

Dr. Robert Bagoff, Chair
West Orange Planning Board
66 Main Street
West Orange, NJ 07052

September 3, 2025

RE: PB-24-01 West Essex Highlands, Inc
Block: 179 Lot: 32 Zone: IH-1 Warner Road
West Orange Township, Essex County, New Jersey

0-30

Dear Dr. Bagoff,

At the request of attorney Bruce Afran, counsel for objectors and We Care NJ Corp., Princeton Hydro has prepared a response to the CME letter dated August 15, 2025 which was addressed to the Chairman and Members of the West Orange Planning Board responding to Princeton Hydro's March 10, 2025 review of the stormwater management system for the above referenced application. Without providing substantial supporting details or evidence, the CME letter generally states that proposed stormwater system is compliant with New Jersey Department of Environmental Protection (NJDEP) design standards and requirements found in NJAC 7:8 and the NJDEP Best Management Practices (BMP) Manual. In lieu of providing any notable supporting reasoning, details or evidence, CME instead simply states and reiterates that the "...Department has determined that this project meets the requirements of the Stormwater Management Rules". In fact, in reference to two critically important points (Time of Concentration calculation and groundwater mounding analysis) the CME letter confirms that they found "some discrepancies" as they relate to both of these key points. However, instead of describing these "discrepancies" to any extent or offering any critical response to the detailed issues outlined in our original letter, they simply state the NJDEP has issued a permit.

As the Municipal Engineer for the Township of West Orange one of their responsibilities is to ensure the stormwater design meets the requirements of the local ordinance. As a Township consultant, they are charged with providing an accurate and independent review of the stormwater system for the proposed West Essex Highlands development. The applicant's ability to secure an NJDEP permit does not relieve CME from their responsibility to provide an accurate, objective and independent analysis of the proposed stormwater plan with respect to the local ordinance.

In the following sections we respond to key elements of the CME letter.

With respect to the applicant's reported site-wide total lack of any seasonal high groundwater indications, the CME letter states:

...[T]he New Jersey Stormwater Best Management Practices Manual (NJ BMP Manual) notes that there are instances where mottling can be absent from a soil profile, therefore, observing mottling in a soil profile is not a requirement. Further, Chapter 12 of the NJ BMP Manual specifically outlines the methods for determining the seasonal high-water table (SHWT) when mottling is not observed in a soil profile. Therefore, based on our review, the Applicant's Engineer's method of determining the SHWT is consistent with the NJ BMP Manual.

The NJDEP BMP Manual Chapter 12 Subsection 1d: Seasonal High Water Table (SHWT) Location #1 (page 12) states the following:

Where mottling showing redoximorphic features is observed at any season of the year, the SHWT shall be taken as the highest level at which the mottling is observed, except when the water table is observed at a level higher than the level of the redoximorphic depletions or concentrations. For





details on determining whether saturated soils are present, the guidance document published by NRCS, "Field Indicators of Hydric Soils in the United States" may be used.

When developing soil logs for test pits, one must look for mottling at any season. Not once was mottling observed in the soil logs and never do the logs follow the guidance found in the "Field Indication of Hydric Soils in the United States". Princeton Hydro performed their own soil logs just outside of the property boundary in a few different locations and found evidence of mottling. These soil logs have been provided to the Board. A reasonable person is left to conclude that the only reason redoximorphic features were not noted is that the person documenting the test pits was not looking for them. The NJDEP BMP Manual requires one to specifically look for evidence of seasonal high groundwater and in the rare occasion it is not found, only then can alternative methods be used to establish the SHWT. Princeton Hydro believes that the person responsible for these soil logs should provide testimony about the methodology they used to document the soil logs.

In addition, CME's position that applicant's engineer's method of determining the SHWT is consistent with the NJ BMP Manual is an overly simplistic interpretation of the Manual's requirements. For example, the soils mapped on the development site and shown of the applicant development plans possess a restrictive horizon or fragipan. The NJDEP BMP Manual has specific requirements for logging soils (Subsection 2c, page 22) that includes the identification of restrictive horizons such as a fragipan. Not a single soil log identified a restrictive horizon. The NJDEP BMP Manual also requires "the depth, or the elevation and thickness of each soil horizon" and that the soils are colored using the Munsell system of classification for hue, value and chroma. The soil horizons described appear to lump layers into several feet thick soil layers. This approach is not consistent with the NJDEP BMP Manual and fails to identify discrete horizons that may include restrictive horizons as should be expected based on the soil mapping.

As stated in the Princeton Hydro report of April 29, 2025 (Attachment A) the failure to identify any restrictive horizons and seasonal high-water table will have a substantial impact on the functioning of the proposed stormwater management system. This resulting design deficiency has real and tangible impacts on downstream residents as it relates to the rate and volume of runoff from the property. It is the sole responsibility of CME to ensure that the proposed system functions in a manner that will satisfy the local ordinance. Despite noting "some discrepancies" on two key comments, the recent CME letter serves to simply document CME's attempt to deflect this responsibility.

With respect to the critical issue of peak flow (flood) control and specifically the Time of Concentration calculations, the CME letter states the following:

...Alternative stormwater management measures, removal rates, or calculation methods may be utilized, subject to any limitations specified in this chapter, provided the design engineer demonstrates to the review agency, in accordance with N.J.A.C. 7:8-5.2(g), that the proposed measure and its design will contribute to achievement of the design and performance standards established by this chapter.

Although N.J.A.C. 7:8 does allow for alternative stormwater management measures, removal rates or calculation methods, these alternative measures require justification to demonstrate the unique nature of the situation that dictated the need for the alternative method. Section N.J.A.C. 7:8-5.2 (g) states the following:

An alternative stormwater management measure, alternative removal rate, and/or alternative method to calculate the removal rate may be used if the design engineer demonstrates the capability of the proposed alternative stormwater management measure and/or the validity of the alternative rate or method to the review agency.

However, no justification, documentation or additional context is provided by the Applicant for the use of alternative methods. The justification for each alternative stormwater measure used by the applicant should have been identified by CME and shared with the public in their August 15th letter. Instead, the CME letter uses this generic reference to alternative methods to justify multiple design features, including the time of concentration calculations, despite the fact that these approaches contradict the NJDEP BMP Manual and standard engineering practice as outlined in our March 10, 2025 letter.



With respect to the Time of Concentration calculation the CME letter concedes the following:

Our office agrees that there appears to be some discrepancies with the time of concentration calculation methodology completed by the Applicant's Engineer as compared to the methodology outlined in the BMP Manual.

If CME's review revealed discrepancies regarding the Time of Concentration calculation methodology, they have an obligation to outline these discrepancies, especially considering the critical implications it has for downstream residents of the Township. However, the CME letter offers no further discussion of these discrepancies and instead simply again deflects their responsibility to the NJDEP.

On the contrary, Princeton Hydro was clear in the March 10, 2025 letter that part of the issue with the time of concentration calculations was not just using different velocity factors which could be classified as an "alternative method" but that the basic underlying analysis of the drainage area was incorrectly executed. Two points of analysis cannot have one drainage area and the flow path to the point of analysis was not complete, stopping several hundred feet short and thereby artificially elevating the existing peak flow rates (thus artificially reducing the necessary size of the stormwater system). The CME letter suggests that alternative methods were used but does not provide any justification for the applicant's methodologies, nor does the CME letter attempt to illustrate how the alternative method complies with the Township's stormwater ordinance. Most importantly, CME other than agreeing that there are "some discrepancies", the CME letter does not offer any objective analysis or professional opinion on whether or not the applicant's approach is sound. As the Township's consulting engineer, CME should not attempt to justify an incorrect analysis by stating that it is simply an alternative stormwater methodology, instead they have a responsibility to objectively analyze the applicant's stormwater design.

This is especially relevant in this context as the 100-year storm for the proposed project would, contrary to the stormwater rules, actually generate higher peak flow rate than what currently exists (see Attachment A pages 19-21). This is an important issue for the Township representatives to consider as there are well-documented flood-prone areas immediately downstream of the proposed development. In order to meet the peak flow rate requirements set forth by the local ordinance, our analysis has shown that the design would need to be substantially changed to increase storage in the proposed stormwater system and this would likely have a substantial impact on the current overall site design.

The CME letter concedes that the number of soil explorations is not compliant with the NJDEP BMP Manual but states that the applicant worked with the NJDEP to determine the number of required soil explorations for the development prior to completion. It is not clear if CME has an explanation for the change of requirements from the NJDEP or the applicant as it relates to this key issue. That justification should be provided as part of the application to the board.

With respect to the groundwater mounding calculations, here again the CME letter states that:

Our office agrees that there appears to be some discrepancies with the groundwater mounding calculation methodology completed by the Applicant's Engineer as compared to the methodology outlined in the BMP Manual.

Again, the CME letter fails to outline or offer any additional information on these discrepancies, and instead deflects this responsibility on the pretense of an NJDEP permit.

The CME letter states that the sanitary sewer piping will not be installed within any of the stormwater management systems. The applicant's engineer will be required to revise the plans prior to construction. However, as shown in Figure 1 below, the sanitary sewer is surrounded by wetlands. Therefore, relocating this pipe will most likely require additional wetlands permitting; a fact and supporting context/information not provided by the CME letter.

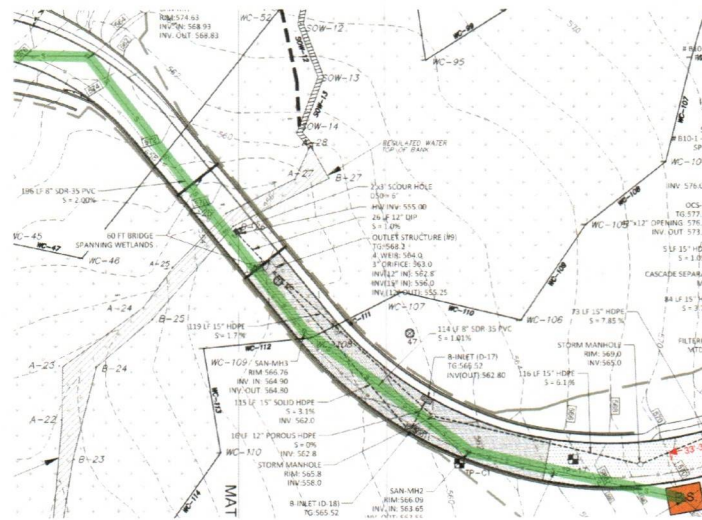


Figure 1: Location of Sanitary Line marked (green) to be relocated.

The relocation of the sanitary sewer out of a proposed stormwater management feature represents the only instance where CME as the municipal engineer is requiring the applicant to revise the plans, while they chose to defer to the NJDEP in all other instances. As stated in our original letter, this design feature is inconsistent with sound engineering practices. Although CME did not appear to take issue with this design flaw in their latest review letter, CME has a responsibility to provide an explanation why they chose to defer to the NJDEP on multiple critical design issues (Time of Concentration methodology/analysis and groundwater mounding) and why they chose not to defer on this issue. It is also important for the public to see a revised plan to understand how the applicant contemplates addressing this issue and how a modified design would achieve compliance with the Township's ordinance while also satisfying NJDEP freshwater wetland and flood hazard area regulations.

We appreciate the opportunity to provide you with these engineering services for you. Please do not hesitate to contact us with any questions regarding this review.

Sincerely

Sean Walsh, PE
Senior Project Manager

Clay Emerson PhD PE CFM
Senior Technical Director

Attachment: Princeton Hydro April 29, 2025 Letter to NJDEP

April 29, 2025

Colleen Keller
Watershed & Land Management Program
New Jersey Department of Environmental Protection
Bureau of Coastal & Land Use Compliance & Enforcement
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RE: PB-24-01 West Essex Highlands, Inc
Block: 179 Lot: 32 Zone: IH-1 Warner Road
West Orange Township, Essex County, New Jersey
Permit No. 722-04-0001.1 LUP230001

Dear Ms. Keller,

At the request of our clients, We Care NJ Corp., Princeton Hydro, LLC has performed an independent technical review of the proposed West Essex Highlands development project (hereinafter termed Project) located in West Orange Township, New Jersey as part of the municipal Planning Board approval process. The applicant, West Essex Highlands received a permit, No. 722-04-0001.1 LUP230001, for activities regulated under the Freshwater Wetland Protection Act and Flood Hazard Area Control Act. NJDEP. It is our understanding that the New Jersey Department of Environmental Protection (NJDEP) reviewed the stormwater management plan for compliance with the New Jersey Stormwater Best Management Practices Manual (BMP Manual) and the Stormwater Management rules at N.J.A.C. 7:8 as part of the issuance of Permit No. 722-04-0001.1 LUP230001. The permit states "[t]he Department has determined that this project meets the requirements of the Stormwater Management rules at N.J.A.C. 7:8."

Although approved by the NJDEP, Princeton Hydro's review of the Township submission identified substantial issues regarding the project's stormwater management design that fail to comply with the requirements of New Jersey's Stormwater Management Rules as well as the New Jersey BMP Manual. One of the concerns regarding this project is that municipalities often view the NJDEP as the state's stormwater expert since they developed the regulations as well as the municipal ordinance that municipalities must review development projects for compliance. When the NJDEP grants a permit prior to or during the municipal review process, municipalities are often pressured by applicants into issuing an approval based simply on the fact that the NJDEP already granted a permit. However, in this case the municipality is confronted with a number of serious compliance issues related to the Site's stormwater management plan that should ultimately result in the denial of the application. **It is in this light that we request the NJDEP suspend the permit based on the conditions set forth at N.J.A.C. 7:13-22.7 Suspension of a**



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verification, and authorization under a general permit, an individual permit, or an emergency authorization.

As part of the municipal review process Princeton Hydro had the chance to review the proposed stormwater management plan for the Project as well as site plans and other documents such as those identified below. Documents central to the contents of this letter include but are not limited to the following:

- Subsurface Investigation Report Subsurface Stormwater Management System West Orange, New Jersey for Garden Homes Short Hills, New Jersey Prepared by Sor Consulting Engineers, Inc. 98 Sand Park Road, Cedar Grove, NJ 07009, Report Number 23-C-17 May 23, 2023, Job No. 23-C-16
- Subsurface Investigation Report Subsurface Stormwater Management System West Orange, New Jersey for Garden Homes Short Hills, New Jersey Prepared by Sor Consulting Engineers, Inc. 98 Sand Park Road, Cedar Grove, NJ 07009, Report Number 21-C-21 April 19, 2021, Job No. 21-C-01
- Subsurface Investigation Report Subsurface Stormwater Management System West Orange, New Jersey for Garden Homes Short Hills, New Jersey Prepared by Sor Consulting Engineers, Inc. 98 Sand Park Road, Cedar Grove, NJ 07009, Report Number 24-C-11 April 4, 2024, Job No. 24-C-02
- Subsurface Investigation Report Subsurface Stormwater Management System West Orange, New Jersey for Garden Homes Short Hills, New Jersey Prepared by Sor Consulting Engineers, Inc. 98 Sand Park Road, Cedar Grove, NJ 07009, Report Number 24-C-02 February 12, 2024, Job No. 24-C-02
- Plan titled, "Preliminary and Final Site Plans West Essex Highlands Block 179 Lot 32, Block 179.17 Lots 8 and 9 Township of West Orange Essex County, New Jersey, Overall Drainage Area Map" prepared by Paul W. Anderson, PE of Anderson Consulting Services LLC., dated September 23, 2022, last revised October 28, 2024.
- Drainage Report, "Stormwater Management Report (formerly Drainage Report) West Essex Highlands Block 179, Lot 32, Township of West Orange, Essex County, New Jersey," prepared for West Essex Highlands Inc., prepared by Anderson Consulting Services LLC., dated March 12, 2023, last revised October 28, 2024.

It is our professional opinion that the application contains critical deficiencies and errors related to stormwater management that are inconsistent with N.J.A.C. 7:8 and the New Jersey BMP Manual. Specific plan deficiencies identified in this letter illustrate that the application fails to demonstrate full compliance with the regulations. **These deficiencies warrant the suspension of Permit No. 722-04-0001.1 LUP230001 in accordance with the provisions of N.J.A.C. 7:13-22.7. Key elements of the failure to fully comply are related to the following.**

- Soil testing requirements
- Groundwater mounding analysis



- Peak flow calculations
- Impacts to onsite wetlands

1.0 INTRODUCTION

West Essex Highlands is a proposed multi-family residential development with recreational facilities and a clubhouse with a limit of disturbance of 1,233,793 sf (28.35 acres). The 120.4 acre parcel is located in the headwaters of Canoe Brook and is currently undeveloped. The steeply sloping site is almost completely forested. The West Essex Highlands development project is currently being reviewed by the Township of West Orange Municipal for Planning Board approval and the proposed project will necessitate the removal of approximately 28.35 acres of relatively mature forest.

The purpose of this letter is to briefly summarize the various deficiencies identified during our review of the revised application materials related to critical aspects of the application's compliance with the New Jersey Stormwater Management Rules at N.J.A.C. 7:8, the BMP Manual and the Township's local stormwater ordinance, §25-29 of the general ordinances.

2.0 STORMWATER MANAGEMENT

It is our professional opinion that the applicant failed to demonstrate compliance with the requirements of N.J.A.C. 7:8. The site plans and stormwater calculations have been reviewed to determine if the design engineer, Anderson Consulting Services LLC (ACS), has demonstrated compliance with N.J.A.C. 7:8, the New Jersey BMP Manual and §25-29 of the Township of West Orange's local stormwater ordinance. We find that both the application to the Township as well as the information submitted to the NJDEP fail to demonstrate that the soil testing requirements of Chapter 12 of the New Jersey BMP Manual have been satisfied for two of the three primary stormwater management performance metrics, groundwater recharge (section P of §25-29) and stormwater runoff quantity standards (section R of §25-29). The following subsections outline our specific concerns as they relate to these three areas with the application submission.

2.1 SOIL TESTING REQUIREMENTS

Before discussing the issues of compliance with two of the three primary stormwater management performance metrics, this section will discuss the soil testing requirements as set forth in Chapter 12 of the New Jersey BMP Manual and compare it to the soil testing documentation provided in this application. The New Jersey BMP manual was developed to provide examples of ways to meet stormwater design standards set by the state. The New Jersey BMP Manual was developed by the NJDEP, in coordination with the New Jersey Department of Agriculture, the New Jersey Department of Community Affairs, the New Jersey Department of Transportation, municipal engineers, county engineers, consulting firms, contractors, and environmental organizations. As stated in Chapter 12 of the New Jersey BMP Manual, understanding the character and saturated hydraulic conductivity of surface and subsurface soils at a proposed land development site is crucial to the design of stormwater best management practices (BMPs) that meet the requirements of the New Jersey Stormwater Management rules at N.J.A.C. 7:8 and §25-29 of the local ordinance. Section 2 of Chapter 12 further clarifies that saturated hydraulic conductivity and depth to Seasonal-High Water Table (SHWT) are of high importance for the design of stormwater BMPs. Subsection 1d of Chapter 12



provides guidelines for determining the upper limit of the zone of saturation which is known as the SHWT. The chapter states there are two methods for determining the SHWT:

1. Where mottling showing redoximorphic features is observed at any season of the year, the SHWT shall be taken at the highest level at which mottling is observed except when the water table is observed at a higher elevation.¹
2. When mottling showing redoximorphic features is not observed the SHWT shall be determined by water level elevation observed in the soil pit or boring when the testing took place from January through April.

Although the identification of redoximorphic features should be a key element of any soil investigation focused on the identification of a SHWT, an understanding of the soils or soil series mapped by the United States Department of Agriculture is an important initial step as it describes the various soil characteristics that may be encountered during an investigation. Copies of the USDA Official Soil Series Descriptions for the Boonton, Haledon and Hasbrouck Soils series are provided as an attachment to this letter. There are two soil series that are mapped over the majority of the Site, Boonton and Haledon. The Boonton soil Series is described as being "very deep moderately well and well drained soils formed in till on uplands."² One of the distinctive features of this soil series is the presence of a fragipan at an average depth of approximately thirty inches. The fragipan is a restrictive horizon that is a firm soil layer that has low to very low hydraulic conductivity. The Soil Profile Description for this soil describes the presence of "a perched water table at a depth of 46-91 centimeters (18-36 inches) from November to May of most years." The Boonton Soils are classified as a Hydrologic Soils Group (HSG) C due to the presence of the fragipan which serves to impede the downward movement of water.

The other common soil series on the Site is the Haledon series. The Haledon series "consists of very deep, somewhat poorly drained soils in low positions on undulating uplands." This soil series also possesses a fragipan in which the hydraulic conductivity is very slow or slow. The Official soil series description indicates that there is "a perched water table within 30 centimeters (12 inches) of the soils surface from late winter to early spring of most years and following periods of extended rainfall."³ Redoximorphic features are present in the B horizon which begins at approximately eight inches below the ground surface.

In addition, the only hydric soil identified on the Site is the Hasbrouck series. This soil "consists of deep, poorly drained soils in depressions on uplands." These soils also have a fragipan that occurs from 40-76 centimeters (approximately 16 to 30 inches). The depth to the water table is indicated to be 0-6 inches.⁴

Although all three soils described above possess fragipans and both the Haledon and Hasbrouck series possess redoximorphic features within the upper eight inches of the ground surface it is important to note that none of the multiple subsurface investigations identified either a fragipan or any redoximorphic features in any single soil profile across the entire site. That is not only very

¹ New Jersey Stormwater Best Management Practices Manual Chapter 12: Soil Testing Criteria. March 2024. Page 12. https://dep.nj.gov/wp-content/uploads/stormwater/bmp/nj_swmp_12.pdf

² USDA Official Soil Series Description: Boonton Series.

³ USDA Official Series Description- Haledon Series.

⁴ USDA Official Series Description- Hasbrouck Series



unusual, but as emphasized in the New Jersey BMP Manual, soil mottling/redoximorphic features should be used to establish the SHWT. The New Jersey BMP Manual also requires the identification of any "soil restrictions including, but not limited to, abrupt textural boundaries likely to restrict the movement of water, e.g., fragipans, dense materials, bedrock and ortstein horizons."⁵ Importantly, soil logs must also be specific in their identification of various colors and textures throughout a profile, as is consistent with the *Field Indicators of Hydric Soils in the United States* referenced by the New Jersey BMP Manual. Color identification is key in correctly identifying mottling by recording the value and chroma of the observed colors which can then be used to properly describe (calculate) the contrast of the mottles. When applying the methods set forth in the New Jersey BMP Manual it is difficult to believe that redoximorphic features would not be present in the surface soils as three of the more extensive soil series on the Site are expected to possess a fragipan and perched water tables.

To determine if the soils on the Site possessed redoximorphic features as described in the USDA's Official Soil Series Descriptions (Attachment A) Princeton Hydro collected soils data at four locations on the adjacent property to the south (Attachment B). The four borings were in Booton and Haledon Soils. All of the borings taken by Princeton Hydro showed that the soils possessed redoximorphic features. The soils data collected by Princeton Hydro support our concern that the perched water table described in the USDA's official soil descriptions was missed and that the SHWT is much higher than indicated. An accurate understanding of the soils as well as onsite hydrology is essential to a stormwater design that meets the NJDEP's minimum requirements.

The original soil investigation on the Site was performed by Sor Consulting Engineers. Soil investigations were done on four separate occasions. Based on the review of the soils data provided in the four Sor Consulting Engineers reports, it is apparent that the SHWT was only established using the elevation of the observed water found in the test pits or borings. It is also important to point out that it does not appear that the analysis of the surface soils was done with a sufficient level of detailed analysis that could have documented the presence of mottling or other evidence of a SHWT. For example, in the Sor Consulting Engineers report dated May, 23, 2023, the report described the soils in TP-C1 and TP-C2 as "[t]he topsoil was underlain by clayey soil and extended to a depth of 3.5 to 4 feet below the surface."⁶ Based on the Official Series Description for a Boonton or Haledon Soil one should expect to observe five distinct soil layers within 48 inches of the surface not two. It should also be noted that neither "topsoil" nor "clayey soil" are soil textures according to the NRCS classification. As noted in the New Jersey BMP Manual, there are instances where mottling can be absent from a soil profile, but it is highly unusual that mottling was not found in any of the soil test pits provided by the applicant, especially since these soil series possess a SHWT related to the presence of perched water above a fragipan. Since soil mottling is a natural and common process in saturated soil conditions it would seem reasonable that some evidence of soil mottling should have been observed in at least some of the soil profiles. The concern regarding the accurate identification of a SHWT is directly related to how well the proposed BMP will function. It is also important to acknowledge

⁵ New Jersey Stormwater Best Management Practices Manual Chapter 12: Soil Testing Criteria. March 2024. Page 23. https://dep.nj.gov/wp-content/uploads/stormwater/bmp/nj_swmp_12.pdf

⁶ Subsurface Investigation Report Subsurface Stormwater Management System West Orange, New Jersey for Garden Homes Short Hills, New Jersey Prepared by Sor Consulting Engineers, Inc. 98 Sand Park Road, Cedar Grove, NJ 07009, Report Number 23-C-17 May 23, 2023, Job No. 23-C-16. Page 5.



that the groundwater level found in a test pit can fluctuate based on recent precipitation. Using soil mottling to determine the SHWT is recommended because it estimates the highest (most conservative) elevation that does not vary with time. It is the position of Princeton Hydro that reliance on observed groundwater elevation has underestimated the elevation of the SHWT.

The New Jersey BMP Manual requires that BMPs maintain a minimum vertical difference of two feet from the bottom of the BMP to the SHWT elevation for BMPs without underdrains. The BMPs in this project do not have underdrains. Although, BMPs 2, 6 and 7 appear to maintain that minimum separation, the method used to establish the SHWT is not compliant with the NJDEP BMP manual as discussed above. If the SHWT elevations are higher than what was recorded in this plan, then there is a risk these designs will not function as envisioned and will not fully comply with the New Jersey BMP Manual. If the groundwater mounding encroaches on the storage area, it will increase the stormwater runoff from the BMP and decrease the amount of groundwater recharge the BMP can provide. N.J.A.C. 7:8 5.4 (§25-29.4 P) sets the groundwater recharge requirements and 7:8 5.6 (§25-29.4 R) sets the minimum reductions in the peak flow rates for runoff exiting a site. If the SHWT is higher in BMPs 2, 6 or 7 that would impact the Site's compliance with both of those standards.

It is also important to point out that the depth to the SHWT more often than not follows a topographic gradient in which the SHWT is deeper in higher landscape positions and becomes increasingly shallower while moving downslope. For this Site this gradient typically ends in the wetlands present at the base of a slope and adjacent to a headwater stream. Based on the landscape position of the wetlands on the Site, in general at the base of slopes, the primary source of hydrology for the wetlands is related to groundwater and groundwater discharge. For an area to be defined as a wetland in New Jersey the SHWT in the wetland must be at a depth of twelve inches or less. A general understanding of this flow path from higher landscape positions to the wetlands is not just important as it relates to wetland impact but also to understanding groundwater on the Site and how well the proposed stormwater BMPs will function. There are at least two examples, Basin 2 and 7, where the proposed basin bottom will be excavated to an elevation below that of the closest wetland and stream. In these cases, the proposed BMP would result in the disruption of the current hydrologic gradient toward the wetland to one that redirects the hydrologic gradient toward the BMPs from the stream or wetland. This will not only impact the wetland but will add an additional source of water to the BMPs that has not been identified by the applicant. This will be discussed again in Section 2.5.

2.2 BMP DESIGN STANDARDS AND SHWT

Princeton Hydro reviewed the SHWT elevations documented in the subsurface investigations against the proposed BMP designs to confirm that each of the proposed BMP's met the minimum two vertical feet of separate from the bottom of the basin to the SHWT. Despite the issue identified in the previous section with respect to the SHWT being underestimated by only observing seepage, Princeton Hydro found that the following BMP's did not meet that minimum standard:

- BMP 6 (Porous Pavement)

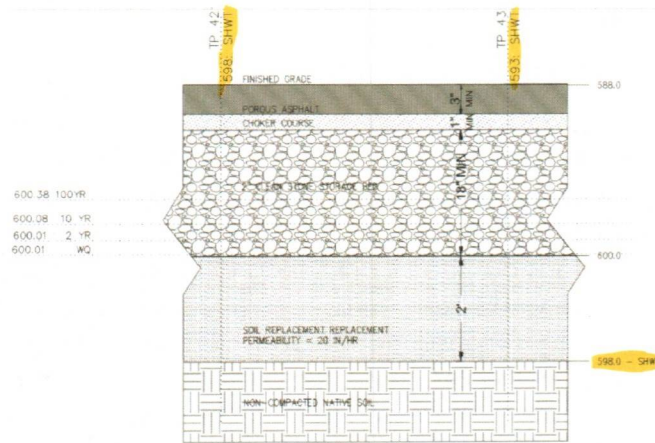


- BMP 4 (Porous Pavement)
- BMP 9 (Aboveground basin)

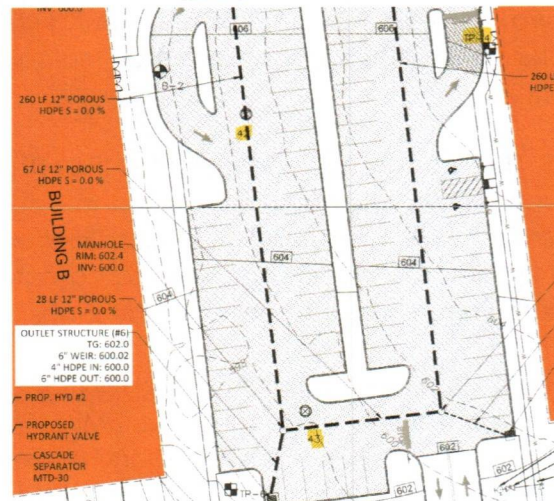
BMP 6 shows a SHWT of 598 using the 2024 soil testing data but the 2021 testing data shows a different story. In 2021, TP 4 shows seepage at 608 which is 10 feet higher than what the plans show. Based on this finding, the porous pavement design is not compliant. The SHWT (which in this case was direct seepage) is within the storage volume of the basin see Figure 1. BMP 4 shows a SHWT of 567 (Figure 2) on the plans but that is only using data from the soil tests taken in 2024 (Test Pit 28). In 2021, soil tests were also taken, and TP 10 (Figure 5) is very close to BMP4. TP 10 shows a SHWT of 573 (Figure 2) six feet higher than TP 28 which would result in the groundwater level being within the storage bed of the BMP, which clearly does not comply with the two-foot minimum separation and would result in a non-functional BMP. There is also an error on the TP-10 soil profile. On the right-hand side of the document, there is an entry for the water level found; however it is left blank. Elsewhere on the same test pit log it states that seepage was found at 3 feet below grade which is an elevation of 573 ($576-3 = 573$). Groundwater seepage is water leaking through the side walls of the soil profile, the seepage is an indicator of the SHWT and it should have been marked that way.

Finally, there is an error with BMP 9. The construction detail states that TP 46 has a SHWT at 548 but the soil profile states the ground surface elevation is 574 and the depth to SHWT is 8 feet which results in an elevation of SHWT at 566. Elevation 566 is much higher than 548 and would require the design to be significantly altered if the design were to comply with the stormwater regulations. See Figure 3 below for the necessary references to the plans and soil profiles.

These findings show that BMPs 4, 6 and 9 are not compliant with NJDEP. The SHWT is too high and would occupy a portion of the storage volume of each of the BMPs. This would result in less groundwater recharge than calculated in the stormwater report and higher peak flow rates from each BMP. The BMPs need to be revised. These revisions could require the BMPs to be widened, shortened or relocated in general. The bottom of the BMPs need to be maintained at the minimum of two feet above the SHWT to meet the requirements. This is another way that the design is not demonstrating compliance with N.J.A.C. 7:8 5.4 (Local Ordinance 25-29.4 P) 7:8 5.6 (Local Ordinance 25-29.4 R).



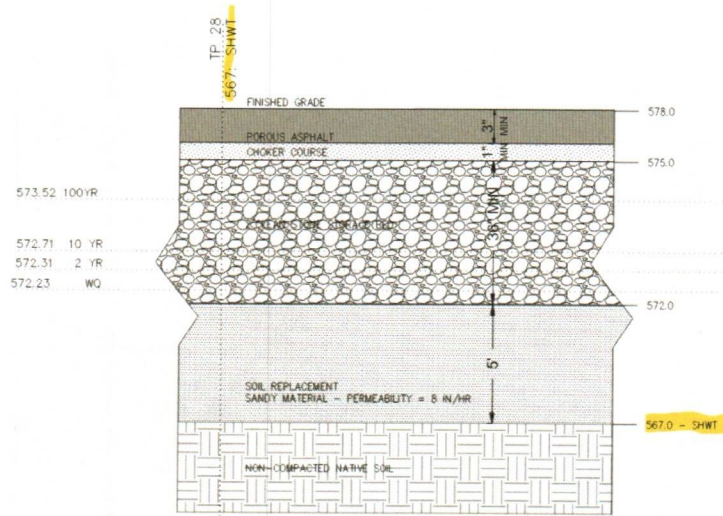
POROUS PAVEMENT #6 SECTION
SCALE: NTS



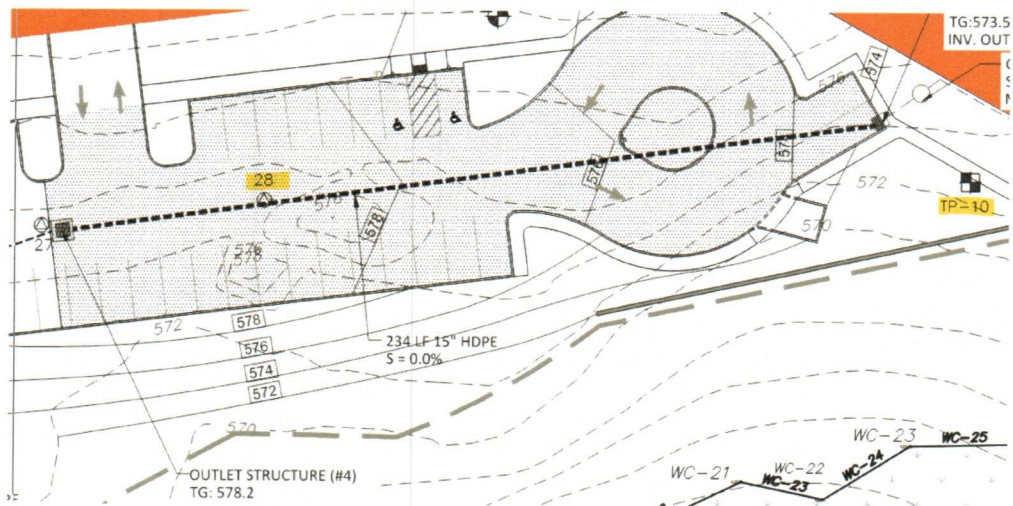
SOR CONSULTING ENGINEERS, INC.		TEST PIT LOG		TEST PIT NO. TP-4	
CLIENT: Garden Homes				GSE	+610' (±)
				WATER LEVEL	"
PROJECT: Proposed Residential Development				DATE	3/25/2021
				JOB NO.	21-C-01
LOCATION: West Orange, New Jersey				REPORT NO.	21-C-12

DEPTH FT.	DENSITY	MOISTURE	DESCRIPTION	REMARKS
1	Soft	Moist	Topsoil/Vegetation 8"	"Water seepage 2"
			Brown coarse to fine Sand, some Silt, little coarse to fine Gravel	
2			Bedrock @ 2'	
Test Pit Completed at 2'-0"				

Figure 1: Cross Section of PP6, Proximity of TP-4 to PP6 and TP-4 Soil Profile.



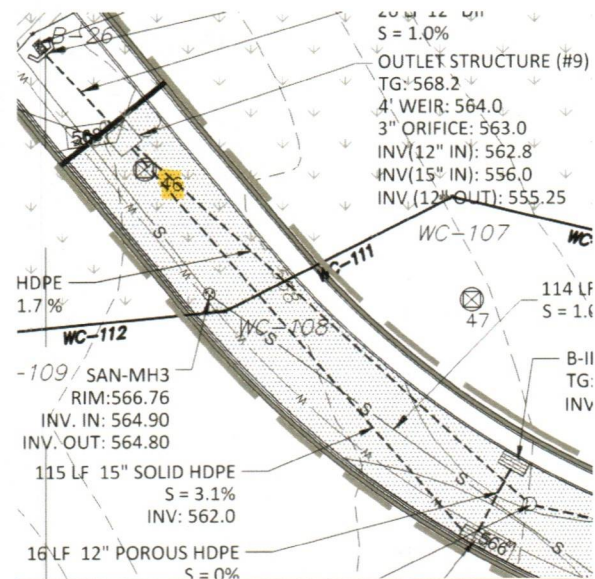
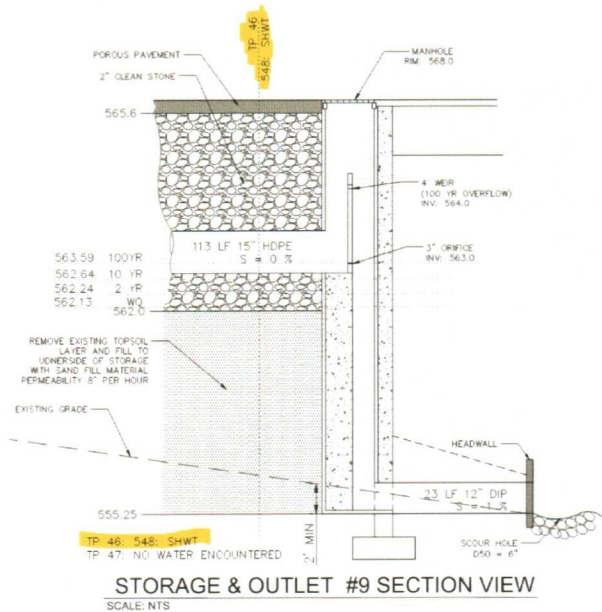
POROUS PAVEMENT #4 SECTION
SCALE: NTS



SOR CONSULTING ENGINEERS, INC.		TEST PIT LOG		TEST PIT NO. TP-10	
CLIENT: Garden Homes				GSE +578' (±)	
PROJECT: Proposed Residential Development				WATER LEVEL *	
LOCATION: West Orange, New Jersey				DATE 3/26/2021	
				JOB NO. 21-C-01	
				REPORT NO. 21-C-12	

DEPTH FT.	DENSITY	MOISTURE	DESCRIPTION	REMARKS
1	Medium Dense	Moist	Topsoil/Vegetation 12"	*Water seepage at 3'-0"
2			Brown coarse to fine Sand, some Silt, some coarse to fine Gravel, occasional cobbles/boulders	
3				

Figure 2: Cross Section of PP4 from Construction Plans, Proximity of TP-10 to PP4, TP-10 Soil Profile.



SOR CONSULTING ENGINEERS, INC.			TEST PIT LOG		TEST PIT NO. TP-46	
CLIENT :			Garden Homes/ West Essex Highlands, Inc.		GSE	+574'
PROJECT :			Stormwater Management System		WATER LEVEL	8'-0"
LOCATION :			West Orange, New Jersey		DATE	3/28/2024
					JOB NO.	24-C-02
					REPORT NO.	24-C-11
DEPTH FT.	DENSITY	MOISTURE	GROUND SURFACE		REMARKS	
1	Soft	Moist	Topsoil/Vegetation			
2			Gray to Reddish Brown Clayey Silt, little coarse to fine Sand, little coarse to fine Gravel (Clay Loam)			
3			2'-6"			
4	Stiff		Light Brown Clayey Silt, little coarse to fine Sand, kluittle coarse to fine Gravel (Clay Loam)			
5			Reddish Brown coarse to fine Sand, some Silt, and medium to fine Gravel (Sandy Loam)			
6			Permeability @ 6' K=0.99 in/hr (K2)			
7						

Figure 3: Cross section at PP9, Location of TP-46, TP-46 Soil Profile.

2.3 SOIL TESTING REQUIREMENTS FOR BMPs

The New Jersey BMP Manual provides guidance on how many test pits are required based on the size of the basin in Subsection 2a of Chapter 12. The soil testing allows a designer to understand how the soil will respond to rainfall, including the elevation of the SHWT and a



measurement of the hydraulic conductivity of the soil at the elevation where infiltration is proposed. It is a crucial part of the design process.

Typically, each BMP is required to have two test pits but more can be required based on the size of the proposed BMP. The SHWT can vary based on its location and it is important to take measurements at different locations to better understand that variation. If an insufficient number of soil tests are taken, the engineer runs the risk of not understanding the elevation of the SHWT across the BMP and could design a BMP that does not have the required separation from the SHWT. A good example of this is PP4 and PP6. If you choose to review only portions of the test pit data the BMP seems properly designed but when you review the data in its entirety, including the 2021 data, you can see how the SHWT varies by location and the design needs to be modified to accommodate the variation.

Princeton Hydro compared the infiltration area of each BMP on the plan to what was entered into the stormwater calculations model. Table 1 is a comparison of the infiltration area found in the model calculations and the infiltration area shown on the plan. The infiltration area is the bottom of the basin, not the side slopes.

Table 1 Comparison of Infiltration Areas shown in the Plan and Stormwater Calculations Model.

BMP ID- BMP Type	Model Infiltration Area (SF)	Plan Infiltration Area (SF)	Difference, Model – Plan (SF)
1 – Large Scale Infiltration Basin	42,000	45,490	-3,490
2 – Small Scale Infiltration Basin	26,023	25,830	193
3 – Porous Pavement	5,227	5,558	-331
4 – Porous Pavement	12,197	12,369	-172
5 – Porous Pavement	14,810	14,611	199
6 – Porous Pavement	35,719	37,473	-1,754
7 – Small Scale Infiltration Basin	14,375	13,405	970
8 – Porous Pavement	10,019	15,900	-5,881
9 – Porous Pavement	6,534	17,981	-11,447
10 – Small Scale Infiltration Basin	9,583	9,467	116
11 – Porous Pavement	13,504	22,826	-9,322
12 – Small Scale Infiltration Basin	900	1,004	-104

There are differences between what was modeled and what was shown on the plan. Many of these differences are not consequential but the differences at BMP 1, 8, 9 and 11 are especially significant and the model should match what is shown on the plan.



Princeton Hydro compared the number of test pits for each BMP to the number required by the New Jersey BMP Manual to confirm if the applicant performed the required minimum number of soil tests for each BMP as is shown below in Table 2. Due to the discrepancy outlined above with respect to the BMP areas, Princeton Hydro used the area shown on the plan for the completion of the table below.

Table 2: Number of Soil Tests Performed for each BMP against the Minimum Number Required.

BMP ID	Infiltration Area (SF) Plan	Number of Tests Provided	Number of Test Required Plan	Compliant (Y/N)
1	45,490	5	8	Y
2	25,830	4	4	Y
3	5,558	2	2	Y
4	12,369	3	3	Y
5	14,611	2	3	N
6	37,473	4	5	N
7	13,405	1	3	N
8	15,900	2	3	N
9	17,981	3	2	Y
10	9,467	1	2	N
11	22,826	4	4	Y
12	1,004	2	2	Y

Based on a review of the site plan alone, it will appear that there were more soil tests performed than are shown in Table 2 for BMP 7. However, the applicant did several soil tests at the wrong time of the year (for example G1 and G2 were taken in May). While you can use mottling to establish the SHWT at any time of the year, water elevation can be used to determine SHWT only if the work was done between January and through April according to the New Jersey BMP Manual. The estimated SHWT provided by the applicant for G1 and G2 is the bottom of the test pit. All the test pits labeled with letters (not TP) and numbers were performed after April and cannot be counted towards compliance. Adequate testing for BMP 7 is essential since the basin bottom is proposed at an elevation of 531.5, approximately 16.5 feet lower than the delineated wetland located a little over fifty feet to the north of the basin.

BMPs 5, 6, 8, and 10 are short one soil test and BMP 7 is short two test pits. This non-compliance is important, especially considering the example of BMP 6 where the elevation of the groundwater was shown to vary greatly due to the natural topography of the site. This is a vulnerability in the design that shows how the project is potentially not conforming to N.J.A.C. 7:8 5.4 (Local Ordinance 25-29.4 P) 7:8 5.6 (Local Ordinance 25-29.4 R) for groundwater recharge and stormwater quantity control standards.

2.4 GROUNDWATER MOUNDING CALCULATIONS

The soil testing showed relatively low hydraulic conductivity for most of the Site. The applicant proposes to replace the existing soil from the bottom of the BMPs to the SHWT with a sandy soil that has much higher hydraulic conductivity in an effort to meet the requirement that all basins



must empty in 72 hours. This is a commonly used practice that has been previously accepted by the NJDEP. However, the applicant accounted for infiltration in the runoff routing calculations. That means that the model assumes some of the runoff is infiltrated, effectively removed from the simulation, and does not travel through the stormwater piping network. When one uses infiltration in their runoff routing calculations, one must provide groundwater mounding calculations for the water quality and 100-year storm. During a rain event, the groundwater will mound below BMPs that infiltrate. Therefore, the designed must provide these calculations to confirm the mounding does not encroach on the storage volume of the BMP. If the calculations indicate that the groundwater mound will intersect the basin bottom, the system will not infiltrate at the rate implied by the calculations and measured hydraulic conductivity. While the applicant did provide calculations for both scenarios, the groundwater mounding analysis for the 100-year event is critically flawed. Upon our further review, we believe that when properly completed the groundwater mounding analysis will indicate groundwater mound conflicts for all of the following BMPs:

- BMP 3
- BMP 4
- BMP10

Princeton Hydro will rely on PP3 as an example of the analysis that was performed on each of the BMPs to determine the mounding issue under the 100-year storm scenario. Princeton Hydro observed that the duration of infiltration in the groundwater mounding analysis for the water quality and the 100-year storm, were nearly identical for both storms (0.21 hours for water quality and 0.2 for one hundred year). The analysis for the water quality storm can be found on page 821 of 946 in the Drainage Report and the analysis for the 100-year storm on page 831 of 946 in the drainage report. The duration of these two different elements of a storm event should be very different. The water quality storm is only 1.25 inches where the 100-year storm is 8.33 inches. That is almost 7 times more water in the 100-year storm, due to the sheer volume difference the time should also be substantially different. The recharge rate is also different for both storms, Princeton Hydro does not know why the recharge rate would have different values for the different storms and maintains that it should be the same for any storm.

As noted previously, the design proposes to replace the existing soil from the bottom of the BMP down to the SHWT with a sandy soil that has a higher hydraulic conductivity to allow the runoff to infiltrate quicker through the BMP storage area. However, the native soil at the SHWT still has a very low hydraulic conductivity so the "infiltrated runoff" from the BMP will back up in the replacement soil since the soils at and below the SHWT infiltrate at a much slower rate. Typically, the stormwater report would provide calculations demonstrating that there was enough storage in the replacement soil to hold the "infiltrated runoff" while it infiltrates below the SHWT at a much slower rate. The calculations would show that the "infiltrated" runoff would be held in the replacement soil and not mound into the storage volume of the BMP. Groundwater mounding into the storage volume would directly impact the runoff peak flow rate calculations and the groundwater recharge calculations by reducing the amount of stormwater volume that could be managed by the BMP.



During the water quality storm, BMP 3 infiltrates 880 cf of runoff. The area of the infiltration basin is 5,558 sf. 880 cf of water is equivalent to about two inches of water over the area of the basin. That means that two vertical inches of water will be held above the SHWT and slowly infiltrate. Assuming a porosity of 0.4 for the sand layer, the two inches of vertical water turns into five inches. That means that there is five inches of water in the sand layer between the SHWT and the bottom of the storage for PP3. The system works under this scenario because the soil replacement area is two feet deep. However, during the 100-year storm, the model assumes that 10,971 cf of water will infiltrate through the system (page 529 of 946 in drainage report). That is because the model is assuming the runoff is infiltrating at a constant rate of five inches per hour. The reality is that at the surface of the basin at the beginning of the storm, the runoff will infiltrate at that rate but once it hits the SHWT it will infiltrate at the much slower rate of 0.25 inches/hour (assuming a factor of safety of 2, based on the soil testing results) that will cause water to back up into the sand layer. Once the system is under the influence of a groundwater mound the rate of infiltration could be expected to decrease by orders of magnitude as the system will rely on horizontal groundwater flow. There needs to be thick enough layer of sand to prevent that runoff from backing up into the storage area of the BMP3. 10,971 cf of water over the area of the basin is equal to 1.97 ft of water. As noted above when you apply the 1.97 feet of water to the anticipated porosity of sand (0.4), the height of the sand and the water is 4.9 feet (59 inches) from the SHWT. BMP 3 (see Figure 4) only provides two feet of sand storage and an additional 26 inches of stone storage (see Figure 7). The system will become overwhelmed during a 100-year storm and the peak flow rates will not be reduced. Instead of infiltrating, a large portion of the 10,971 cf that the model says will infiltrate will discharge through the stormwater system. The design will fail and potentially create higher peak flow runoff rates than currently exist. Furthermore, this design issue is not isolated to BMP 3 since any unanticipated surcharge from the BMP will be captured by inlets further downstream and will potentially overwhelm those inlets. If the excess runoff is captured by the inlets, the runoff will enter either BMP 1 or 2, it could overwhelm those systems and increase the peak flow rates from those BMPs as well.

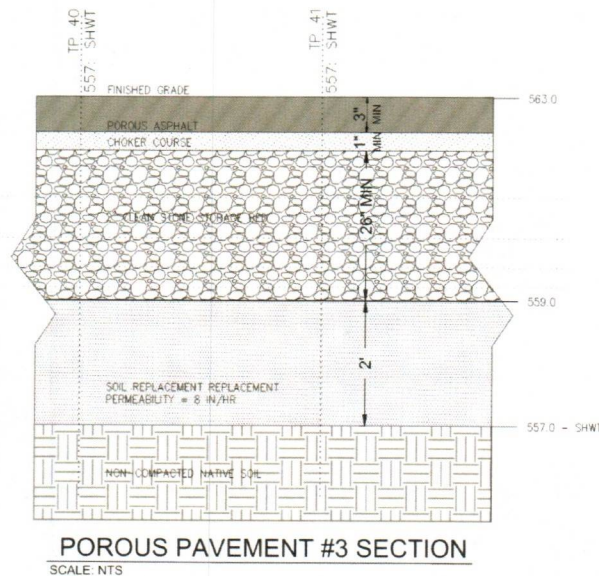


Figure 4: Cross Section of BMP 3.

2.5 IMPACTS TO WETLANDS

In the existing conditions, the stormwater runoff generated from the existing topography travels over the surface and reaches the upgradient wetlands providing valuable water to the wetland ecosystem. In the proposed condition, the discharge locations for each of the drainage areas are at the bottom of the project area. This is illustrated in Figure 5. The blue arrows show the existing flow paths and the fuchsia arrows represent the proposed flow paths. The proposed stormwater system intends to route the stormwater runoff through a pipe network to basins where all the surface runoff will discharge much further downstream. The drainage area to the wetlands uphill of the discharge locations will have a smaller drainage area and collect less stormwater runoff. Princeton Hydro included two attachments that show the existing drainage areas for eastern and western wetlands. The western wetlands have a drainage area of approximately 32 acres. The proposed improvements to DA for the western wetlands will reduce the drainage area by nine acres or 28% of the total existing drainage area. The eastern wetlands have a drainage area of 48 acres. The proposed improvements to the DA for the eastern wetland will reduce the drainage area by 16 acres or 33% of the total existing drainage area.

In addition, to the modified drainage areas to the wetlands there are at least two instances where the proposed design will result in the hydrologic gradient of groundwater to the wetlands being modified and redirected toward two of the proposed infiltration basins, BMP 2 and BMP 7. For example, the bottom of BMP 2 is at elevation 544 (this is incorrectly identified as being 544.5 on plan sheet SP-55 as the bottom of the basin should be the base of the 6-inch sand layer). Figure 6 shows a cross section of BMP 2 with the elevations of the adjacent wetland. In this case, the basin bottom is situated as much as six feet below the elevation of the wetland which is less than 75 feet from the wetland to the east (see Figures 6 and 7). More importantly, the groundwater data indicates that the SHWT for boring six is approximately ten feet lower than that of the surface of the nearby wetland. In addition, TP22 is located approximately fifty to the



northwest of the basin and the SHWT is indicated to be at an elevation of 545, a foot above the basin bottom. It is important to reiterate that no redoximorphic features were identified by the applicant's professionals in any of the borings.

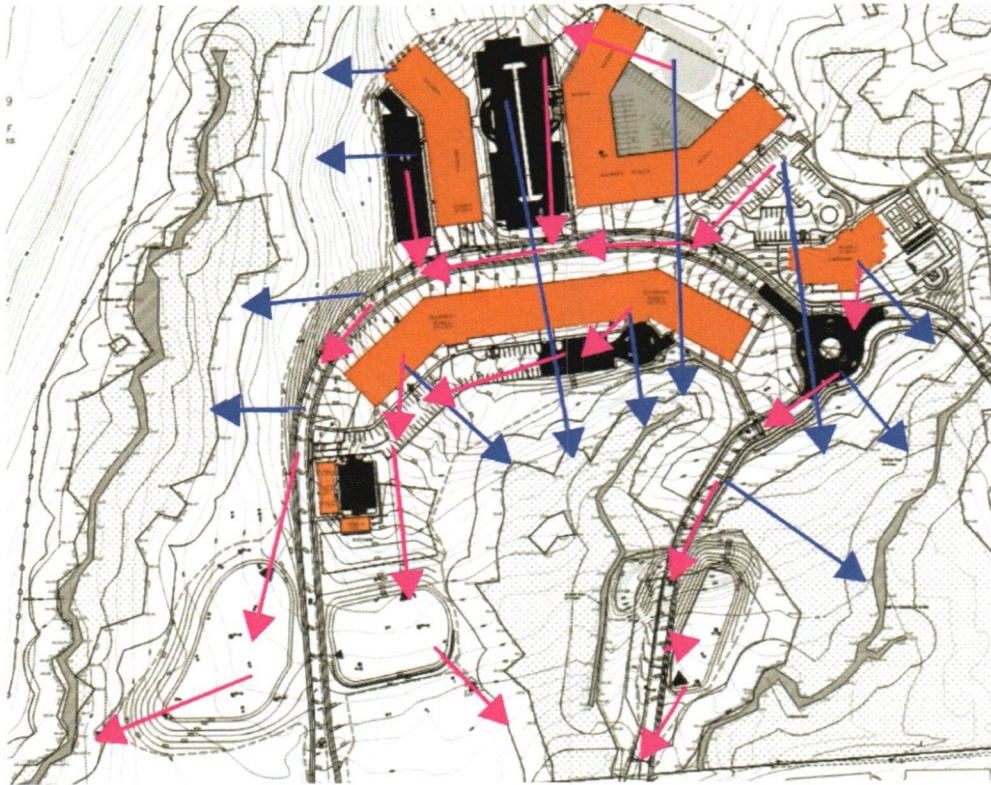


Figure 5: Proposed Grading Plan with Blue Arrows showing the existing drainage path and the Fuchsia arrows showing the proposed drainage paths and how the runoff is being diverted from the wetlands.

Both BMP 2 and 7 are proposed to be excavated to an elevation below nearby wetlands. In these cases, the proposed BMP would result in the disruption of the current hydrologic gradient toward the wetland to one that redirects the hydrologic gradient toward the BMPs from the wetland. This will not only impact the wetland but will add an additional source of water to the BMPs that has not been identified by the applicant. This is especially relevant for BMP 7 where the basin is proposed to be excavated to an elevation approximately 16.5 feet lower than the delineated wetland located a little over 50 feet to the north of the basin. The relationship of wetlands and state open waters to infiltration basins should have been considered in the design of the proposed stormwater BMPs as the current design will not just impact the function of the BMPs but also impact the wetlands. The impacts to the wetlands related to changes in hydrology also warrants reconsideration by the NJDEP as it relates to the 401 Water Quality Certification the NJDEP granted to this applicant.

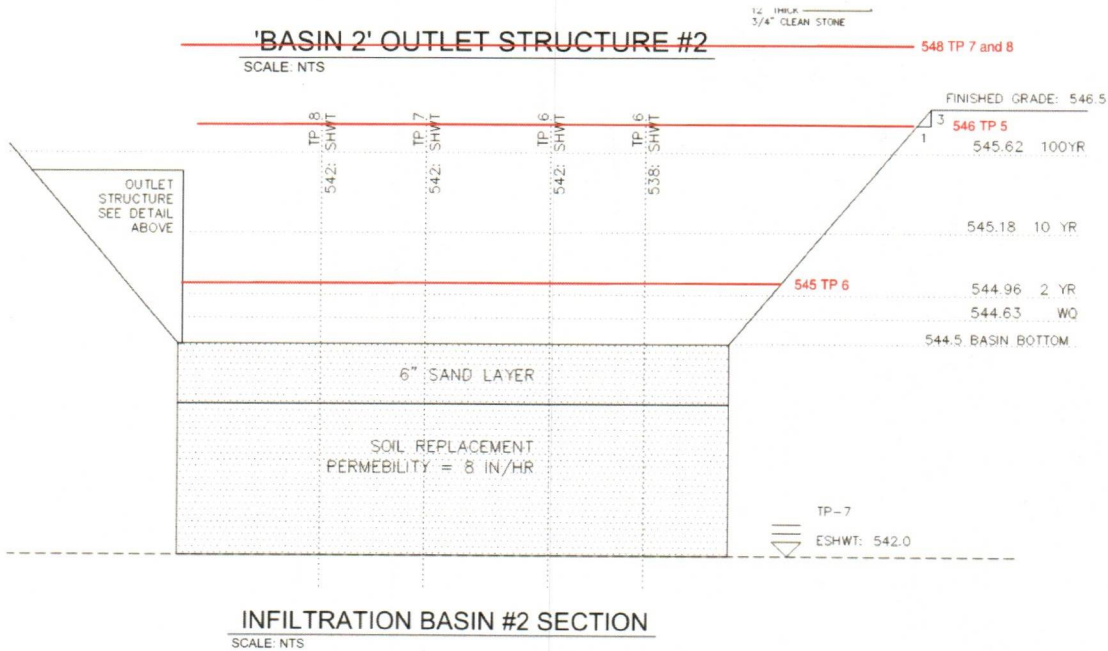


Figure 6 Cross section of BMP 2 from the construction plans.
 The red lines mark the surface elevation of the nearby wetland.

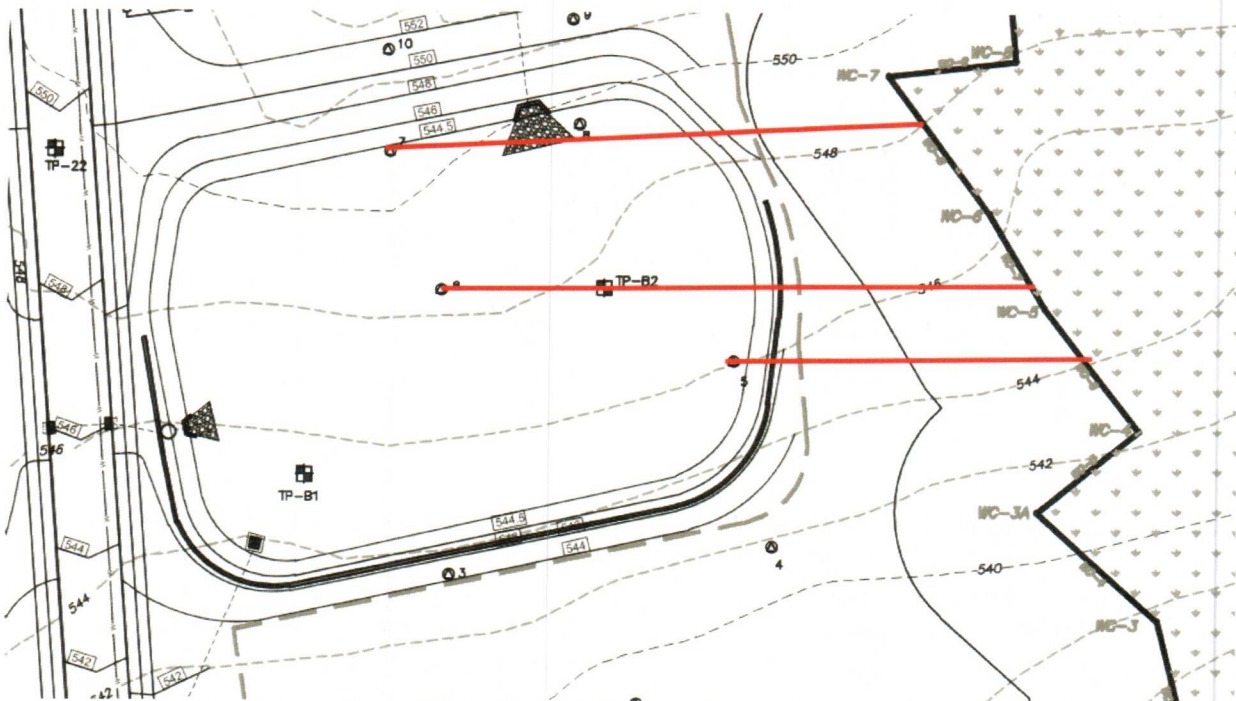


Figure 7 Plan view of BMP 2 from the construction plans.
 The red lines show the relationship of adjacent wetland to BMP.

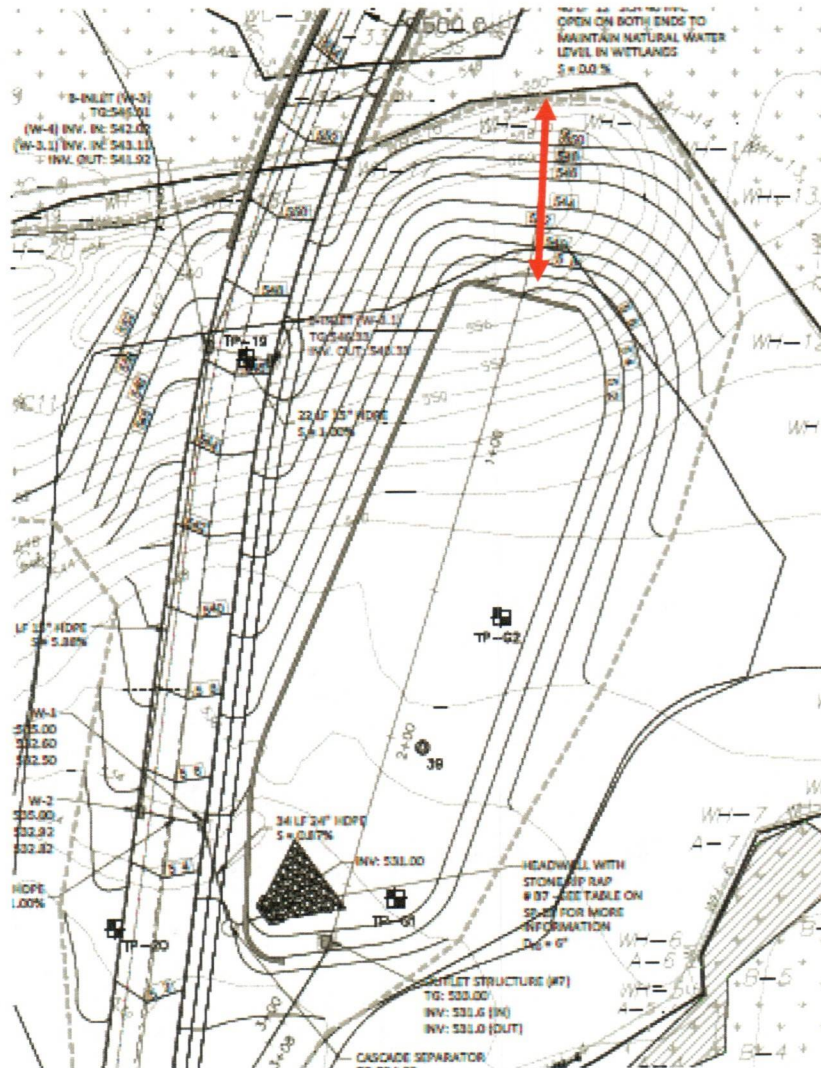


Figure 8 Plan view of BMP 7 from the construction plans showing 16.5 foot cut downgradient of mapped wetland to the north.

2.6 TIME OF CONCENTRATION

Existing conditions were incorrectly calculated for this project. The time of concentration (TC) is the time it takes for runoff to travel through the watershed on the longest hydrologic flow path. The designer used an outdated method to determine the TC for the drainage areas POA 1 and 2. Due to the very small size of the drainage area for POA 3, it was not included in this analysis. The plans describe the land use as "unpaved" which is an older land use classification that is not used in the latest method. Princeton Hydro would note that this method was not issued during the last update to the stormwater rules which NJDEP ruled did not apply to this project, but it was updated on the previous rule change in 2021 which do apply to this application. TC for this system was broken down into two different flows: sheet flow and shallow concentrated flow. Runoff then transitions from sheet flow to shallow separator concentrated flow. Shallow concentrated flow



occurs after sheet flow and the depths range from 0.1 to 0.5 ft. To demonstrate the magnitude of how incorrect TC calculations are, Princeton Hydro recalculated the shallow concentrated flow portion of the TC for both POA 1 and 2.

For POA1, the designer stated that it would take 7.2 minutes for the runoff to travel 1,625 ft via shallow concentrated flow. The average slope for that length is 5.5%. According to Chapter 5 of the New Jersey BMP manual, the velocity of runoff traveling through a forested area with heavy ground liter is 0.55 fps when the slope is 5.5% (Figure 5-13 of New Jersey BMP Manual). The travel length of 1,625 ft divided by 0.55 fps is equal to 49 minutes. The revised TC is almost seven times longer than what is shown on the stormwater report.

For POA 2, the report states that it takes 1.9 minutes to travel 564 ft via shallow concentrated flow. The average slope for that length is 9.2%. That is an average velocity of 5 fps. The New Jersey BMP Manual states the velocity of runoff at a slope of 9.2% for wooded area is 0.75 fps (Figure 5-13). Using that velocity the TC is 12.5 minutes. Again, the revised TC is almost seven times longer than what is shown on the stormwater report.

Establishing the existing TC and peak flow rates are a crucial part of a compliant design. The TC has a significant impact on the existing peak flow rate. All development projects are required to have their peak flow rates leaving the site be less than the existing peak flow rate. In general, a shorter existing condition TC translates to a higher peak flow rate. The higher your peak flow rate, the easier it is to apparently meet your peak flow rate reduction requirements. An over-representation of the existing peak flow rate allows for a reduction in the size of your stormwater basins. The problem with this approach is that it does not reflect reality or site conditions and instead of reducing the peak flow rate generated by the project it will increase the rate in comparison to the existing conditions.

The flow path shown on the Drainage area Map for POA 2 is only 664 feet long and that matches what is shown on the model. The TC is meant to measure the time it takes for the water to travel the entire flow path. The actual flow path for POA 2 is greater than 664 ft. The discharge location is approximately 700 feet away from where the analysis ends (as the crow flies, see Figure 9). This analysis is incorrect and incomplete because it does not capture the entire flow path.

This is similar to using the older TC calculation, as it artificially shortens TC so it shortens the peak flow rates for the existing conditions and potentially risks the proposed improvements increasing the flow rate leaving a site instead of decreasing as the regulations require.

To understand the impact that the TC errors have on the design, Princeton Hydro calculated the TC for POA 2 using the correct method and included the entire flow path. The applicant's report has a total TC of 16.8 minutes. Princeton Hydro's calculations show a TC of 60.8. That is about 3.5 times longer than that calculated by ACS. For the two-year storm, PH calculated a peak flow



is 7.52 cfs. The applicant's

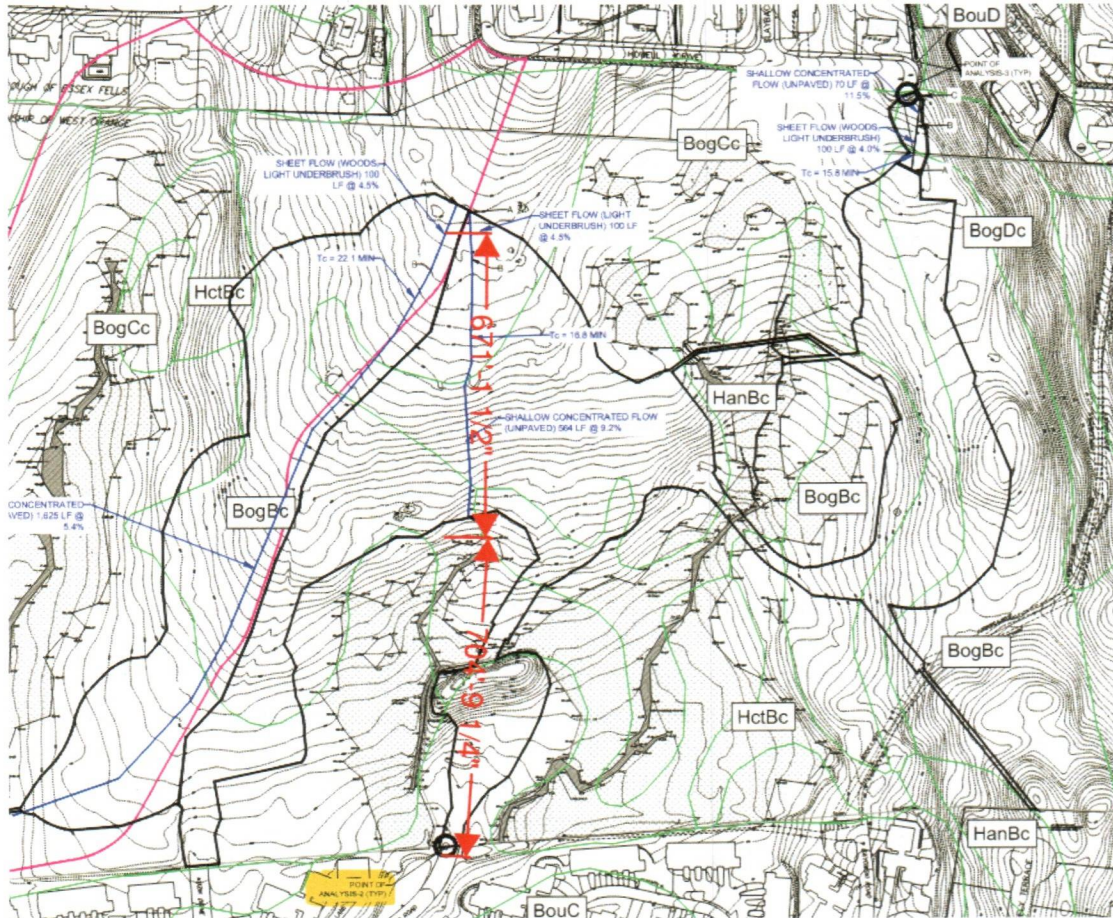


Figure 9: Existing Conditions Drainage Path for POA-2, demonstrating how the analysis stops approximately 700 feet short of the POA location.

model states 14.76 cfs (page 22) while their report states 17.53 cfs (page 14). Princeton Hydro also found that the existing peak flow rates in the report do not match the flow rates in the model results found in the report appendix. This should be corrected. For the purpose of this report, the results found in the modeling calculation appendix were evaluated against Princeton Hydro's own calculations. Based on our calculations the peak flow rate for the development is 3.76 cfs under existing conditions for the two-year storm. Currently the design's peak flow rate under the post-development conditions is 7.24 cfs which is almost twice what should be permitted. Princeton Hydro calculated the peak flow rate for the 100-year storm at 37.7cfs but the applicant's model states the peak flow rate at 72.79. The peak flow rate for the proposed condition is 38.99 cfs. During the 100-year storm, the proposed Site will actually generate higher peak flow rate than what currently exists. This is an alarming situation especially considering there are flood prone areas immediately downstream. To meet the peak flow rate requirements state forth by the NJDEP and the local ordinance would require the volume storage for the BMPs to be dramatically increased. This would have a substantial impact on the current site design.



The analysis of the existing drainage area for POA2 has yet another flaw. The drainage area for POA 2 has two clear discharge locations in the proposed condition, but it only assumes discharge location at Kuzik Road (see Figure 10). The design has two discharge locations, but the modeling assumes they are combined. The flows do eventually combine but that is approximately 600 ft into the adjacent neighborhood. The drainage area analysis must be reanalyzed as two separate drainage areas with two separate analyses to ensure the peak flow rate at both locations does not increase. It is difficult to understand at this time how this change will impact the proposed design but it could be substantial. This re-evaluation is necessary to ensure that the peak flow rate of runoff from the Site is compliant with the state and local regulations and to prevent downstream flooding.

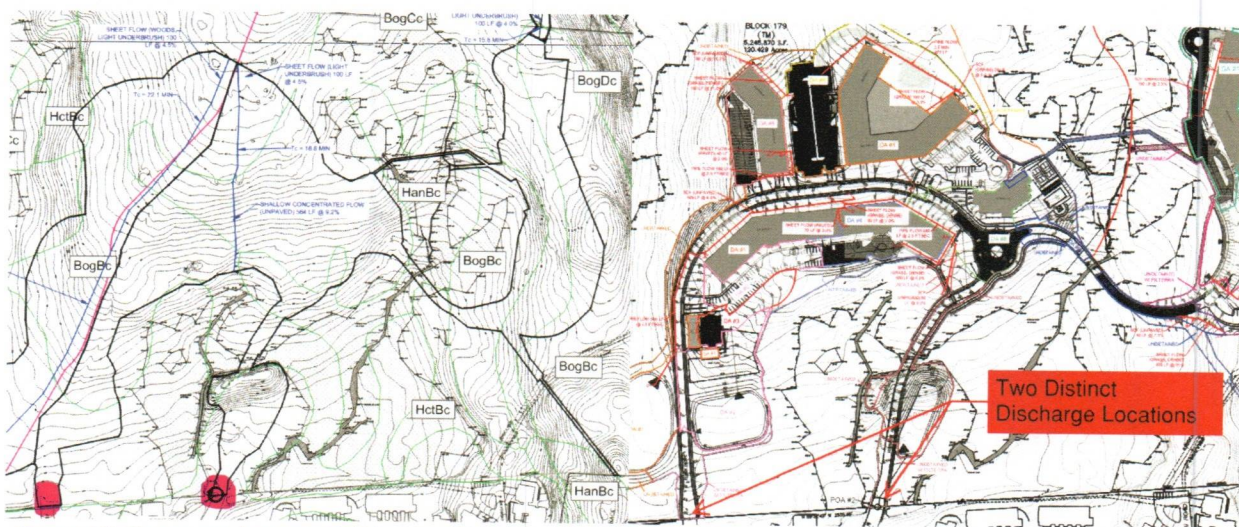


Figure 10: These are images of DA-1 and DA-2 from the Stormwater report to demonstrate how the DA for POA 2 should be modeled as two separate DA's because there are two separate points of discharge.

2.8 SEPARATION OF SANITARY INFRASTRUCTURE AND BMP

The design has a sanitary pipe traveling through porous pavement system (Figure 11). While we are not aware of a specific rule against having a sanitary line traveling through a subsurface basin, it appears to be a poor design decision that is counter to the rules and common engineering design sense. The purpose of the distances is to prevent leaking sanitary pipes from entering the stormwater system and potentially causing an illicit discharge of raw wastewater. The design should be modified to relocate the sanitary pipe out of the subsurface system. This may require the project to have additional Flood Hazard and/or Wetlands Permitting depending on how the layout is impacted by this modification.

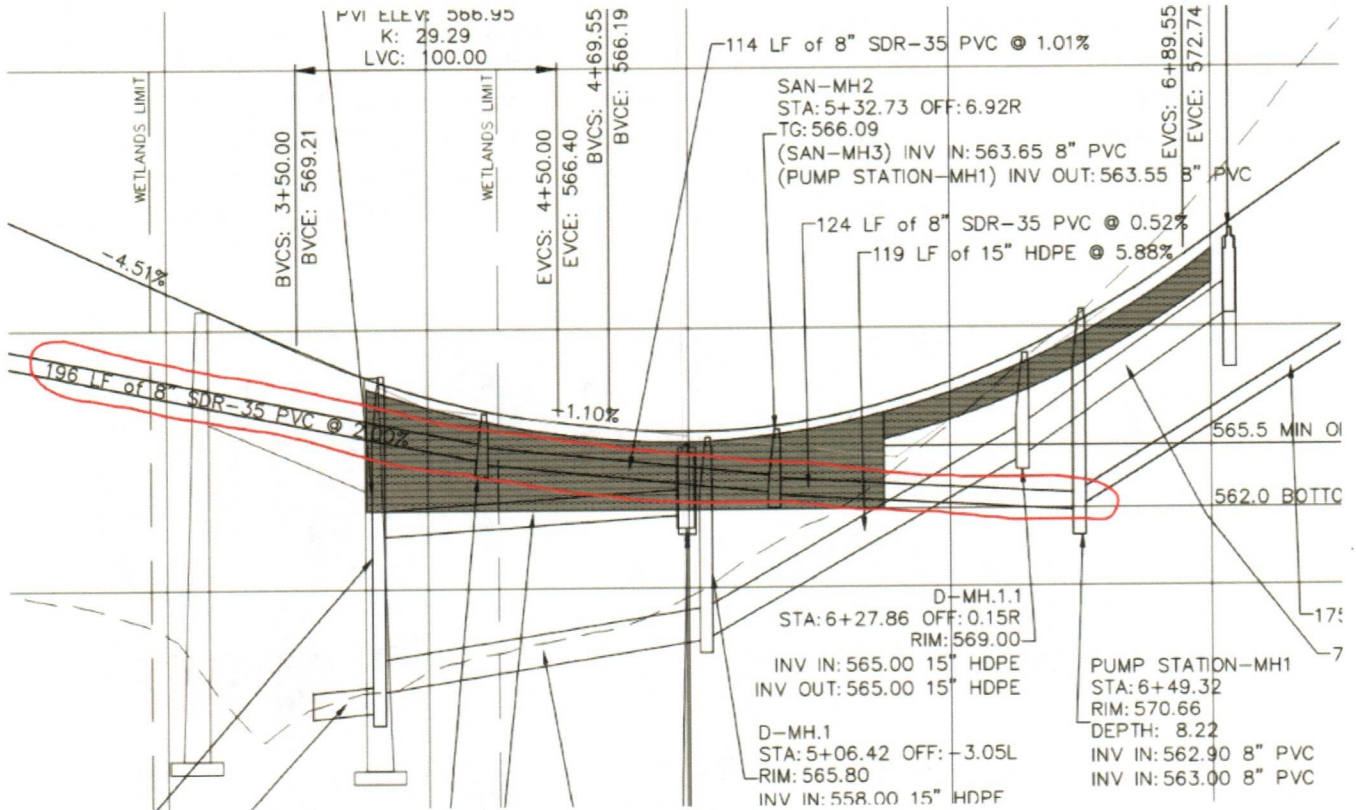


Figure 11: Profile of BMP 9 showing a sanitary line traveling through the BMP.

3.0 SUMMARY

In conclusion, our detailed review has found that the application is not in compliance with applicable State and local stormwater requirements (§25-29). It is the professional opinion of Princeton Hydro that the application does not meet all three central performance requirements of the local stormwater ordinance or the requirements of N.J.A.C. 7:8. The applicant's failure to meet the minimum requirements of N.J.A.C. 7:8. And the New Jersey BMP Manual will increase peak flow downstream of the Site. The increase in peak flow would be made even worse when applying the new rainfall data.

Since the project has not demonstrated compliance with all three specific stormwater management requirements of the central goals of stormwater management planning as outlined in N.J.A.C. 7:8 and §25-29 of the local general ordinance, in our professional opinion, the application is non-approvable as designed. If the application is approved as designed, the development will increase the frequency and severity of damage expected during a flood in the adjacent and downstream areas.



I appreciate the opportunity to provide you with these engineering services for you. Please do not hesitate to contact me with any questions regarding this review. My clients, We Care NJ would be pleased to meet with you so that we may discuss our concerns about the substantial stormwater issues associated with the proposed West Essex Highlands project. Please feel free to contact me at mgallagher@princetonhydro.com if you have any questions.

Thank you.

Sincerely,

A handwritten signature in blue ink, appearing to read 'Mark Gallagher'.

Mark Gallagher
Vice President
Princeton Hydro, LLC

A handwritten signature in blue ink, appearing to read 'Sean Walsh'.

Sean Walsh, PE
Senior Project Manager
Princeton Hydro, LLC

File: P/2151.002/documents/permit review

Attachments: Attachment A: Soil Report of Area from USDA, Boonton Soil Series Description, Haledon Soil Series Description,
Hasbrouck Soil Series Description
Attachment B: Location Map of Soil Borings taken by Princeton Hydro, Soil Boring Logs (Bor-1 to 4)

cc: Dennis Contois (Dennis.Contois@dep.nj.gov)
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Joseph Pannullo (joe@pannullo.com)
Bill Potter Esq. (potterrex@cs.com)



Attachment A

USDA Official Soils Series Descriptions

LOCATION HASBROUCK

NJ

Established Series
Rev. CFE-SG-SMF
01/2013

HASBROUCK SERIES

The Hasbrouck series consists of very deep, poorly drained soils in depressions on uplands. They typically formed from eroded and redeposited glacial materials overlying till. Slope ranges from 0 to 8 percent. Saturated hydraulic conductivity is moderately high or high in the solum above the fragipan, moderately low or low in the fragipan, and moderately high or high in the substratum. Mean annual temperature is about 50 degrees F., and mean annual precipitation is about 44 inches.

TAXONOMIC CLASS: Fine-loamy, mixed, active, mesic Typic Fragiqualfs

TYPICAL PEDON: Hasbrouck stony silt loam, 1 percent slope, wooded. (Colors are for moist soil unless otherwise stated.)

A--0 to 8 cm; very dark gray (10YR 3/1) stony silt loam, gray (10YR 6/1) dry; moderate coarse granular structure; friable; common medium and fine roots; 10 percent stones, 15 percent cobbles and gravel; very strongly acid; clear wavy boundary. (5 to 15 cm thick)

Eg--8 to 25 inches; grayish brown (10YR 5/2) and dark gray (10YR 4/1) stony silt loam; moderate coarse granular structure; friable; few fine and medium roots; 10 percent stones, 15 percent cobbles and gravel; common fine prominent brownish yellow (10YR 6/6) and olive yellow (2.5Y 6/6) redoximorphic concentrations; very strongly acid; gradual wavy boundary. (13 to 20 cm thick)

BEg--25 to 36 cm; pinkish gray (7.5YR 6/2) gravelly loam; weak medium subangular blocky structure; friable; few fine roots; few faint clay films on faces of peds; 10 percent gravel, 5 percent cobbles; many fine and medium prominent yellowish brown (10YR 5/4) and brownish yellow (10YR 6/6) redoximorphic concentrations; moderately acid; gradual wavy boundary. (0 to 15 cm thick)

Btg--36 to 61 inches; gray (5YR 6/1) sandy clay loam; moderate coarse subangular blocky structure; friable, plastic; few fine roots; many distinct clay films on faces of peds and clay bridging between sand grains; 10 percent gravel; many medium and coarse prominent reddish yellow (7.5YR 6/6) and brownish yellow (10YR 6/6) redoximorphic concentrations; slightly acid; abrupt wavy boundary. (25 to 41 cm thick)

Bx--61 to 107 cm; reddish brown (5YR 4/4) gravelly sandy loam; weak thick platy structure; very firm, brittle; 25 percent gravel, 2 percent cobbles; few faint strong brown (7.5YR 5/6) clay films on faces of peds; few black (N2/0) stains; slightly acid; abrupt smooth boundary. (28 to 76 cm thick)

C--107 to 183 cm; reddish brown (5YR 4/4) gravelly sandy loam; weak very thick platy structure grading to massive within 152 cm; friable; 25 percent gravel, 5 percent cobbles; neutral.

TYPE LOCATION: Passaic County, New Jersey; Wayne Township, 1,680 feet west of Wayne Township municipal buildings, 10 feet south of dirt road.

RANGE IN CHARACTERISTICS: Solum thickness commonly ranges from 51 to 127 cm. Depth to the top of the fragipan ranges from 40 to 76 cm. Depth to red shale, sandstone, or basalt bedrock is typically more than 3 meters below the surface. Rock fragment content in the solum above a lithologic discontinuity, where present, ranges from 0 to 35 percent by volume. Rock fragment content in the fragipan and the C horizon commonly ranges from 15 to 50 percent by volume but the range in the fragipan ranges as low as 4 percent. Rock fragments larger than 8 cm in diameter, range from 0 to 15 percent by volume in the solum and from 0 to 30 percent in the C horizon. Reaction ranges from very strongly acid through slightly acid in the solum above the fragipan, from moderately acid through slightly acid in the fragipan, and from slightly acid through mildly alkaline in the C horizon.

Some pedons have an O horizon.

The A or Ap horizon has hue of 5YR through 10YR, value of 2 through 4, and chroma of 1 through 3. Dry value is 6 or

more. Texture is loam or silt loam in the fine-earth fraction.

The E or Eg horizon has hue of 2.5YR through 10YR, value of 3 through 6, and chroma of 1 or 2. Mottles with higher value and chroma are few or common. Texture ranges from sandy loam to silt loam in the fine-earth fraction.

The BEg horizon, where present, has hue of 2.5YR through 10YR, value of 3 through 6, and chroma of 1 or 2. Redoximorphic features with higher chroma are common or many. Texture ranges from fine sandy loam to silt loam in the fine-earth fraction.

The Btg horizon has hue of 2.5YR through 10YR, value of 3 through 7, and chroma of 1 or 2. Redoximorphic features with higher chroma are common or many. Texture is loam, clay loam, or sandy clay loam in the fine-earth fraction. Clay content dominantly is between 20 and 30 percent.

The Bx horizon has hue of 2.5YR through 10YR, value of 3 through 7, and chroma of 1 through 8. Texture is commonly loam, loam, fine sandy loam, or sandy loam. Clay content dominantly is between 10 and 20 percent. Structure is weak or moderate, medium or thick platy, and may be within weak coarse prisms. Ped coat colors are one or two units of value higher than ped interiors.

The C horizon has hue of 10R through 10YR, value of 3 through 7, and chroma of 0 through 6. Texture is dominantly sandy loam but ranges from loamy sand to loam in the fine-earth fraction. Clay content is less than 10 percent. The C horizon is massive, but may have weak, very thick platy layers in the upper 60 cm. Consistence is friable or firm.

COMPETING SERIES: This is the [Frenchtown](#) series. Frenchtown soils have rock fragments that are dominantly sandstone gravel.

GEOGRAPHIC SETTING: Hasbrouck soils are in nearly level or gently sloping depressions, drainageways, and areas adjacent to narrow floodplains of minor streams on uplands. Slope ranges from 0 to 8 percent. The soils formed in eroded and redeposited glacial materials on till of Wisconsin Age. The till materials are composed primarily of red shales, red sandstone, and basalt.

GEOGRAPHICALLY ASSOCIATED SOILS: These include the well to moderately well drained [Boonton](#) soils and the somewhat poorly drained [Haledon](#) soils which formed in till and are on the adjacent uplands. The well drained [Netcong](#) soils, which do not have a fragipan, are on sideslopes of uplands. The well drained [Holyoke](#) and [Yalesville](#) soils are shallow and moderately deep soils on hills and ridges. The poorly or very poorly drained [Preakness](#) soils are on adjacent outwash plains and terraces.

DRAINAGE AND PERMEABILITY: Poorly drained. Runoff is negligible to high. Permeability is moderately rapid or moderate in the solum above the fragipan, slow or very slow in the fragipan, and moderately rapid or moderate in the C horizon. Saturated hydraulic conductivity is moderately low to high in the solum and substratum and very low to moderately low in the fragipan.

USE AND VEGETATION: Most of the areas are wooded. A few of the gently sloping areas are used for recreation. Native vegetation is dominated by red maple, ash, pin oak, and swamp white oak.

DISTRIBUTION AND EXTENT: Northern New Jersey. The soil is of limited extent with approximately 5,000 acres mapped.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Amherst, Massachusetts

SERIES ESTABLISHED: Bergen County, New Jersey 1986.

REMARKS: The Hasbrouck series replaced those soils which were previously correlated as Haledon Variant in Middlesex and Passaic Counties, New Jersey. Cation exchange activity class determined from a review of associated soils. Geographical location and coordinates could not be reliably determined from the described location.

Diagnostic horizons and features recognized in this pedon include:

1. Ochric epipedon - the zone from the surface to a depth of 14 inches (A, Eg and BEg horizons).
2. Argillic horizon - the zone from 14 to 24 inches (Btg horizon).
3. Fragipan - the zone from 24 to 42 inches (Bx horizon).

3/31/25, 1:10 PM

Official Series Description - HASBROUCK Series

National Cooperative Soil Survey
U.S.A.

LOCATION HALEDON

NJ+NY

Established Series
Rev. CFE-RAS-SMF
01/2013

HALEDON SERIES

The Haledon series consists of very deep, somewhat poorly drained soils in low positions on undulating uplands. They formed in glacial till. Slope ranges from 0 to 15 percent. Saturated hydraulic conductivity is moderately high or high above the fragipan and very slow or slow in the fragipan and densic materials. Mean annual temperature is about 13 degrees C and mean annual precipitation is about 1258 mm.

TAXONOMIC CLASS: Coarse-loamy, mixed, active, mesic Aquic Fragiudalfs

TYPICAL PEDON: Haledon cobbly loam at an elevation of about 140 m. (Colors are for moist soil.)

Ap--0 to 20 cm; very dark grayish brown (10YR 3/2) cobbly loam, gray (10YR 6/1) dry; moderate medium granular structure; very friable; many roots; common fine pores; 25 percent rock fragments of stones, cobbles and gravel; moderately acid; clear wavy boundary. (15 to 25 cm thick)

Bt1--20 to 41 cm; yellowish brown (10YR 5/4) cobbly loam; moderate medium subangular blocky structure; friable, slightly sticky; common roots that decrease in number with depth; common fine tubular pores; few faint brown (7.5YR 4/4) clay films on faces of peds and in sand and pebble niches; 20 percent rock fragments, dominantly cobbles and coarse gravel and some stones; common coarse and medium distinct brown (7.5YR 4/4) masses of iron accumulation, common fine and medium faint brown (10YR 5/3) iron depletions, and few fine distinct strong brown (7.5YR 5/8) masses of iron accumulation; moderately acid; gradual wavy boundary. (10 to 46 cm thick)

Bt2--41 to 76 cm; yellowish brown (10YR 5/4) and brown (7.5YR 4/4) cobbly loam; moderate medium subangular blocky structure; friable; few fine roots; few fine tubular pores; brown (7.5YR 4/4) clay films on faces of peds and common bridging with semi-waxy clay films; 20 percent rock fragments, dominantly cobbles and gravel; common coarse distinct dark brown (7.5YR 3/2) iron depletions, common fine faint pale brown (10YR 6/3) masses of iron accumulation, few fine distinct strong brown (7.5YR 5/8) masses of iron accumulation, and few to common fine distinct light brownish gray (10YR 6/2) masses of iron accumulation and grayish brown (10YR 5/2) iron depletions that increase in number with depth; moderately acid; abrupt smooth boundary. (0 to 41 cm thick)

Bx1--76 to 97 cm; brown (7.5YR 4/4) gravelly sandy loam streaked and splotched with yellowish brown (10YR 5/4); weak very thick platy structure; very firm; brittle; few fine roots between peds or in structures; very few fine vesicular pores; very few distinct waxy and semi-waxy clay and silt coats on plate surfaces; common faint silt and clay bridging between sand grains; few fine black (10YR 2/1) manganese stains on ped surfaces; 20 percent rock fragments, dominantly gravel; moderately acid; clear smooth boundary. (15 to 51 cm thick)

Bx2--97 to 114 cm; variegated brown (7.5YR 4/4), light brownish gray (10YR 6/2), strong brown (7.5YR 5/6), yellowish brown (10YR 5/6), and brown (10YR 5/3) gravelly sandy loam; moderate very thick platy structure; very firm; brittle; very few fine vesicular pores; very few distinct clay films on faces of peds; few fine black (10YR 2/1) manganese stains on ped surfaces; 20 percent rock fragments, dominantly gravel; moderately acid; abrupt smooth boundary. (0 to 51 cm thick)

Cd--114 to 183 cm; brown (10YR 4/3) gravelly sandy loam; massive; very firm; few fine vesicular pores; 30 percent rock fragments, dominantly gravel; slightly acid.

TYPE LOCATION: Passaic County, New Jersey; Township of Wayne, 10 feet west of unimproved dirt road, 1,000 feet north of junction of dirt road with Patterson-Hamburg turnpike. Junction of dirt road with turnpike is 1,600 feet east of entrance to north Jersey Country Club; USGS Paterson quadrangle, longitude 40 degrees 57 minutes 20 seconds N., latitude 74 degrees 12 minutes 45 seconds W, NAD 27.

RANGE IN CHARACTERISTICS: Thickness of the solum ranges from 102 to 152 cm. Depth to the fragipan is 61 to 90 cm. Depth to bedrock is greater than 2 m. Rock fragments of mostly gravel, cobbles, and stones of basalt, shale, sandstone and gneiss range from 5 to 25 percent in the solum and from 15 to 35 percent in the substratum. Mineralogy is dominated by quartz, feldspar, amphibole and mica. Reaction ranges from extremely acid to moderately acid in the upper part of the solum, from strongly acid to slightly acid in the lower part of the solum and upper part of the C horizon,

and from moderately acid to neutral in the lower part of the C horizon.

The O horizon, where present, has hue of 7.5YR or 10YR, value of 2, and chroma of 1 or 2. The in lieu texture is commonly highly decomposed plant material but the range includes slightly to highly decomposed plant material.

The Ap horizon has hue of 7.5YR to 2.5Y, value of 3 or 4, and chroma of 2 to 4. Value is 6 or more when dry. Some pedons have an A horizon up to 13 cm thick. It has hue of 7.5YR to 2.5Y, value of 2 or 3, and chroma of 1 or 2. Texture is loam or silt loam in the fine-earth fraction.

Some pedons have a BA horizon. It has hue of 7.5YR or 10YR, value and chroma of 4 to 6. Texture has the same range as the A horizon.

The Bt horizon has hue of 5YR to 10YR and value of 4 to 8. Chroma ranges from 3 to 6 in the upper part of the B and from 1 to 6 in the lower part. Redoximorphic features are few to common in the upper part and range to many in the lower part. Low chroma redoximorphic features are within the top 25 cm of the Bt horizon. Texture is loam, silt loam, or fine sandy loam in the fine-earth fraction.

The Bx or Btx horizon has hue of 5YR to 10YR, value of 4 to 6, and chroma of 2 to 6, or it is mottled or variegated with these and other colors. Black stains are in most pedons. Texture is sandy loam, fine sandy loam, or loam in the fine-earth fraction. Structure is weak or moderate, thick or very thick platy or the horizons are massive. Consistence is firm or very firm.

The Cd horizon, where present, has hue of 2.5YR to 2.5Y, value of 3 to 6, and chroma of 2 to 6. High and low chroma redoximorphic features and black stains are in most pedons. Texture ranges from loam to sandy loam in the fine-earth fraction.

COMPETING SERIES: There are no other series in the same family.

Related soils in other families are the [Boonton](#), [Califon](#), [Hibernia](#), [Rockaway](#), [Wethersfield](#) and [Wurtsboro](#) soils. Boonton and Rockaway soils do not have low chroma redoximorphic features in the upper 10 inches of the argillic horizon. Califon and Hibernia soils have less than 35 percent base saturation. Wethersfield and Wurtsboro soils do not have argillic horizons.

GEOGRAPHIC SETTING: Haledon soils are at the base of steeper sloping uplands and in shallow drainageways. Slope ranges from 0 to 15 percent. The soils developed in coarse textured glacial till composed primarily of basalt, red sandstone and shale, and granitic gneiss with lesser amounts of quartzite and gray sandstone and shale. The mean annual precipitation ranges from 102 to 122 cm. The mean annual temperature commonly ranges from 7 to 10 degrees C but the range includes up to 13 degrees C in or near urban areas. The frost-free days range from 140 to 160 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the [Boonton](#), [Rockaway](#) and the [Holyoke](#) soils. Boonton and Rockaway soils usually are in higher positions in the landscape. Holyoke soils are in a higher position in the landscape and are shallow to bedrock.

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY: Somewhat poorly drained. Surface runoff is medium to very high. Saturated hydraulic conductivity is moderately high or high above the fragipan and very slow or slow in the fragipan and densic materials. A perched high water table is within 30 cm of the surface in the late winter and early spring of most years, and following periods of extended rainfall. Lateral seepage is common, particularly at slope breaks.

USE AND VEGETATION: Most areas are wooded or in idle fields. Much of this soil is used for housing or urban development. Vegetation is largely forest dominated by oak and maple with some birch and ash.

DISTRIBUTION AND EXTENT: Northeastern New Jersey and New York City metropolitan area; MLRA 144A. The series is of moderate extent.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Amherst, Massachusetts

SERIES ESTABLISHED: Morris County, New Jersey, 1971.

REMARKS: Diagnostic horizons and other features recognized in this pedon include:

1. Ochric epipedon - the zone from 0 to 20 cm (Ap horizon).
2. Argillic horizon - the zone from 20 to 76 cm (Bt horizon).
3. Fragipan - the very firm, brittle zone from 76 to 114 cm (Bx horizon).

4. Aquic feature - low chroma redoximorphic features are in the upper 25 cm of the argillic horizon (Bt2 horizon).

National Cooperative Soil Survey
U.S.A.

LOCATION BOONTON

NJ+NY

Established Series
Rev. WDB-SG-SMF
12/2012

BOONTON SERIES

The Boonton series consists of deep or very deep moderately well and well drained soils formed in till on uplands. They are moderately deep to a fragipan. Slope ranges from 0 to 50 percent. Saturated hydraulic conductivity is moderately low to high in the mineral soil above the fragipan, low or very low in the fragipan, and low to high below the fragipan. Mean annual temperature is about 12 degrees C and mean annual precipitation is about 1090 millimeters.

TAXONOMIC CLASS: Coarse-loamy, mixed, active, mesic Oxyaquic Fragiudalfs

TYPICAL PEDON: Boonton silt loam idle pasture, at an elevation of about 155 feet. (Colors are for moist soil.)

Ap -- 0 to 20 centimeters; brown (10YR 4/3) silt loam; moderate fine and medium granular structure; very friable; many fine and common medium and coarse roots; many fine and medium tubular pores; common uncoated sand grains; 5 percent subangular stones, cobbles, and gravel; very strongly acid; clear smooth boundary. (15 to 25 centimeters thick.)

BA -- 20 to 38 centimeters; dark yellowish brown (10YR 4/4) fine sandy loam; weak medium subangular blocky structure; very friable; many fine and common medium and coarse roots; common fine tubular pores; many coated sand grains; 10 percent gravel and cobbles; very strongly acid; clear wavy boundary. (0 to 23 centimeters thick.)

Bt1 -- 38 to 58 centimeters; brown (7.5YR 4/4) gravelly loam; moderate medium subangular blocky structure; friable; common fine and few medium and coarse roots; common fine tubular pores; common faint clay films on horizontal and vertical faces of peds; few distinct clay films lining pores; 15 percent gravel, 2 percent cobbles; strongly acid; clear wavy boundary.

Bt2 -- 58 to 76 centimeters; brown (7.5YR 4/4) gravelly fine sandy loam; weak coarse and medium subangular blocky structure; friable; common fine and few medium and coarse roots; few fine tubular pores; few faint clay films on horizontal and vertical faces of peds; 20 percent gravel, 2 percent cobbles; strongly acid; abrupt smooth boundary. (Combined thickness of the Bt horizons is 30 to 56 centimeters.)

Btx -- 76 to 127 centimeters; dark reddish brown (5YR 3/4) gravelly sandy loam; strong very thick platy structure; very firm, brittle; few roots between peds; few fine vesicular pores; few distinct clay films on faces of peds; 20 percent gravel, 2 percent cobbles and stones; few fine distinct black (N 2/0) and few fine distinct brown (7.5YR 5/2) areas of iron depletion; strongly acid; gradual wavy boundary. (25 to 76 centimeters thick.)

Cd -- 127 to 165 centimeters; dark reddish brown (5YR 3/4) gravelly sandy loam; weak medium and thick platy structure in upper part and massive in lower part; very firm, brittle; 25 percent gravel, 2 percent cobbles; slightly acid.

TYPE LOCATION: Passaic County, New Jersey; Totowa Borough, 0.2 mile northeast of Totowa Road on Brookmans Lane, 585 feet east of Brookmans Lane in idle pasture. USGS Paterson quadrangle; Latitude 40 degrees, 54 minutes, 44 seconds N, Longitude 74 degrees, 12 minutes, 11 seconds W, NAD 1927.

RANGE IN CHARACTERISTICS: Thickness of the solum ranges from 91 to more than 153 centimeters. Depth to bedrock is more than 122 centimeters. The top of the fragipan is at a depth of 50 to 91 centimeters. In most pedons, the upper part of the fragipan is part of the argillic horizon. Few or common redoximorphic features are in some pedons, but depletions with chroma of 2 or less are absent within 40 centimeters of the mineral soil surface. Rock fragments of mostly rounded gravel occur throughout the soil, and range from 0 to 35 percent in individual horizons. Stones and cobbles range from 0 to 10 percent in the solum and from 0 to 20 percent in the substratum. Reaction is strongly acid to extremely acid in the upper part of the solum. It ranges from strongly acid to slightly acid in the lower part of the solum, and from moderately acid to neutral in the C horizon.

Some pedons have O horizons with hue of 10YR, value of 2 or 3, and chroma of 1 or 2. In lieu texture is slightly decomposed to highly decomposed plant material.

The Ap or A horizon has hue of 7.5YR or 10YR, value of 2 to 5, and chroma of 1 to 4. Texture of the Ap or A horizon is silt

loam, loam, fine sandy loam or sandy loam in the fine earth fraction. Some pedons have thin unplowed A horizons up to 5 centimeters thick with color and texture the same as the Ap.

The BA or BE horizon commonly has hue of 7.5YR or 10YR but the range includes 5YR, value of 4 or 5, and chroma of 3 to 6. Texture is silt loam, loam, fine sandy loam, or sandy loam in the fine earth fraction.

The Bt horizon has hue of 2.5YR to 10YR, value of 3 to 5, and chroma of 4 to 6. Pedons with the redder hues have a higher proportion of red sandstone or shale. Texture is fine sandy loam, sandy loam, loam, or silt loam in the fine earth fraction. Structure is commonly moderate to weak, coarse to fine subangular blocky. Some pedons have platy structure in places.

The Btx or Bx horizon has hue of 2.5YR to 10YR, value of 3 to 5, and chroma of 3 to 6. Texture is sandy loam, fine sandy loam or loam in the fine earth fraction. Structure is weak or moderate very coarse prismatic to moderate or strong, thin to very thick platy. It is very firm or firm, and brittle.

Some pedons may have a BC horizon.

The Cd or C horizon has hue of 2.5YR to 10YR, value of 3 to 6, and chroma of 3 to 6. It is commonly loam, sandy loam, fine sandy loam, or loamy fine sand in the fine earth fraction but the range includes loamy sand in some places. It has weak medium to thick platy layers or is massive, and consistence ranges from very firm to very friable. In some pedons the C layer is loose friable till.

COMPETING SERIES: There are no other series currently in the same family.

The [Readington](#), [Rockaway](#), [Turbotville](#), and [Wooster](#) series are in related families. Rockaway soils have rock fragments dominated by granitic gneiss and have less than 35 percent base saturation in the lower part of the solum and C horizon. Readington, Turbotville, and Wooster soils are fine-loamy.

GEOGRAPHIC SETTING: Boonton soils are on gently sloping to very steep uplands. Slope is usually smooth and regular and gradient ranges from 0 to 50 percent. The soils formed in glacial till composed mostly of red to brown shale, sandstone, basalt, and some granitic gneiss. The climate is humid temperate. Mean annual temperature ranges from 10 to 14 degrees C and precipitation ranges from 1020 to 1140 millimeters. Frost free season is 130 to 150 days.

GEOGRAPHICALLY ASSOCIATED SOILS: [Holyoke](#) and [Haledon](#) are the most extensive associated soils and are developed from similar materials. Holyoke soils are shallow to basalt bedrock and usually are on higher and steeper positions in the landscape. Haledon soils have low chroma depletions in the top 10 inches of the argillic horizon and are in lower positions in the landscape, in drainageways, or at the base of steeper slopes. Other associated soils are [Riverhead](#) and [Dunellen](#) which formed in stratified, water sorted material.

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY: Moderately well and well drained. Runoff is slow to rapid. Saturated hydraulic conductivity is moderately low to high in the mineral soil above the fragipan, low or very low in the fragipan, and low to high below the fragipan. There is a perched water table at a depth of 46 to 91 centimeters from November to May of most years.

USE AND VEGETATION: Most Boonton soils are in areas that have become highly urbanized. Undeveloped sites are wooded or idle fields. Wooded areas have oaks, red maple, white ash, hickory, gray birch, and dogwood trees.

DISTRIBUTION AND EXTENT: Till uplands in Northeastern New Jersey and southeastern New York. MLRA 144A and 149B. The series is of moderate extent (62,000 acres).

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Amherst, Massachusetts

SERIES ESTABLISHED: Morris County, New Jersey 1971.

REMARKS: Alfisols classification is inferred from decreasing acidity and the high proportion of ultra basic grains and fragments in the lower part of the solum and C horizon. CE activity class is inferred from similar soils. Geographic coordinates were determined from the narrative description for the type location.

Diagnostic horizons and feature recognized in this pedon include:

1. Ochric epipedon - the zone from the surface of the soil to a depth of 38 centimeters (Ap and BA horizons).
2. Argillic horizon - the zone from 38 to 127 centimeters (Bt1, Bt2, and Btx horizon).
3. Fragipan - the zone from 76 to 127 centimeters (Btx horizon).

4. Densic materials - the zone from 127 to 165 centimeters (Cd horizon).

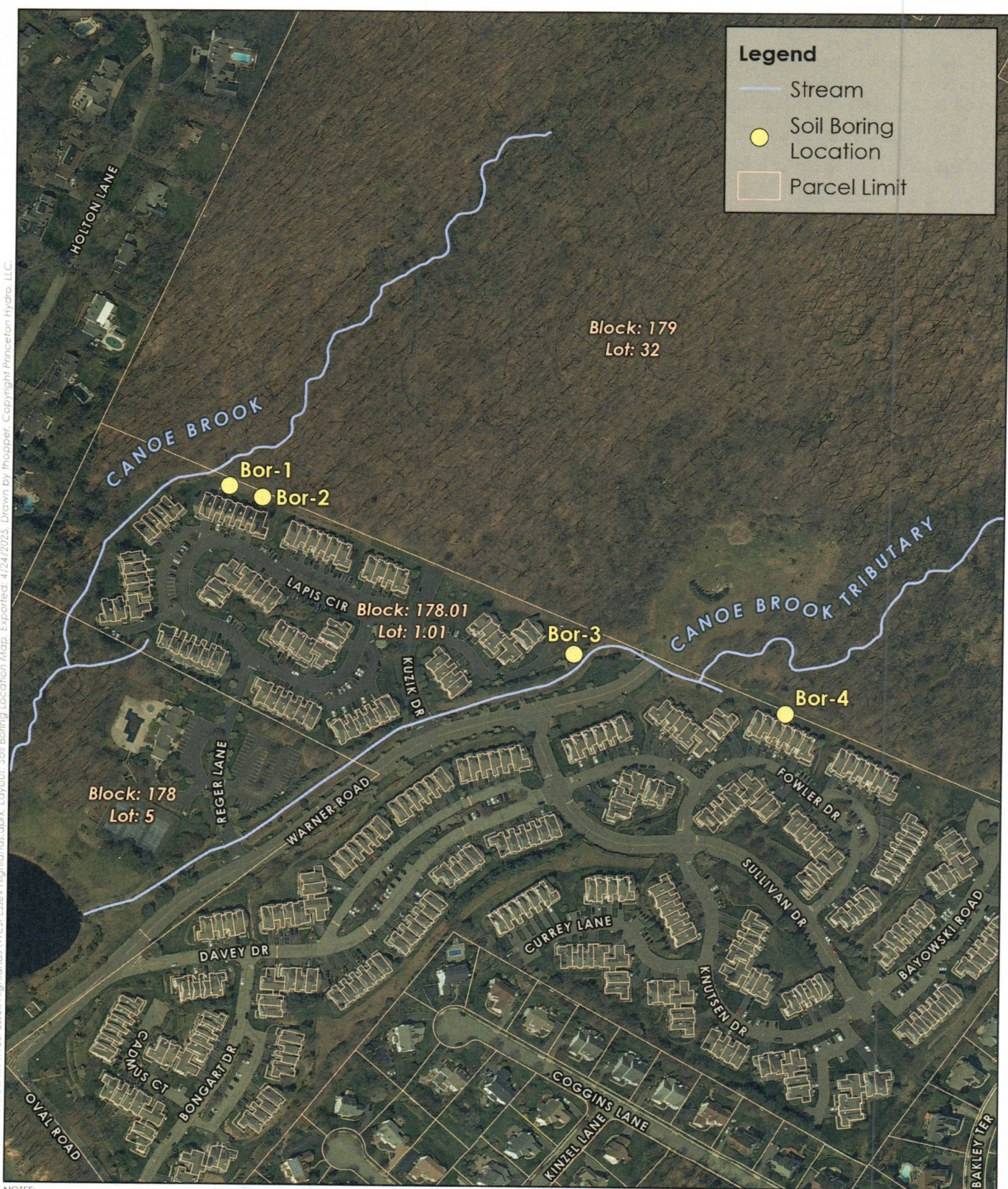
National Cooperative Soil Survey
U.S.A.



Attachment B

Princeton Hydro Soil Profile Descriptions with Location Map

File: P:\215\GIS\APR\West Essex Highlands.aprx Layout: Soil Boring Location Map. Exported: 4/24/2025. Drawn by: Tropper. Copyright Princeton Hydro, LLC.



Legend

Stream

Soil Boring Location

Parcel Limit

NOTES:
1. Soil boring locations are approximate.
2. Streams obtained from the United States Geological Survey's (USGS) National Hydrography Dataset (NHD).
3. Parcel limits (Essex County, 2023), 2020 aerial imagery, and road names obtained from the New Jersey Geographic Information Network.

0150300

Feet

Spatial Reference: NAD 1983 2011 StatePlane New Jersey FIPS 2900 Ft US

**SOIL BORING
LOCATION MAP**

WEST ESSEX HIGHLANDS
WEST ORANGE TOWNSHIP
ESSEX COUNTY, NEW JERSEY

PH

PRINCETON HYDRO
SCIENCE DESIGN ENGINEERING

www.PrincetonHydro.com

Sampling Point: Bor-1

Northcentral and Northeast Region – Version 2.0

Sampling Point: Bor-3

Northcentral and Northeast Region – Version 2.0

Sampling Point: Bor-2

Northcentral and Northeast Region – Version 2.0

Sampling Point: Bor-4

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

¹Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains.²Location: PL=Pore Lining, M=Matrix.

Indicators for Problematic Hydric Soils³:

- | | | |
|---|--|--|
| ☐ Histosol (A1) | ☐ Polyvalue Below Surface (S8) (LRR R, MLRA 149B) | ☐ 2 cm Muck (A10) (LRR K, L, MLRA 149B) |
| ☐ Histic Epipedon (A2) | ☐ Thin Dark Surface (S9) (LRR R, MLRA 149B) | ☐ Coast Prairie Redox (A16) (LRR K, L, R) |
| ☐ Black Histic (A3) | ☐ Loamy Mucky Mineral (F1) (LRR K, L) | ☐ 5 cm Mucky Peat or Peat (S3) (LRR K, L, R) |
| ☐ Hydrogen Sulfide (A4) | ☐ Loamy Gleyed Matrix (F2) | ☐ Dark Surface (S7) (LRR K, L) |
| ☐ Stratified Layers (A5) | ☐ Depleted Matrix (F3) | ☐ Polyvalue Below Surface (S8) (LRR K, L) |
| ☐ Depleted Below Dark Surface (A11) | ☒ Redox Dark Surface (F6) | ☐ Thin Dark Surface (S9) (LRR K, L) |
| ☐ Thick Dark Surface (A12) | ☐ Depleted Dark Surface (F7) | ☐ Iron-Manganese Masses (F12) (LRR K, L, R) |
| ☐ Sandy Mucky Mineral (S1) | ☐ Redox Depressions (F8) | ☐ Piedmont Floodplain Soils (F19) (MLRA 149B) |
| ☐ Sandy Gleyed Matrix (S4) | | ☐ Mesic Spodic (TA6) (MLRA 144A, 145, 149B) |
| ☐ Sandy Redox (S5) | | ☐ Red Parent Material (F21) |
| ☐ Stripped Matrix (S6) | | ☐ Very Shallow Dark Surface (TF12) |
| ☐ Dark Surface (S7) (LRR R, MLRA 149B) | | ☐ Other (Explain in Remarks) |

³Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Hydric Soil Present?	Yes	X	No
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Type: Refusal (fill, gravel, etc.)

Depth (inches): 6

Remarks:

1. Bor-4 = N(y) 556,926; E(x) 723,926
2. Boring was taken within soil mapping unit identified as BouB (Boonton-Urban land, Boonton substratum complex, 0 to 8 percent slopes).
3. Boring located within USACE Northcentral and Northeast Region.
4. Redoximorphic features were prominent throughout the upper part (0"-6") of the soil surface. Redoximorphic features occurred in the form of iron concentrations.