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August 29, 2017

Mr. Jim McCarthy  
Newburyport Planning Board  
60 Pleasant Street  
Newburyport MA 01950

RE: OW-6 Groundwater Evaluation  
Evergreen Commons  
18 Boyd Dr and 5 Brown Avenue

Dear Mr. McCarthy and Planning Board Members;

Please see the following information in response to Doug Gove's AECOM email dated August 10, 2017. The email indicates the potential for groundwater on the golf course to reach up to elevation 60-61(NAVD88) based upon well readings during and after the 2006 Mother's Day rain event in the City's observation well #6 located just north-east of the golf course. Based on our evaluation, groundwater never approached this elevation on the course and within our proposed work area. We have provided the following information documenting water levels during that time and our analysis of why the OW-6 reading may have spiked during that rainfall event.

1. The surface water level on the golf course peaked at approximately elevation 56.0-56.2(NAVD88). This has been determined by correlating water levels from photographs submitted by abutters during the permitting process with a survey control point on the property. See Figure 1 for photograph of water level with survey control point located on a small island high point about 4-6 inches above that water level. The control point elevation is at 56.50(NAVD88). The groundwater on the site could not be above this static water level. In particular the June 22, 2006 reading of 60.4(NAVD88) does not correlate whatsoever to the golf course with the golf course open and all surface water receded back into ponds and well below the surrounding fairway elevations at the time of that well reading.
2. The email refers to a groundwater gradient with elevation on the golf course 1-2 feet above that of OW-6 readings, referring to the NGI graphic from September 2016. This gradient occurred during the summer and early fall when Well #2 is in operation. During the winter and spring when the Well #2 is not in use there is a reduced gradient from OW-6. As indicated in Test Pit #1 and supplemental Test Pit "A" witnessed by the City's planning

board peer review consultant on August 20, 2017, we see seasonal high groundwater elevations above that than the majority of the site where mottling indicates high groundwater at elevation 52(NAVD88). The soil mottles in the test pits along the property line adjacent to OW-6 indicate estimated seasonal high groundwater between elevation 54 and 55 (NAVD88). This elevation correlates with the historic reading from OW-6. See Figure 2 for this information. See Figure 2-Supplemental Groundwater Analysis and Figure 4 – Supplemental Boring Logs for this information.

3. The reason for the groundwater mound at this location is the fact that OW-6 lies with a separate isolated land subject to flooding (ILSF) area. There is a low area where untreated stormwater is directly discharged via a stormwater culvert from Briggs Avenue along with some of the homes on Boyd Drive both areas which are contributing drainage to the OW-6 ILSF. Based upon the ILSF calculation using a 7 inch rainfall event we see an ILSF elevation of 62.3(NAVD88) with the limit immediately adjacent to OW-6. We also calculated a 12 inch rainfall event, similar to that of the Mother's Day rainfall event and saw a flooding elevation of 63.8(NAVD88). Compounding this is the presence of a bedrock high under this area not allowing the water to readily seep back into the aquifer and limiting lateral flow. For these reasons OW-6 should not be used as an indicator of what should be used for groundwater levels found throughout the golf course aquifer. See Figure 2 – Supplemental Groundwater Analysis and Figure 3 – Briggs Ave ILSF Calculation.
4. Based upon information provided from the home owner of 16 Boyd Drive the groundwater was substantially below his basement elevation of 57.5(NGVD88). During the Mother's Day storm event there was extensive surface water running into and filling his basement. Upon recommendation from his neighbor located at 15 Boyd Drive, he drilled holes in the basement floor and the water immediately drained from the basement into the soil below. He experienced minor water in basement of the accessory building on the property to a maximum depth of 12 inches. The basement of this structure is at elevation 54.0(NAVD88). This would put the maximum water elevation of 55.0(NAVD88). It is not clear if this was caused by surface runoff or by a temporary increase in the groundwater elevation. We do know that once water was pumped form basement it did not fill back up and was dry on June 22, 2016 when the maximum groundwater elevation was taken in OW-6. See Figure 2-Supplemental Groundwater Analysis for this information.

#### Proposed Design Modification

The current design provides for all basement elevations to be at or above 56.6(NAVD88). The closest foundation to OW-6 is 190 feet away with a proposed basement elevation of 58.95(NAVD88). Given the distance from OW-6 and the higher basement elevation at this location we are confident this basement is resilient even with a rain even of the magnitude of the Mother's Day rain event. Although we are confident the design provides for flood resiliency with an event such as the Mother's Day 2006, we are proposing to slightly adjust of the basements and roadway elevation on the project. We are proposing to lift the roadway by 6" which will allow the bio-retention areas to be lifted with the lowest bottom elevation to be at 55.2(NAVD88). This provides

a resiliency for even an extreme situation, keeping the bottom elevation above any potential groundwater spike during a storm event such as the 2006 Mother's Day event. Additionally, we are proposing to lift the lowest basement elevation to 57.5(NAVD88) or 11 inches above the current lowest proposed elevation. This small change provides an added factor of safety and resiliency for any potential future extreme events exceeding the 100 year storm event that is typically used at the extreme storm event in stormwater design. We are currently updating drawing to reflect this slight upward adjustment of proposed elevation and expect to be submitting the revised drawings within the week. We look forward to reviewing these changes at the September 20<sup>th</sup> Planning Board meeting. In the interim please feel free to contact me with questions.

Respectfully submitted,

*Stephen Sawyer*

Stephen Sawyer P.E.  
Design Consultants Inc.

cc: Conservation Commission  
Christiansen & Sergi  
Horsley Witten





SURVEY CONTROL POINT  
56.50 ON TOP OF SMALL  
GRASS ISLAND



\* ELEVATION ESTIMATED FROM INTERPELLATION FROM SITE PLAN. FIELD SURVEY OF LOCATION IN PROCESS.

NOTE 1.  
BASEMENT ELEVATION = 57.5  
DURING MOTHERS DAY STORM EVENT  
HOLES DRILLED IN BASEMENT FLOOR  
TO ALLOW SURFACE RUNOFF FLOWING  
INTO BASEMENT TO DRAIN. NO  
HISTORY OF GROUNDWATER IN  
BASEMENT.

NOTE 2.  
BASEMENT ELEVATION = 54.0  
DURING MOTHERS DAY STORM EVENT  
APROXIMATELY 12" MAXIMUM WATER IN  
BASEMENT. (POSSIBLE MAXIMUM  
GROUNDWATER ELEVATION OF 55.0±)

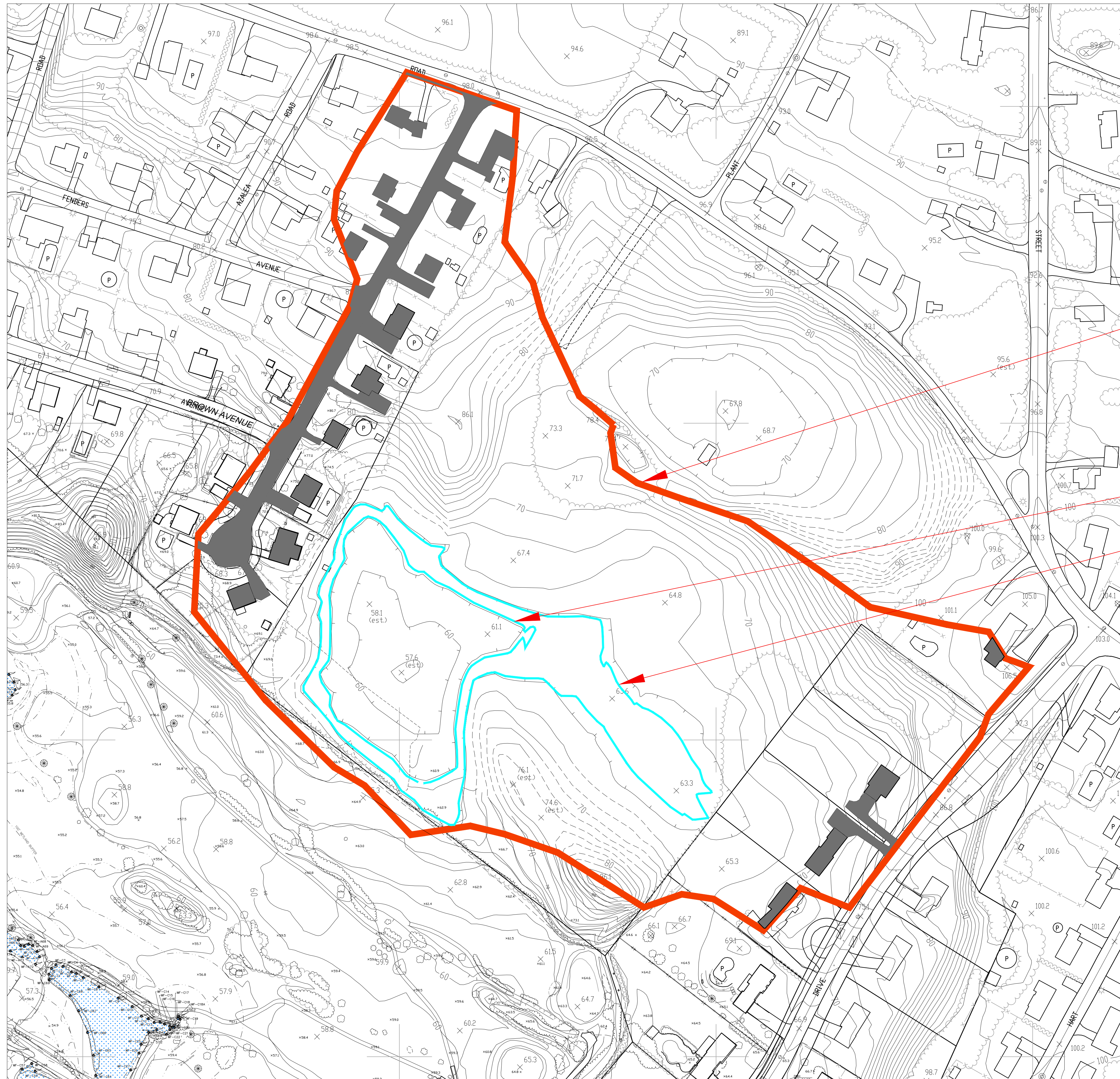
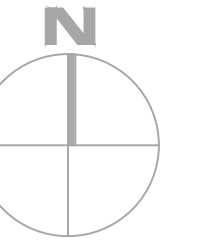
NOTE 3.  
BASED ON STANDARD ILSF CALCULATION  
7" RAIN EVENT. THE BRIGGS ILSF  
ELEVATION IS 6.7 FEET HIGHER THAN THE  
ILSF ELEVATION ON THE GOLF COURSE.  
THIS WOULD BE A MAJOR CONTRIBUTING  
FACTOR FOR OW-6 HIGH SPIKED  
READINGS AROUND EXTREME EVENTS.

NOTE 4.  
BASED ON PHOTOGRAPHS OF THE  
MOTHERS DAY STORM EVENT THE  
MAXIMUM WATER ELEVATION DURING THIS  
EVENT IS ESTIMATED AT 56.0±.



FIGURE-2  
SUPPLEMENTAL GROUNDWATER  
ANALYSIS FIGURE  
DESIGN CONSULTANTS INC.  
AUGUST 23, 2017



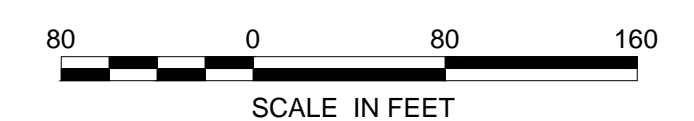


BRIGGS AVE. ILSF OFF PROPERTY  
CONTRIBUTION AREA=821,000 SF(18.8 Ac.)

7"RAIN EVENT ILSF AREA ELEV=62.3±  
103,570 CF

12"RAIN EVENT ILSF AREA ELEV=63.8±  
276,655 CF

FIGURE-3  
BRIGGS AVE. ILSF CALCULATION  
DESIGN CONSULTANTS INC.  
AUGUST 23, 2017





# SOIL SUITABILITY ASSESSMENT REPORT

## COMMONWEALTH OF MASSACHUSETTS

### NEWBURYPORT

#### SOIL SUITABILITY ASSESSMENT FOR ON-SITE STORMWATER MANAGEMENT

##### SITE INFORMATION

Map 110 & Lot 20

Street Address: 18 Boyd Drive Town: Newburyport State: Massachusetts Zip Code: 01950 County: Essex  
Land Use: Recreational; Evergreen Valley Golf Course Latitude: ~42° 49' 27.3" N Longitude: ~70° 54' 46.4" W

##### PUBLISHED SOIL DATA AND MAP UNIT DESCRIPTION

Physiographic Division: Appalachian Highlands Physio. Province: New England Physio. Section: Seaboard lowland section

Soil map unit: 254A – Merrimac fine sandy loam (sandy, mixed, mesic, Typic Dystrochrepts), 0-3% slopes

NRCS/USDA web soil survey: Essex County, Massachusetts, Northern part. Map Scale: 1:500'

Hydric or upland soil: Upland soil Average depth to water table: >120" Depth to restrictive feature: >120"

Frequency of flooding: None Frequency of ponding: None Available water capacity: Low (~4.6")

Drainage Class: Somewhat excessively drained Hydrologic Soil Group: A Ksat: High (1.42 – 99.00 in/hr)

Soil limitations: High permeability, deep seasonal and apparent groundwater elevations, loose & unstable substratum.

##### WETLAND AREA & USGS WELL MEASUREMENTS

National Wetland Inventory Map: NA Wetlands Conservancy Program: NA Bordering vegetative wetland: >100 feet

Current Water Resource Condition (USGS): Well Site # 424841071004101- MA-HLW 23 Haverhill, MA.,

Well completed in Sand and gravel aquifers and ice-contact deposits, including kames and eskers.

Well depth: 15.10 feet Land surface altitude: 100.00 feet above NGVD29

Latitude: ~42°48'41.8" N Longitude: ~71°00'41.7"

Most recent data value: 12.64' on 8/20/17 (depth to water level in feet below land surface). Range: Above normal

##### SURFICIAL & BEDROCK GEOLOGY

Surficial geology: Qsu: Late Pleistocene, Wisconsin Stage – undifferentiated sandy glaciofluvial deposits

Geologic parent material: Sandy proglacial outwash deposits Geomorphic landform: Outwash terrace

Slope aspect: Westerly Landform position (2D): footslope Landform position (3D): tread

Slope gradient: ~03-05% Down slope shape: Convex Across slope shape: Convex Slope complexity: Simple

Bedrock outcropping in vicinity: Not observed Glacial erratics in vicinity: None observed

Bedrock Type: Newburyport Volcanic Complex: Lower Devonian, Porphyritic andesite, includes tuffaceous mudstone beds containing fossils of Late Silurian through Early Devonian age.

# TP17-A DEEP OBSERVATION HOLE

18 Boyd Drive, Newburyport, Massachusetts

Date: August 20, 2017 Time: 09:20 Weather: Clear, warm, ~75-80°F, light East wind

Position on landscape: Terrace tread Slope aspect: Westerly Land Cover: Grass

Property line: 10<sup>+</sup> feet Drainage way: 50<sup>+</sup> feet Drinking water well: 100<sup>+</sup> feet

Wetlands: 100<sup>+</sup> feet Open water body: 400<sup>+</sup> feet Abutting septic system: NA

Soil moisture status: Dry to damp with increased depth

## SOIL PROFILE ► TP17-A

Depth below land surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA/ NRCS)	Soil Color (Munsell)	Redoxomorphic Features/ ESHGWT	Consistence, grade, size, structure, grain size, soil moisture state, roots, horizon boundary, clasts, stratification, artifacts, restrictive features, etc.
00 → 05"	A <sub>p</sub>	Sandy Loam	10YR3/2 very dark grayish brown	none observed	Very friable; moderate-grade fine-to-medium subangular granular structure; somewhat cohesive matrix; fine grained mineral content; dry; nonplastic; nonsticky; common grass roots; free of clasts; clear wavy boundary.
05 → 33"	C <sup>^</sup>	Loamy Sand gravelly	2.5Y6/6 olive yellow	none observed	Human transported material; Mechanically mixed anthropogenic layer; loose; structurless; mixed fine-to-coarse grained mineral content in a loamy sand matrix; dry; nonplastic; nonsticky; ~25% rounded to subrounded gravel and ~45% rounded to subrounded content of mixed lithology; clear wavy boundary.
18 → 121"	2C	Sand fine & medium grained	2.5Y6/3 lite yellowish brown	@ 120" (f,1,f) 7.5R5/8 10Y7/1	Loose; structurless; very unstable; mixed fine to medium grained mineral content; slightly damp matrix at depth of excavation; nonplastic; nonsticky; somewhat weakly stratified and poorly graded; free of clasts; stratified beds gently dipping to the North-Northeast; no apparent water observed and no refusal at test hole depth.

Depth to bedrock: >121"

Seasonal High Groundwater Table: 120"

Phreatic water table (weep) : >121"



# TP17-A DEEP OBSERVATION HOLE

18 Boyd Drive, Newburyport, Massachusetts

DEPTH TO APPARENT/ PHREATIC GROUNDWATER TABLE: None Observed

Apparent water seeping from pit face: \_\_\_\_\_ (Below land surface) Depth to stabilized apparent water: \_\_\_\_\_ (Below land surface)

Soil moisture state: Dry to slightly damp with depth

## ESTIMATED SEASONAL HIGH GROUNDWATER TABLE:

Depth of Estimated Seasonal High Groundwater Table: 120" (below land surface)

Type: Masses on sand grains Abundance: Few Size: Fine Contrast: Faint

Shape: Irregular; laminar to spheroidal Moisture state: Slightly damp Location: 2C matrix

Hardness: Soft Boundary: Sharp Concentration color: 7.5R 5/8 (red) Reduction color: 10Y 7/1 (bluish gray)

## DETERMINATION OF HIGH GROUNDWATER ELEVATION

Observed depth to stabilized phreatic water: \_\_\_\_\_ inches below grade

Observed water weeping from side of deep hole: \_\_\_\_\_ inches below grade

Observed depth to redoximorphic features: 120" inches below grade

## DEPTH OF NATURALLY OCCURRING PERVIOUS MATERIAL: ► 7.33 feet

Depth of naturally occurring pervious material in TP17-A Upper boundary: 33"

Lower boundary: 121"

## Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.017.

Alexander F. Parker License #1848

Printed name of evaluator & license number

June 1998

Date of Soil Evaluator Certification

Mr. Philip Christiansen, P.E.

Town of Newburyport Planning Board peer reviewer.

08/20/17

Date of soil testing



# TP17-B DEEP OBSERVATION HOLE

18 Boyd Drive, Newburyport, Massachusetts

Date: August 20, 2017 Time: 09:45 Weather: Clear, warm, ~75-80°F, light East wind

Position on landscape: Terrace tread Slope aspect: Westerly Land Cover: Grass

Property line: 10<sup>+</sup> feet Drainage way: 50<sup>+</sup> feet Drinking water well: 100<sup>+</sup> feet

Wetlands: 100<sup>+</sup> feet Open water body: 400<sup>+</sup> feet Abutting septic system: NA

Soil moisture status: Dry to damp with increased depth

## SOIL PROFILE ► TP17-B

Depth below land surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA/ NRCS)	Soil Color (Munsell)	Redoxomorphic Features/ ESHGWT	Consistence, grade, size, structure, grain size, soil moisture state, roots, horizon boundary, clasts, stratification, artifacts, restrictive features, etc.
00 → 06"	A <sub>p</sub>	Sandy Loam	10YR3/2 very dark grayish brown	none observed	Very friable; moderate-grade fine-to-medium subangular granular structure; somewhat cohesive matrix; fine grained mineral content; dry; nonplastic; nonsticky; common grass roots; free of clasts; clear wavy boundary.
06 → 24"	C <sup>^</sup>	Loamy Sand gravelly	2.5Y6/6 olive yellow	none observed	Human transported material; Mechanically mixed anthropogenic layer; very loose; structurless; mixed fine-to-coarse grained mineral content in a loamy sand matrix; dry; ~25% rounded to subrounded gravel and ~45% rounded to subrounded content of mixed lithology; clear wavy boundary.
24 → 33"	2C <sub>1</sub>	Sand fine & medium grained	2.5Y5/3 lite olive brown	none observed	Loose; structurless; very unstable; mixed fine-to-medium grained mineral content; dry matrix; nonplastic; nonsticky; somewhat weakly stratified and poorly graded; free of clasts; stratified beds dipping gently to the North-Northeast; clear wavy boundary.
33 → 100"	2C <sub>2</sub>	Sand medium grained	10YR 5/4 yellowish brown	@ 65" (f,1,f) 7.5R5/8 10Y7/1	Loose; structurless; very unstable; medium grained mineral content; slightly damp matrix at depth of excavation; nonplastic; nonsticky; somewhat weakly stratified and poorly graded; free of clasts; stratified beds dipping gently to the North-Northeast; apparent water observed at 69"; no refusal at test hole depth.

Depth to bedrock: ≥100" Seasonal High Groundwater Table: 65" Phreatic water table (weep): 69"



# TP17-B DEEP OBSERVATION HOLE

18 Boyd Drive, Newburyport, Massachusetts

DEPTH TO APPARENT/ PHREATIC GROUNDWATER TABLE: None Observed

Apparent water seeping from pit face: 69" (Below land surface) Depth to stabilized apparent water: \_\_\_\_\_ (Below land surface)

Soil moisture state: Dry to wet below 66" in depth

## ESTIMATED SEASONAL HIGH GROUNDWATER TABLE:

Depth of Estimated Seasonal High Groundwater Table: 65" (below land surface)

Type: Masses on sand grains Abundance: Common Size: Medium Contrast: Faint

Shape: Irregular; laminar to spheroidal Moisture state: Slightly damp Location: 2C matrix

Hardness: Soft Boundary: Sharp Concentration color: 7.5R 5/8 (red) Reduction color: 10Y 7/1 (bluish gray)

## DETERMINATION OF HIGH GROUNDWATER ELEVATION

Observed depth to stabilized phreatic water: \_\_\_\_\_ inches below grade

Observed water weeping from side of deep hole: 69" inches below grade

Observed depth to redoximorphic features: 65" inches below grade

## DEPTH OF NATURALLY OCCURRING PERVIOUS MATERIAL: ► 6.33 feet

Depth of naturally occurring pervious material in TP17-B Upper boundary: 24"

Lower boundary: 100"

## Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.017.

Alexander F. Parker License #1848

Printed name of evaluator & license number

June 1998

Date of Soil Evaluator Certification

Mr. Philip Christiansen, P.E.

Town of Newburyport Planning Board peer reviewer.

08/20/17

Date of soil testing



# TP17-C DEEP OBSERVATION HOLE

18 Boyd Drive, Newburyport, Massachusetts

Date: August 20, 2017 Time: 10:17 Weather: Clear, warm, ~75-80°F, light East wind

Position on landscape: Terrace tread Slope aspect: Westerly Land Cover: Grass

Property line: 10<sup>+</sup> feet Drainage way: 50<sup>+</sup> feet Drinking water well: 100<sup>+</sup> feet

Wetlands: 100<sup>+</sup> feet Open water body: 400<sup>+</sup> feet Abutting septic system: NA

Soil moisture status: Dry to damp with increased depth

## SOIL PROFILE ► TP17-C

Depth below land surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA/ NRCS)	Soil Color (Munsell)	Redoxomorphic Features/ ESHGWT	Consistence, grade, size, structure, grain size, soil moisture state, roots, horizon boundary, clasts, stratification, artifacts, restrictive features, etc.
00 → 05"	A <sub>p</sub>	Sandy Loam	10YR3/2 very dark grayish brown	none observed	Very friable; moderate-grade fine-to-medium subangular granular structure; somewhat cohesive matrix; fine grained mineral content; dry; nonplastic; nonsticky; common grass roots; free of clasts; clear wavy boundary.
05 → 49"	C <sup>^</sup>	Loamy Sand gravelly	2.5Y6/6 olive yellow	none observed	Human transported material; Mechanically mixed anthropogenic layer; very loose; structurless; mixed fine-to-coarse grained mineral content in a loamy sand matrix; dry; nonplastic; nonsticky; ~25% rounded to subrounded gravel and ~45% rounded to subrounded content of mixed lithology; clear wavy boundary.
49 → 59"	C <sup>^</sup>	Loam and Silt Loam mix	10YR2/1 black	none observed	Human transported material; Mechanically mixed anthropogenic layer; massive; structurless; fine grained mineral content; slightly moist; nonplastic; slightly sticky; ~15% angular to subangular gravel content of mixed lithology; ash and shells within matrix; clear wavy boundary.
59 → 121"	2C	Sand fine & medium grained	10YR 5/4 yellowish brown	@ 104" (f, l, f) 7.5R5/8 10Y7/1	Loose; structurless; very unstable; mixed fine-to-medium grained mineral content; dry matrix; nonplastic; nonsticky; somewhat weakly stratified and poorly graded; free of clasts; stratified beds dipping gently to the North-Northeast; apparent water observed at 108"; no refusal at test hole depth.

Depth to bedrock: >121" Seasonal High Groundwater Table: 104" Phreatic water table (weep): 108"



# TP17-C DEEP OBSERVATION HOLE

18 Boyd Drive, Newburyport, Massachusetts

DEPTH TO APPARENT/ PHREATIC GROUNDWATER TABLE: None Observed

Apparent water seeping from pit face: 108" (Below land surface) Depth to stabilized apparent water: \_\_\_\_\_ (Below land surface)

Soil moisture state: Dry to wet below 106" in depth

## ESTIMATED SEASONAL HIGH GROUNDWATER TABLE:

Depth of Estimated Seasonal High Groundwater Table: 104" (below land surface)

Type: Masses on sand grains Abundance: Common Size: Medium Contrast: Faint

Shape: Irregular; laminar to spheroidal Moisture state: Slightly damp Location: 2C matrix

Hardness: Soft Boundary: Sharp Concentration color: 7.5R 5/8 (red) Reduction color: 10Y 7/1 (bluish gray)

## DETERMINATION OF HIGH GROUNDWATER ELEVATION

Observed depth to stabilized phreatic water: \_\_\_\_\_ inches below grade

Observed water weeping from side of deep hole: 108" inches below grade

Observed depth to redoximorphic features: 104" inches below grade

## DEPTH OF NATURALLY OCCURRING PERVIOUS MATERIAL: ► 5.17 feet

Depth of naturally occurring pervious material in TP17-C Upper boundary: 59"

Lower boundary: 121"

## Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.017.

Alexander F. Parker License #1848

Printed name of evaluator & license number

June 1998

Date of Soil Evaluator Certification

Mr. Philip Christiansen, P.E.

Town of Newburyport Planning Board peer reviewer.

08/20/17

Date of soil testing



# TP17-D DEEP OBSERVATION HOLE

18 Boyd Drive, Newburyport, Massachusetts

Date: August 20, 2017 Time: 10:40 Weather: Clear, warm, ~75-80°F, light East wind

Position on landscape: Terrace tread Slope aspect: Westerly Land Cover: Grass

Property line: 10<sup>+</sup> feet Drainage way: 50<sup>+</sup> feet Drinking water well: 100<sup>+</sup> feet

Wetlands: 100<sup>+</sup> feet Open water body: 400<sup>+</sup> feet Abutting septic system: NA

Soil moisture status: Dry to damp with increased depth

## SOIL PROFILE ► TP17-D

Depth below land surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA/ NRCS)	Soil Color (Munsell)	Redoxomorphic Features/ ESHGWT	Consistence, grade, size, structure, grain size, soil moisture state, roots, horizon boundary, clasts, stratification, artifacts, restrictive features, etc.
00 → 06"	A <sub>p</sub>	Sandy Loam	10YR3/2 very dark grayish brown	none observed	Very friable; moderate-grade fine-to-medium subangular granular structure; somewhat cohesive matrix; fine grained mineral content; dry; nonplastic; nonsticky; common grass roots; free of clasts; clear wavy boundary.
06 → 39"	2C <sub>1</sub>	Sand fine & medium grained	2.5Y5/3 lite olive brown	none observed	Loose; structurless; very unstable; mixed fine-to-medium grained mineral content; dry matrix; nonplastic; nonsticky; somewhat weakly stratified and poorly graded; free of clasts; stratified beds dipping gently to the North-Northeast; clear wavy boundary.
39 → 121"	2C <sub>2</sub>	Sand medium grained	10YR 5/4 yellowish brown	@ 115" (f,1,f) 7.5R5/8 10Y7/1	Loose; structurless; very unstable; medium grained mineral content; slightly damp matrix at depth of excavation; nonplastic; nonsticky; somewhat weakly stratified and poorly graded; free of clasts; stratified beds dipping gently to the North-Northeast; apparent water observed at 119"; no refusal at test hole depth.

Depth to bedrock: ≥121" Seasonal High Groundwater Table: 115" Phreatic water table (weep): 119"



# TP17-D DEEP OBSERVATION HOLE

18 Boyd Drive, Newburyport, Massachusetts

DEPTH TO APPARENT/ PHREATIC GROUNDWATER TABLE: None Observed

Apparent water seeping from pit face: 119" (Below land surface) Depth to stabilized apparent water: \_\_\_\_\_ (Below land surface)

Soil moisture state: Dry to wet below 116" in depth

## ESTIMATED SEASONAL HIGH GROUNDWATER TABLE:

Depth of Estimated Seasonal High Groundwater Table: 115" (below land surface)

Type: Masses on sand grains Abundance: Common Size: Medium Contrast: Faint

Shape: Irregular; laminar to spheroidal Moisture state: Slightly damp Location: 2C matrix

Hardness: Soft Boundary: Sharp Concentration color: 7.5R 5/8 (red) Reduction color: 10Y 7/1 (bluish gray)

## DETERMINATION OF HIGH GROUNDWATER ELEVATION

Observed depth to stabilized phreatic water: \_\_\_\_\_ inches below grade

Observed water weeping from side of deep hole: 119" inches below grade

Observed depth to redoximorphic features: 115" inches below grade

## DEPTH OF NATURALLY OCCURRING PERVIOUS MATERIAL: ► 0.00 feet

Depth of naturally occurring pervious material in TP17-D Upper boundary: 00"

Lower boundary: 00"

## Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.017.

Alexander F. Parker License #1848

Printed name of evaluator & license number

June 1998

Date of Soil Evaluator Certification

Mr. Philip Christiansen, P.E.

Town of Newburyport Planning Board peer reviewer.

08/20/17

Date of soil testing



# TP17-E DEEP OBSERVATION HOLE

18 Boyd Drive, Newburyport, Massachusetts

Date: August 20, 2017 Time: 11:03 Weather: Clear, warm, ~75-80°F, light East wind

Position on landscape: Terrace tread Slope aspect: Westerly Land Cover: Grass

Property line: 10<sup>+</sup> feet Drainage way: 50<sup>+</sup> feet Drinking water well: 100<sup>+</sup> feet

Wetlands: 100<sup>+</sup> feet Open water body: 400<sup>+</sup> feet Abutting septic system: NA

Soil moisture status: Dry to damp with increased depth

## SOIL PROFILE ► TP17-E

Depth below land surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA/ NRCS)	Soil Color (Munsell)	Redoxomorphic Features/ ESHGWT	Consistence, grade, size, structure, grain size, soil moisture state, roots, horizon boundary, clasts, stratification, artifacts, restrictive features, etc.
00 → 06"	A <sub>p</sub>	Sandy Loam	10YR3/2 very dark grayish brown	none observed	Very friable; moderate-grade fine-to-medium subangular granular structure; somewhat cohesive matrix; fine grained mineral content; dry; nonplastic; nonsticky; common grass roots; free of clasts; clear wavy boundary.
06 → 48"	2C <sub>1</sub>	Sand fine & medium grained	2.5Y5/3 lite olive brown	none observed	Loose; structurless; very unstable; mixed fine-to-medium grained mineral content; dry matrix; nonplastic; nonsticky; somewhat weakly stratified and poorly graded; free of clasts; stratified beds dipping gently to the North-Northeast; clear wavy boundary.
48 → 121"	2C <sub>2</sub>	Loam and Silt Loam mix	10YR2/1 black	@ 97" (f,1,f) 7.5R5/8 10Y7/1	Human transported material; Mechanically mixed anthropogenic layer; massive; structurless; fine grained mineral content; slightly moist; nonplastic; slightly sticky; ~15% angular to subangular gravel content of mixed lithology; ash and shells within matrix; apparent water observed at 110"; no refusal at test hole depth.

Depth to bedrock: ≥121" Seasonal High Groundwater Table: 97" Phreatic water table (weep): 110"



# TP17-E DEEP OBSERVATION HOLE

18 Boyd Drive, Newburyport, Massachusetts

DEPTH TO APPARENT/ PHREATIC GROUNDWATER TABLE: None Observed

Apparent water seeping from pit face: 110" (Below land surface) Depth to stabilized apparent water: \_\_\_\_\_ (Below land surface)

Soil moisture state: Dry to wet below 103" in depth

## ESTIMATED SEASONAL HIGH GROUNDWATER TABLE:

Depth of Estimated Seasonal High Groundwater Table: 97" (below land surface)

Type: Masses on sand grains Abundance: Common Size: Medium Contrast: Faint

Shape: Irregular; laminar to spheroidal Moisture state: Slightly damp Location: 2C matrix

Hardness: Soft Boundary: Sharp Concentration color: 7.5R 5/8 (red) Reduction color: 10Y 7/1 (bluish gray)

## DETERMINATION OF HIGH GROUNDWATER ELEVATION

Observed depth to stabilized phreatic water: \_\_\_\_\_ inches below grade

Observed water weeping from side of deep hole: 110" inches below grade

Observed depth to redoximorphic features: 97" inches below grade

## DEPTH OF NATURALLY OCCURRING PERVIOUS MATERIAL: ► 0.00 feet

Depth of naturally occurring pervious material in TP17-E Upper boundary: 00"

Lower boundary: 00"

## Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.017.

Alexander F. Parker License #1848

Printed name of evaluator & license number

June 1998

Date of Soil Evaluator Certification

Mr. Philip Christiansen, P.E.

Town of Newburyport Planning Board peer reviewer.

08/20/17

Date of soil testing