVELLY COARSE SAND; LOOSE; SINGLE GRAIN

21”-36” OLIVE BROWN 2.5Y 4/3; MEDIUM SAND; LOOSE; SINGLE GRAIN

36– 48” LIGHT OLIVE BROWN 2.5Y 5/3; FINE SAND; FRIABLE; MASSIVE

48- 55” OLIVE GRAY 5Y 4/2; FINE SAND; FRIABLE; MASSIVE (redoximorphic features in this layer to a change in texture).

55- 84" DARK GRAYISH BROWN 2.5Y 4/2; MEDIUM TO COARSE SAND; LOOSE; SINGLE GRAIN REDOXIMORPHIC FEATUERS DUE TO THE SEASONAL HIGH WATER TABLE UP TO 72 INCHES. SOIL SATURATED AT 84 INCHES.

# Attachment C

Marion Cross School

7/03/19 Boring/Monitoring Well Descriptions

By Beth Erickson, Senior Hydrogeologist

Lincoln Applied Geology, Inc.

Lincoln Applied Geology, Inc. 163 Revell Road, Lincoln, VT 05443 (802) 453-4384



| | | | |
|---|---|---|---|
| Client: Marion Cross School | | File Number:19021 | Boring/Well MW-2 |
| Project: Marion Cross School | | **Well Construction Data** | |
| Date Started: 7/3/19 | Date Completed: | Screen: 1.25" 10 slot | From: 3 -To: 10 |
| Logged By: Beth Erickson | Checked By: | Pack: Sand | From: 2 -To: 10 |
| Drilling Co.: T&K Drilling | Driller: Sean and Kevin | Seal: Bentonite | From: 1 -To: 2 |
| Method: Direct Push | Equipment: Geoprobe | Grout: | From: -To: |
| Boring Depth: 10 | Ground Surface Elevation: | Top of Casing Elevation: ground surface/flush mounted roadbox | |
| Initial GW Level: 6-7 ∇ | GW Level: ∇ 7.55 | Casing/Stick Up: / Casing Diameter: | |

| DEPTH | SAMPLE DESCRIPTION | DEPTH | % | RECOVERY | PID | Time |
|---|---|---|---|---|---|---|
| 0-3 | 0-1' - Grass and organic top soil with roots. 1-3' fine sand, some angular gravel | | | 3 | | |
| 3-6 | Medium sand with thin silt/fine sand lenses at 5' and 6' | | | 3 | | |
| 6-9 | 6-8' Higher energy coarse to medium sand and rounded gravel. 8-9' fine sand, few thin silt lenses. Wet at 6-7' | | | 1.5 | | |
| 9-12 | Very wet coarse to medium sand and small angular gravel (very little recovery) | | | 1 | | |
| 12-15 | 12-14' Wet fine sand, few silt lenses. 14-15' coarse to medium sand | | | 3 | | |
| | *End of boring at 15 - hole collapsing in due to sands* | | | | | |
| | *Notes: Closest to building near force main, near TH-1* | | | | | |
| | *Developed until clear with peristaltic pump. Water at 7.55' BTOC 30 min. after installation* | | | | | |
| | | | | | | |

Wet At 6-7

Bottom of Boring At: 15

Time At:

| Soil Samples | | | Water Samples | |
|---|---|---|---|---|
| Interval | Time | Analysis | Time | Analysis |
| | | | | |
| | | | | |
| | | | | |

Lincoln Applied Geology, Inc. Environmental Consultants
163 Revell Road, Lincoln, VT 05443 (802) 453-4384



| | | | |
|---|---|---|---|
| Client: Marion Cross School | | File Number:19021 | Boring/Well MW-3 |
| Project: Marion Cross School | | **Well Construction Data** | |
| Date Started: 7/3/19 | Date Completed: | Screen: 1" 10 slot | From: 3 -To: 10 |
| Logged By: Beth Erickson | Checked By: | Pack: Sand | From: 2 -To: 10 |
| Drilling Co.: T&K Drilling | Driller: Sean and Kevin | Seal: Bentonite | From: 1 -To: 2 |
| Method: Direct Push | Equipment: Geoprobe | Grout: | From: -To: |
| Boring Depth: 10 | Ground Surface Elevation: | Top of Casing Elevation: ground surface/flush mounted roadbox | |
| Initial GW Level: 6 ∇ | GW Level: ∇ 6.8 | Casing/Stick Up: / Casing Diameter: | |

| DEPTH | SAMPLE DESCRIPTION | DEPTH | % | RECOVERY | PID | Time |
|---|---|---|---|---|---|---|
| 0-3 | 0-1' grass above organic topsoil, roots. 1-3' medium to coarse sand some angular gravel | | | 3 | | |
| 3-6 | Medium to coarse sand, some angular gravel | | | 2.75 | | |
| 6-9 | As above, wet | | | 2.5 | | |
| 9-12 | 9-11' as above. 11-12 fine sand to silt | | | 3 | | |
| | | | | | | |
| | | | | | | |
| | *Notes: In straight line with 3rd base/homeplate path near kickball field, near TH-3* | | | | | |
| | *Developed until clear with peristaltic pump. Water at 6.8' BTOC 20 min. after installation* | | | | | |
| | | | | | | |

| | Soil Samples | | | Water Samples | |
|---|---|---|---|---|---|
| | Interval | Time | Analysis | Time | Analysis |
| Wet At 6 | | | | | |
| Bottom of Boring At: 12 | | | | | |
| Time At: | | | | | |

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| | | | |
|---|---|---|---|
| Client: Marion Cross School | | File Number:19021 | Boring/Well MW-1 |
| Project: Marion Cross School | | **Well Construction Data** | |
| Date Started: 7/3/19 | Date Completed: | Screen: 1.25" 10 slot | From: 3 -To: 10 |
| Logged By: Beth Erickson | Checked By: | Pack: Sand | From: 2 -To: 10 |
| Drilling Co.: T&K Drilling | Driller: Sean and Kevin | Seal:.Bentonite | From: 1 -To: 2 |
| Method: Direct Push | Equipment: Geoprobe | Grout: | From: -To: |
| Boring Depth: 10 | Ground Surface Elevation: | Top of Casing Elevation: ground surface/flush mounted roadbox | |
| Initial GW Level: 7 ∇ | GW Level: ∇ 6.8 | Casing/Stick Up: / Casing Diameter: | |

| DEPTH | SAMPLE DESCRIPTION | DEPTH | % | RECOVERY | PID | Time |
|---|---|---|---|---|---|---|
| 0-3 | Grass above sorted fine sand, trace gravel | | | 3 | | |
| 3-6 | Fine to medium sand, some rounded gravel | | | 2.5 | | |
| 6-9 | As above, wet at 7' | | | 3 | | |
| 9-12 | as above, wet | | | 2 | | |
| | | | | | | |
| | | | | | | |
| | *Notes: Adjacent to TH-4, furthest from school* | | | | | |
| | *Developed until clear with peristaltic pump. Water at 6.8' BTOC 45 min. after installation* | | | | | |
| | | | | | | |

Wet At 7

Bottom of Boring At: 12

Time At:

| Soil Samples | | | Water Samples | |
|---|---|---|---|---|
| Interval | Time | Analysis | Time | Analysis |
| | | | | |
| | | | | |
| | | | | |

# Attachment D

## Marion Cross School

## 7/30/19 Hydraulic Conductivity Test Results

## And

## Site Specific Mounding Analysis and Calibration

By Stephen Revell, CPG Senior Hydrogeologist

Lincoln Applied Geology, Inc.

Hydraulic Conductivity Test Results
Marion Cross School
Wastewater Disposal Area Hydrogeological Analysis
July 30, 2019
By Stephen Revell, CPG Senior Hydrogeologist

1. Test Description

Three falling head type hydraulic conductivity tests were conducted using monitoring well 1,2 and 3. Prior to conducting each test, the wells were pre-soaked by saturating the screen several times. Water levels were monitored with two electric tapes set at the top and bottom of the 7' well screens. Water was added to each well with a hose from a hose bib at the school. After pre-soaking, falling head tests were run on each well and the 5' drop in head from 2' to 7' was timed with a stop watch.

2. Test Method

The three monitoring wells (MW-1, MW-2 & MW-3) are shown on the Overall Site Plan prepared by Pathway Consulting. They are located within the effluent flow system directly adjacent to the disposal area. The three wells were utilized to conduct two falling head hydraulic conductivity/mean permeability tests on February 5, 2019 that were subsequently analyzed using Hvorslev's Method presented below:

$$K=\frac{(411)(D)}{\Delta t}\ln\frac{H1}{H2} \text{ where,}$$

K= hydraulic conductivity or mean permeability in feet/day
D= well diameter in feet
H1= water column at test start
H2= water column at test finish
Δt= elapsed time in minutes for the water column drop
411= conversation factor to generate units in feet/day

3. Test Analysis

MW-1

$$K=\frac{(411)(0.104')}{1.2\ minutes}\ln\frac{7'}{2'}$$

K= 42.7 feet/day

MW-2

$$K=\frac{(411)(0.08')}{1.1\ minutes}\ln\frac{7'}{2'}$$

K= 40.48 feet/ day

MW-3

$$K=\frac{(410)(0.083')}{1.1\ minutes}\ln\frac{7'}{2'}$$

K= 40.94 feet/day

Average Hydraulic Conductivity = 41.37 feet/day

F:\CLIENTS\2018\18101\Hydraulic Conductivity Test Results.docx

Site Specific Mounding Analysis and Calibration
Marion Cross School
Wastewater Disposal Area Hydrogeologic Analysis
By Stephen Revell, CPG Senior Hydrogeologist

## 1. Site Specific Effluent Mounding Analysis

Using Darcy's Law for a sloping site or Q=kihl, where

Q= Daily Wastewater Discharge, in $ft^3$/day
k= Hydraulic Conductivity, in feet/day
i= Groundwater Gradient, in feet/foot calculated from the monitoring wells
h= Effluent Mound beneath the disposal area, in feet
l= Length of the disposal area, in feet

Using the data from the falling head test on MW-1, MW-2 and MW-3, where

Q= 5000 gpd or 668 $ft^3$/day
k= 41.37 feet/day
i= 0.0068 feet/foot
l= 280'
h= solve for h or 8.48' effluent mound

Using literature values for hydraulic conductivity, where

Q= 5000 gpd or 668 $ft^3$/day
k= 50 & 100 feet/day
i= 0.0068 feet/foot
l= 280'
h= solve for h or 7' and 3.5' effluent mound

## 2. Calibration of Darcy's Law Model using Hantush Model

The Darcy's Law modeling was reasonably calibrated using the Hantush model which is used to calculate mounding on a site with a flat to low gradient. It assumes flow from all sides of the application area. In the case of this wastewater disposal site, it assumes a flat gradient sand deposit. The Hantush model was run using the following input variables, where

Length of Field= 220'
Width of Field= 100'
Hydraulic Conductivity= 41.37, 50 and 100 feet/day
Specific Yield= 0.001
Time to Approximate Steady State= 10 years or 3650 days
Discharge Rate= 5000 gallons/day
Initial Saturated Thickness= 6 feet

The tabulated results of the Hantush Model are attached which indicate an effluent mound 2.14 feet, 1.86 feet and 1.08 feet will form beneath the application area. The use of the model suggests that the mounding associated with the simultaneous use of disposal fields will be much less than that calculated using Darcy's Law, so the use of Hantush to calibrate Darcy's

Law is not applicable because there is not flow in all directions. The use of the Hantush Model does confirm to the greatest degree the analysis conducted by Wagner, Heindel and Noyes(WHN) in 1988 which showed a 1.5' mound resulting beneath each 5000 gpd system.

## 3. Calibration of Darcy's Law Model using WHN Groundwater Gradient

The WHN gradient calculated in 1988 was 0.0042 feet/feet. This gradient was used to calculate effluent mounding using Darcy's Law with the same input values that were used in 1. Site Specific Effluent Mounding Analysis.

Q= 5000 gpd or 668 cuft/day
k= 41.37 feet/day, 50 feet/day and 100 feet/day
i= 0.0042 feet/feet
l= 280'
h= solve for h or 13.7', 11.4', and 5.68'

Using the 1988 WHN gradient data, Darcy's Law calculated an effluent mounding of 13.7', 11.4' and 5.68'. Although the effluent mounding was greater using WHN data(which was less than that calculated in #1 above), the results compare favorably with the effluent mounding calculated in #1 above. This comparison suggests that if an active groundwater gradient in a specific direction can be calculated from groundwater elevation data, Darcy's Law or another method for a sloping site should be used because the Hantush Model is based on effluent flow in 4 directions from a disposal field.

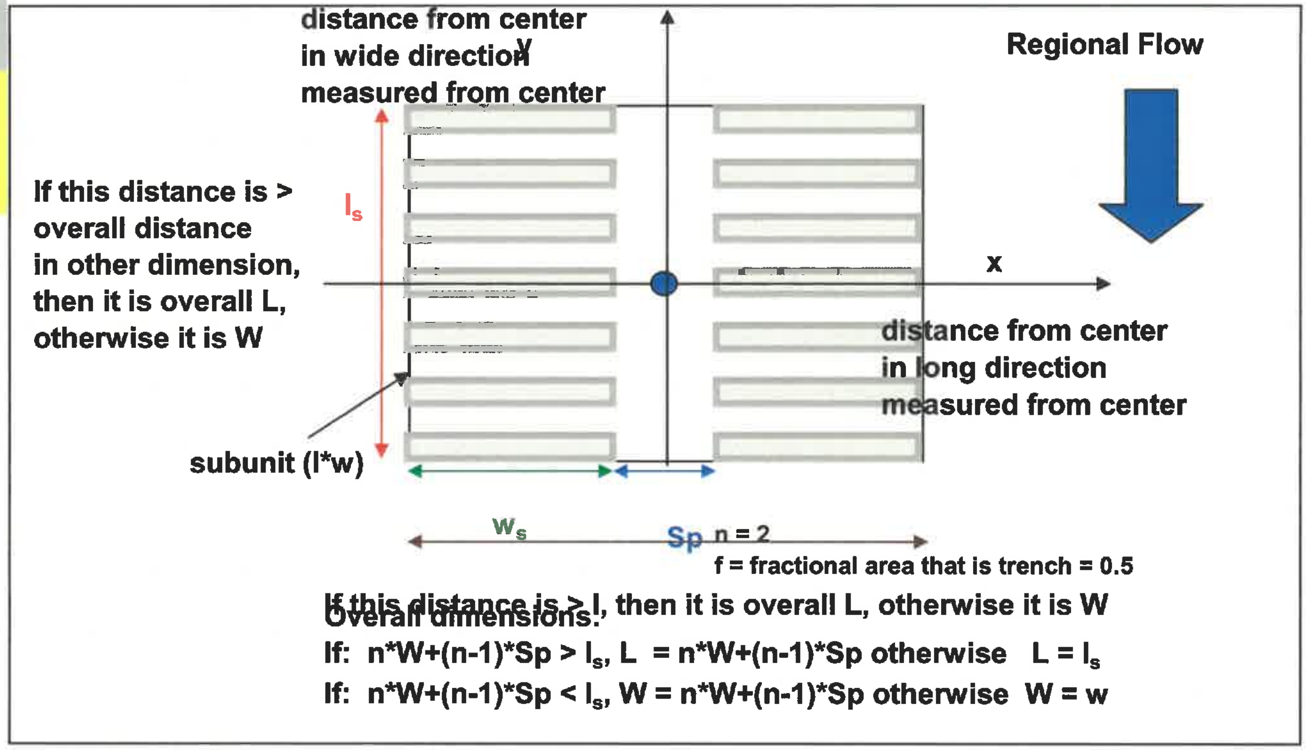
## Water Table Mounding calculated based on Hantush 1967, WRR

**Enter data in green cells as per their yellow labels, other values will be computed from those entr**

**Results are highlighted in pink.**

| Zmax Beneath Center of Entire Drain Field (L*W) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Meters and Days | Length of Drain Field Subunit | Width of Drain Field Subunit | | Separation between Drain Field Subunits | Fraction of Drain Field Subunit that is Trench Area | Horizontal Hydraulic Conductivity | Specific Yield use 0.001 to approximate steady state at 10 years | time use 10 years to approximate steady state |
| | $l_s$ | $w_s$ | | Sp | f | Kh | Sy | time |
| | ft | ft | | ft | | ft/days | none | days |
| | 220 | 100 | | 0 | 1 | 41.37 | 0.001 | 3650 |
| Number of subunits, n | L<br>220 | W<br>100 | q effective in subunit ls x ws<br>ft/day | q in trenches<br>ft/day | q' effective on LxW<br>ft/day | Q<br>gallons/day | Zmax 12 iterations<br>ft | Initial Saturated Thickness<br>ft |
| 1 | 220 | 100 | 0.0304 | 0.0304 | 0.0304 | 5000 | 2.140 | 6 |

ries.




| alpha | beta | a2+b2 | W part1 | W(a2+b2) | S* | z1 | hiter | alpha | beta |
|---|---|---|---|---|---|---|---|---|---|
| | | NOTE: if a2+b2>0.04, solution is inaccurate | | | | | | | |
| 0.00182725 | 0.000830568 | 4.02868E-06 | 11.84486 | 11.84485976 | 2.58667E-05 | 2.392 | 7.195948246 | 0.001668513 | 0.000758415 |

## Water Table Mounding calculated based on Hantush 1967, WRR

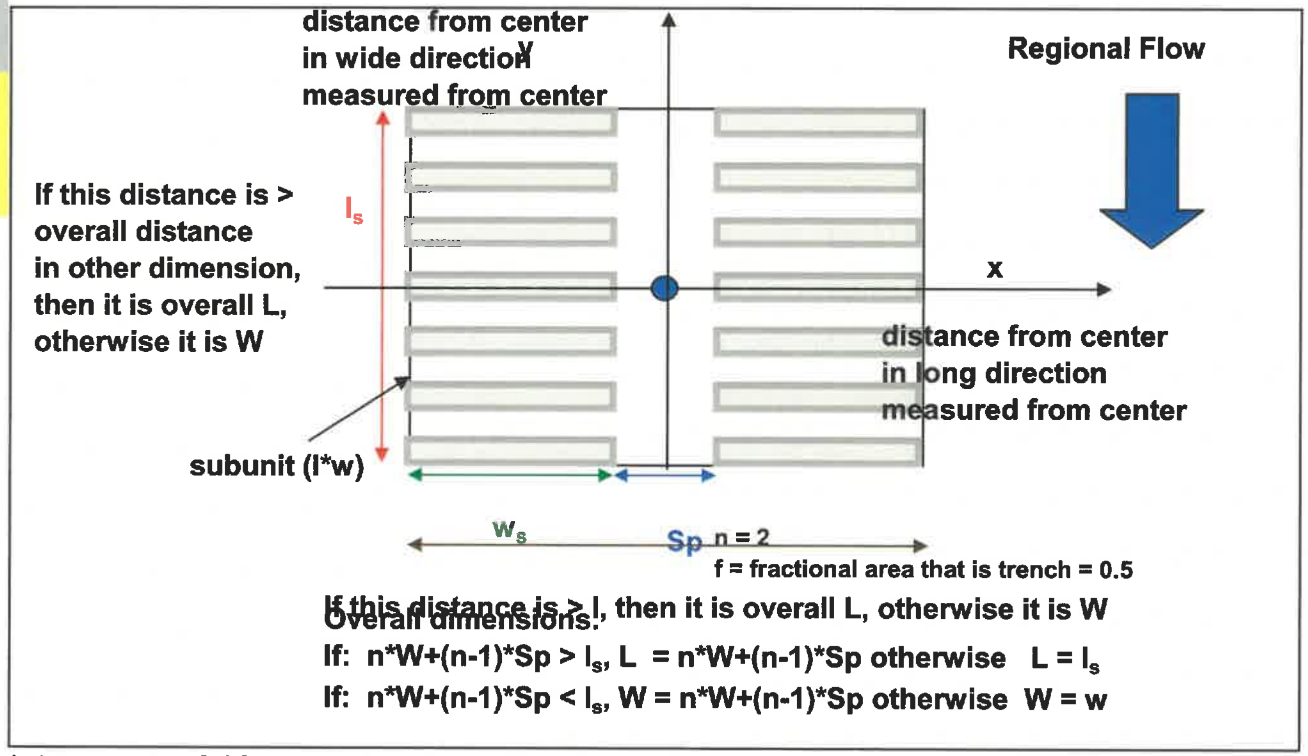
**Enter data in green cells as per their yellow labels, other values will be computed from those entr**

**Results are highlighted in pink.**

### Zmax Beneath Center of Entire Drain Field (L*W)

| Meters and Days | Length of Drain Field Subunit | Width of Drain Field Subunit | | Separation between Drain Field Subunits | Fraction of Drain Field Subunit that is Trench Area | Horizontal Hydraulic Conductivity | Specific Yield use 0.001 to approximate steady state at 10 years | time use 10 years to approximate steady state |
|---|---|---|---|---|---|---|---|---|
| | $l_s$ | $w_s$ | | Sp | f | Kh | Sy | time |
| | ft | ft | | ft | | ft/days | none | days |
| | 220 | 100 | | 0 | 1 | 50 | 0.001 | 3650 |
| Number of subunits, n | L 220 | W 100 | q effective in subunit ls x ws ft/day | q in trenches ft/day | q' effective on LxW ft/day | Q gallons/day | Zmax 12 iterations ft | Initial Saturated Thickness ft |
| 1 | 220 | 100 | 0.0304 | 0.0304 | 0.0304 | 5000 | 1.858 | 6 |

ries.




NOTE: if a2+b2>0.04, solution is inaccurate

| alpha | beta | a2+b2 | W part1 | W(a2+b2) | S* | z1 | hiter | alpha | beta |
|---|---|---|---|---|---|---|---|---|---|
| 0.001662094 | 0.000755497 | 3.33333E-06 | 12.034326 | 12.03432609 | 2.1705E-05 | 2.055 | 7.027576568 | 0.001535778 | 0.000698081 |

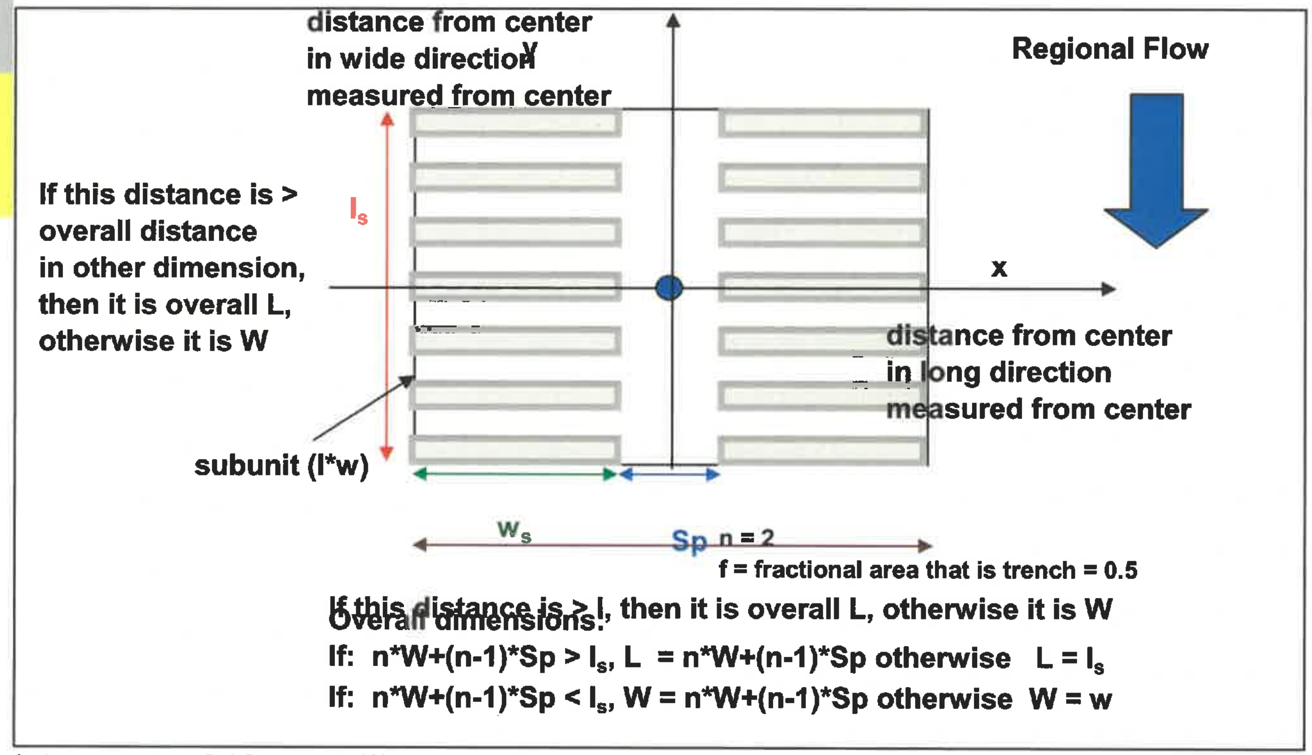
## Water Table Mounding calculated based on Hantush 1967, WRR

**Enter data in green cells as per their yellow labels, other values will be computed from those entr**

**Results are highlighted in pink.**

| Zmax Beneath Center of Entire Drain Field (L*W) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Meters and Days | Length of Drain Field Subunit | Width of Drain Field Subunit | | Separation between Drain Field Subunits | Fraction of Drain Field Subunit that is Trench Area | Horizontal Hydraulic Conductivity | Specific Yield use 0.001 to approximate steady state at 10 years | time use 10 years to approximate steady state |
| | $l_s$ | $w_s$ | | Sp | f | Kh | Sy | time |
| | ft | ft | | ft | | ft/days | none | days |
| | 220 | 100 | | 0 | 1 | 100 | 0.001 | 3650 |
| Number of subunits, n | L<br>220 | W<br>100 | q effective in subunit ls x ws<br>ft/day | q in trenches<br>ft/day | q' effective on LxW<br>ft/day | Q<br>gallons/day | Zmax 12 iterations<br>ft | Initial Saturated Thickness<br>ft |
| 1 | 220 | 100 | 0.0304 | 0.0304 | 0.0304 | 5000 | 1.079 | 6 |

ries.




NOTE: if a2+b2>0.04, solution is inaccurate

| alpha | beta | a2+b2 | W part1 | W(a2+b2) | S* | z1 | hiter | alpha | beta |
|---|---|---|---|---|---|---|---|---|---|
| 0.001175278 | 0.000534217 | 1.66667E-06 | 12.727472 | 12.7274716 | 1.14066E-05 | 1.154 | 6.57701561 | 0.00112254 | 0.000510245 |

# Attachment E

## Marion Cross School

## 03/09/2020 – 03/31/2020

## Monitoring Well Figures 1 - 4

Figure 1. Marion Cross School, MW-1, March 9 - 31 Water Elevation (ft)
(Driveway Side of System)

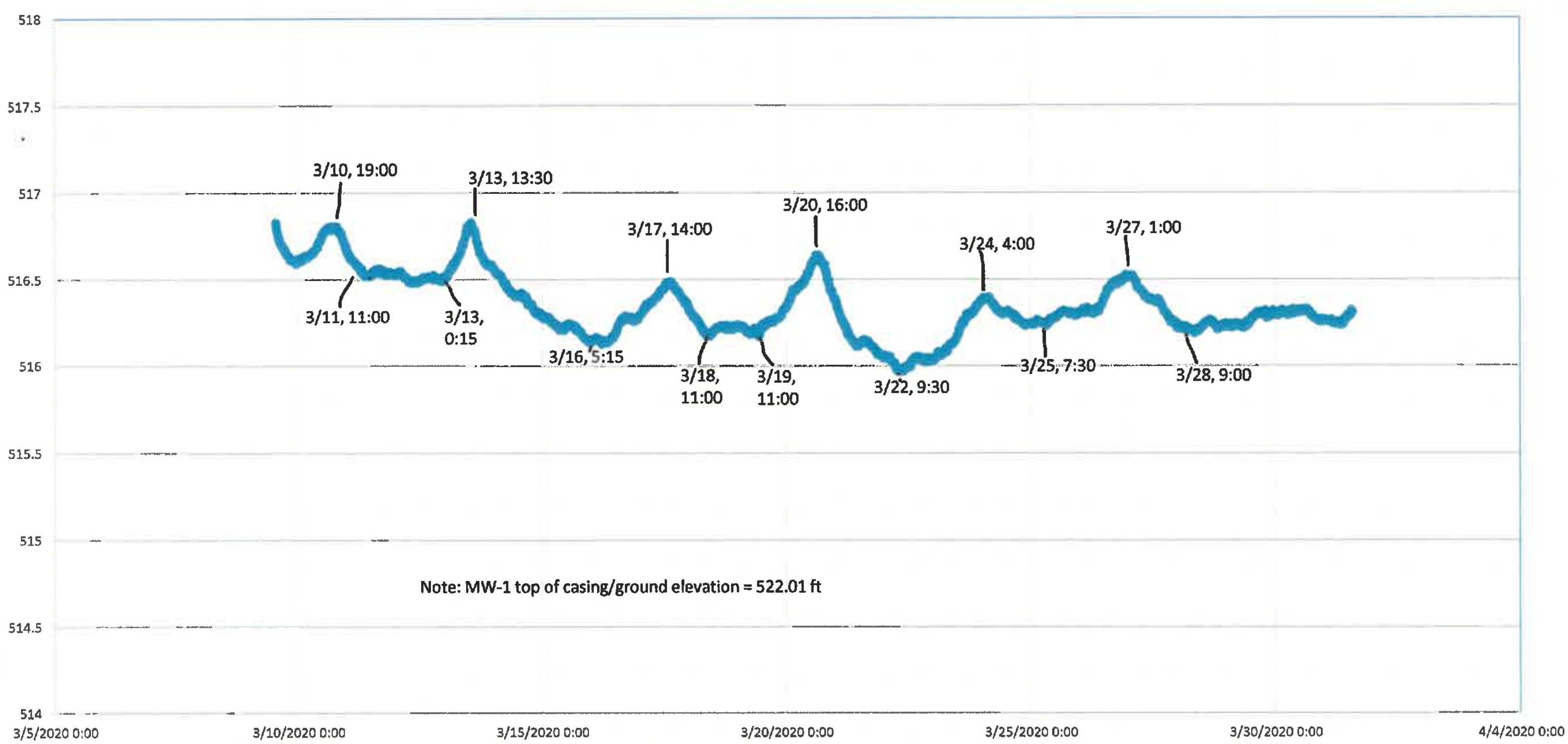
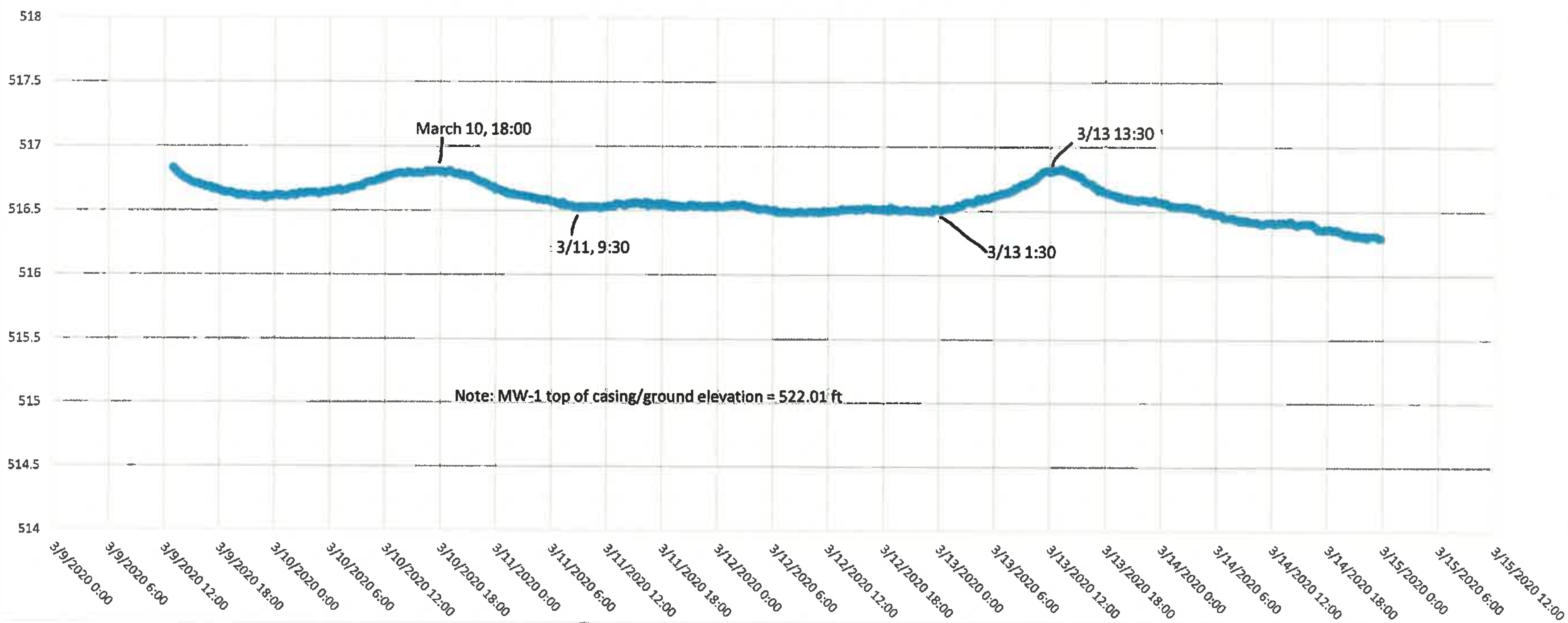


Figure 2. Marion Cross School, MW-1, March 9 - 14, Water Elevation (ft)
(Driveway Side of System)



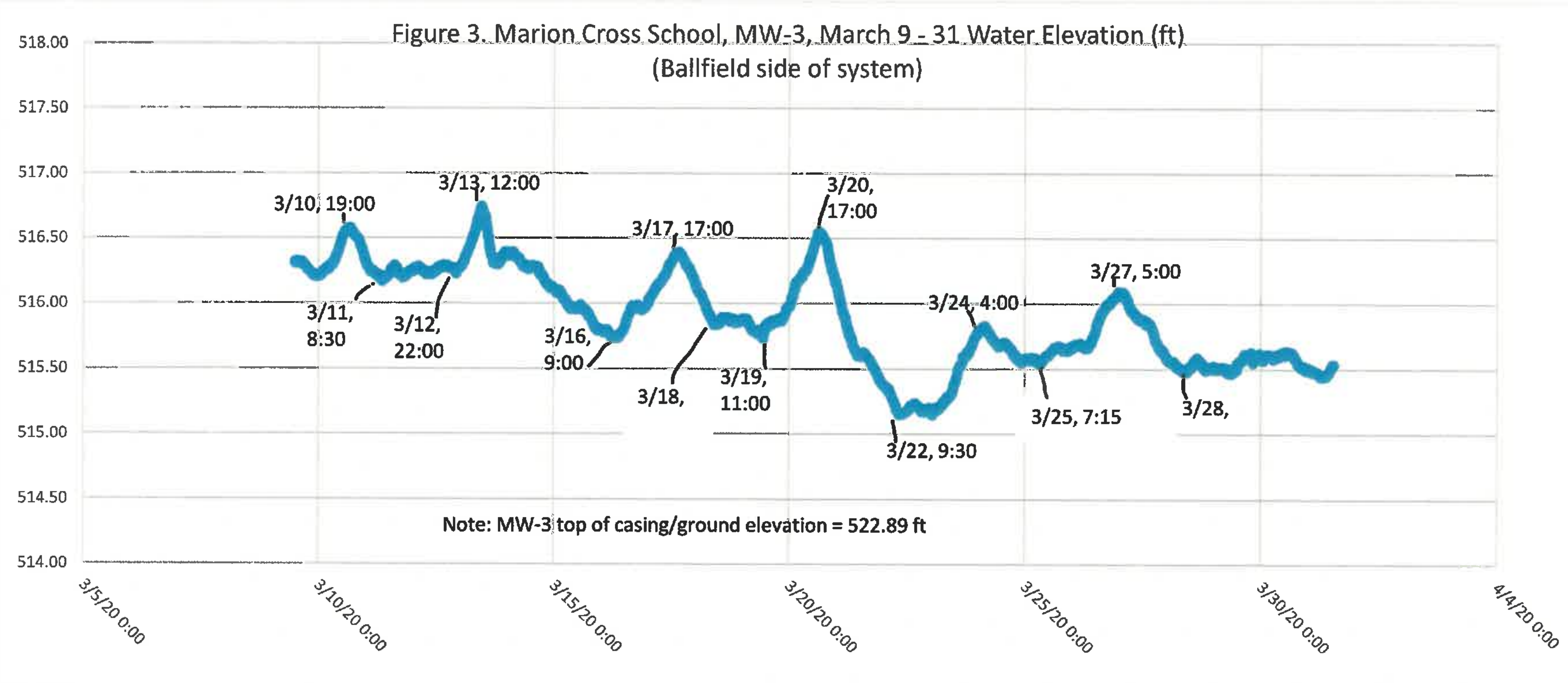


Figure 3. Marion Cross School, MW-3, March 9 - 31 Water Elevation (ft)
(Ballfield side of system)
518.00
517.50
517.00
516.50
516.00
515.50
515.00
514.50
514.00
3/10, 19:00
3/13, 12:00
3/17, 17:00
3/20, 17:00
3/24, 4:00
3/27, 5:00
3/11, 8:30
3/12, 22:00
3/16, 9:00
3/18,
3/19, 11:00
3/22, 9:30
3/25, 7:15
3/28,
Note: MW-3 top of casing/ground elevation = 522.89 ft
3/5/20 0:00
3/10/20 0:00
3/15/20 0:00
3/20/20 0:00
3/25/20 0:00
3/30/20 0:00
4/4/20 0:00

Figure 4. Marion Cross School, MW-3, March 9-14 Water Elevation (ft)
(Ballfield side of system)