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May 22, 2020

Craig J. Flaherty
President & Senior Engineer
Redniss & Mead
22 1st Street, Stamford CT 06905

RE: Response to Comments (April 30, 2020)
Engineer Review - Ox Ridge Elementary School

Dear Mr. Flaherty,

Please find responses to the questions and comments transmitted on April 30, 2020, regarding the site modifications associated with the Ox Ridge Elementary School in Darien, CT. The following is a summary of each of the questions or comments with our response, as well as where the alteration occurred on the plans, if required. Please find enclosed with this letter the updated plans that incorporates plan revisions generated by your review and comments. Our response to each comment has been addressed in *italics*.

1. Engineering Plans
    a. Review soil conditions in the vicinity of the underground detention system. TP-01 and TP-02 are on the downhill side of the system. Groundwater was observed 7' below grade in TP-02. The closest boring uphill of the system (LB-04) reached groundwater 7' below grade as well. Existing grade within the footprint of the system falls between elevation 198-205 resulting in groundwater at elevation 191-198. The bottom of stone elevation is 191.17. for exfiltration and groundwater recharge to be achieved by the system, a minimum separation distance 1' above the restrictive layer should be maintained across the entire footprint of the system.

       Benesch Response: The Drainage Plan Sheet C101 has been revised to shift the detention system west. The existing grade within the footprint of the system now falls between 196-200; not 198-205. TP-01 and TP-02 were performed at approximate elevation 197.4 which means that groundwater can be expected at elevation 190.4. The bottom elevation of the stone is 191.17. We have added a 6" perforated underdrain 15' upgradient of the detention system at elevation 189.18, which we anticipate will lower the water table to approximately 189.18, which is two (2) feet below the bottom of the stone base.

    b. Additional test pits should be performed along the eastern edge of the detention system in order to confirm a level water table which would support the design as submitted.

       Benesch Response: See previous response.

    c. The perforated pipe underdrain around the perimeter of the underground detention system is set 2" below the bottom of stone. This will effectively short circuit the system and capture runoff prior to infiltration. The invert of the underdrain should be set at the bottom of the StormTrap unit if the goal is to infiltrate the runoff stored in the crushed stone below the system.

Benesch Response: The perimeter underdrain around the detention basin has been removed and replaced with the upgradient underdrain as previously described.

d. The detention system should be sized to treat the Water Quality Volume for all tributary areas, including off-site basin and proposed roof. If it is undersized it will compromise the efficacy of the system. Please note that the Town of Darien's Stormwater Management and Drainage Manual only states that roof runoff does not require pretreatment prior to infiltration. It is acceptable that off-site runoff is not treated, but it must then bypass any BMP providing treatment.

   Benesch Response: The required water quality volume for the site (including all basins) is 17,475 CF and the stone voids beneath the chambers provide 19,062 CF.

e. We suggest the engineer consider segregating the water quality storage in a separate uphill infiltration system located in the fill pocket along the western end of the proposed parking. Additional soil testing should be performed within the footprint of any new systems to confirm the depth of the restrictive layer and infiltration rate.

   Benesch Response: Benesch has considered an additional water quality storage system, however the water quality volume is being provided within the stone voids beneath the proposed detention chambers. In addition, a Hydroguard HG6 will be used to treat the water quality flow of basins P2A, P2C1, and P2C2.

f. The Hydroworks Hydroguard should be sized for all tributary areas (Basins: P2C1, P2C2, and P2A). The P2A Basin may bypass the structure if it is bypassing the detention system as well.

   Benesch Response: The Hydroguard has been upsized to the HG6 to provide treatment for basins P2C1, P2C2, and P2A. The required WQF for P2A, P2C1, and P2C2 is 1.65 cfs and the HG6 can treat a WQF up to 2.6 cfs for ConnDOT applications. The P2A basin will not bypass the detention system as an additional pipe trunk line will incur significant cost to the project.

g. Review soil conditions below all the bioretention / bioswale areas. Pond liner should be used around any system that does not maintain 1' of separation above the restrictive layer. If no pond liner is used, a hydraulic conductivity test should be performed at the bottom of each of the proposed BMP to confirm the soil can adequately infiltrate the designed stormwater volumes.

   Benesch Response: Benesch will not take credit for bioretention/bioswale areas in the stormwater computations however, they will remain as part of the plan.

h. Review the location of the perforated pipe. Solid pipe is utilized in two of the western rain gardens.

   Benesch Response: The pipe in the southwestern drainage swales is part of that system's oversized trunk line. The catch basins in those locations are at the bottom of the swale. Additionally, there are building underdrains close by that will keep the water table below the bottom of the swales.

i. A significant amount of cut is occurring in the southeast corner of the property. Consider extending a curtain drain along the outside edge of the radiused walk to intercept groundwater before it bleeds out of the bottom of the cut slope. The 18” perforated pipe (P-18) is already serving a similar function. Provide a curtain drain detail.

Benesch Response: A radiused curtain drain has been provided in the southeast corner of the property along the access drive at the bottom of the slope. A detail has been provided on Sheet C300.

j. The proposed grading creates a low point along the building face to the south and west of the courtyard, where a first-floor elevation of 210 is maintained. Low points are critical areas that require scrutiny. Should the outlet pipe be damaged., clogged, or overwhelmed by a storm larger than the design storm, the building could flood without auxiliary conveyance by positive overland flow or redundant systems. We recommend modified grading to provide an overland flow path for runoff that surcharges out of the drainage structures during extreme rainfall events or in the event of a failure in the conveyance system. We also recommend the design team strongly consider raising the elevation of the lowest building floor as it is indicated up to 14 feet below grade (below observed groundwater) and 3 feet lower than the downhill property boundary.

Benesch Response: The grading in this area has been revised to direct flow away from the building. In addition, the pipe system has been upsized to a 24” - 30” trunk line in the event of a failure or clogging in the conveyance system. The design team has considered adjusting floor elevations but decided against it as there are several architectural components driving this decision.

k. The proposed drainage within the courtyard is considered critical since stormwater has no overland flow path away from the building. The courtyard drainage ties into the lower portion of a drainage system capturing and conveying runoff from a 3.71-acre drainage basin. Due to the low rim elevation of the courtyard area drains, stormwater could surcharge out of the drainage structures should the downstream system reach capacity or otherwise be obstructed. Update the courtyard drainage to provide redundant outlets under the building. The combined capacity of the two outlets should be equal to the 100-year storm. Provide an updated Hydraflow analysis with a profile depicting the hydraulic grade line along the entirety of the run from the detention system through the lowest grates in the courtyard.

Benesch Response: The pipe line to the west of the building has been upsized to 24” - 30” in the plan to remove stormwater out of the courtyard area quicker. Additionally, the plans have been revised to include two (2) 18” pipes that convey stormwater from the courtyard underneath the building. The revised Hydraflow analysis has been included in the updated Stormwater Management Report and provides hydraulic grade lines sufficiently below grade for the 50-year storm in all pipes. Additionally, the pipe trunk line to the west and south of the building is capable of carrying the 1,000-year storm.

l. The conveyance system from yard Drain S-17 to the detention system is considered critical for the reasons mentioned in comments J and K. Size the pipes to adequately convey the 50-year storm. Provide an updated Hydraflow analysis with a profile depicting the hydraulic grade line along the entirety of the run.

Benesch Response: The 15" pipe under the building has been revised to double 18" pipes to remove stormwater out of the courtyard area quicker. These pipes are capable of carrying the 50-year storm with the hydraulic grade line sufficiently below grade.

m. Provide more information regarding the collection of the roof runoff. It does not seem feasible to convey roof runoff from the southerly extents of the rooftop to the north face of the building as indicated it is critical to understand how roof runoff will be conveyed to make sure the site drainage system is sized accordingly.

Benesch Response: Additional roof leaders have been added around the perimeter of the building to provide roof drainage that is more feasible. These leaders have been added and analyzed in the updated HydraFlow analysis.

n. Provide the footing drain discharge locations. Due to the large areas of cut, groundwater baseflows should be calculated and included in the HydroCAD model.

Benesch Response: The footing drain discharge location has been included in the plan and modeled in the Hydraflow model; not the HydroCAD model. The building footing drain and the detention system underdrain are now designed to convey flow around the detention. We have included, in the hydraulic model, assumed flows generated by groundwater, with input from the project geotechnical engineer.

2. Hydrologic and Hydraulic Calculations
   a. The groundwater recharge volume was deducted from the Water Quality Volume and no storage was provided in the system for this volume of water. Provide storage to capture and infiltrate the groundwater recharge volume.

   Benesch Response: The groundwater recharge volume is provided within the 30" stone base of the detention system.

   b. Check the recharge volume calculations. Below is the total calculated while accounting for the existing impervious coverage in the model:
      i. B Soils: (3.93 ac)(43,560 SF/ac)(0.25"/12"/ft)) = 3,566 CF
      ii. C Soils: (1.46 ac)(43,560 SF/ac)(0.10"/12"/ft)) = 529 CF
      iii. Total = 4,095 CF

   Benesch Response: Recharge volumes have been recomputed to be 4,093 CF as revised in the recharge section. This volume is being provided within the 30" stone base of the detention system.

   c. Check the Water Quality Flow calculations. There are discrepancies in the WQV Applied Impervious Area and Time of Concentration.

   Benesch Response: The Water Quality Flow calculations have been revised so that the WQV Applied Impervious Areas and Times of Concentration correspond to the areas used in the WQV calculations.

   d. Provide sizing calculations for the rain gardens.

Benesch Response: Drainage swales will still be provided, however no credit for infiltration will be taken and the rain gardens have been revised to provide solid pipes and tops of frames flush with the bottom of the rain garden. For this reason, sizing calculations are not warranted.

e. The underdrain around the underground detention systems should be modeled as a separate outlet since it bypasses the weir in the outlet control structure.

Benesch Response: The revised underdrain, as well as the building footing drain system, have been revised to route around the detention system.

f. Model pipe P-21 as an outlet for Detention 1 that is routed through the weir (Device #1). The proposed design does not allow runoff to reach the outlet control structure until the water elevation reached the Detention 1 and invert out of 192.50. The model currently depicts water discharging the system at elevation 191.00.

Benesch Response: Model Pipe P-21 refers to a small 10' leg of the perimeter underdrain which enters the outlet control structure behind the weir; the plan has been revised to make this clearer. Pipe P-50 is the outlet of the detention system into the control structure and has been modeled as the 30" RCP (primary) at elevation 191.00.

g. Provide the elevation storage table for Detention 1 and include hydrographs for the 50-year storm.

Benesch Response: The elevation-storage table and hydrographs for the 50-year storm have been provided with this revised submission.

h. The exfiltration rate should only be used in the model if 1' of separation is provided above the restrictive layer. The rate should be equal to the measured rate with an applied factor of safety of 2.

Benesch Response: The water table has been lowered per previous responses.

i. Provide the 100-year model to ensure the system does not fail in that event.

Benesch Response: The 100-year model has been provided.

j. Review the time of concentrations used in the existing conditions model. All on-site sheet flows should reflect the meadow conditions and used a Manning's number of 0.24 and a velocity factor of 15.0 fps for shallow concentrated flow.

Benesch Response: The existing HydroCAD model has been revised so that all sheet flows reflect a "Grass: Dense" surface description (which corresponds to a 0.24 Manning's number) and all shallow concentrated flows reflect a "Grassed Waterway" surface description (which corresponds to a 15.0 fps velocity factor.

k. Review the off-site portion of the E1 basin time of concentration. The off-site portion of the P1A model takes a different route resulting in a longer time of concentration.

Benesch Response: The P1A basin is expected to take a different (and longer) time of concentration path than the E1 basin due to the proposed building addition being constructed. The grades in this area will be changing so that stormwater is routed around the new building.

l. Update the Manning's Roughness coefficient for the concrete pipe channel in the E2A Basin to n=0.015.

Benesch Response: The Manning's Roughness coefficient for the concrete pipe channel in the E2A basin has been updated to n = 0.015.

m. Check the pipe lengths used in the proposed time of concentrations. All of them appear to extend beyond the detention basin.

Benesch Response: Pipe lengths used in the proposed time of concentrations have all been revised so that they end when they enter the detention basin. This slightly reduced the time of concentrations.

n. Review the sizing of the pipes conveying runoff. The HGL exceeds grade in pipes P-62 through P-64.

Benesch Response: The HydraFlow analysis has been revised to safely convey the 50-year storm through all the pipes in the drainage network. Further, the upsized drainage network south of the building has been sized to safely convey the 1,000-year storm.

o. Provide sizing calculations for the preformed scour hole and riprap.

Benesch Response: Sizing calculations for the preformed scour hole and riprap have been provided in the revised Stormwater Management Report.

p. Update the HydroCAD and Hydraflow model to reflect any changes resulting from any of the previous comments.

Benesch Response: HydroCAD and HydraFlow models have been updated and revised to reflect all the above comments. These are included in the revised Stormwater Management Report.

3. Stony Brook Analysis
   a. Update the Stony Brook analysis to only include WS SB-010, WS SB-020, WS SBT1-10, and WS SB-031.

   Benesch Response: The Stony Brook analysis has been updated to only include WS SB-010, WS SB-020, WS SBT1-10, and WS SB-031.

   b. The existing conditions model should include a modified WS-SB-031 with the studied area split out and modeled using the Total Site Link (ET) from the Existing Conditions – Ox Ridge HydroCAD Model.

Benesch Response: The existing conditions model has been revised to include a modified WB-SB-031 with the site split out and linked from the Existing Conditions – Ox Ridge HydroCAD Model.

c. The total areas should be consistent between the existing and proposed model.

Benesch Response: The areas between the existing and proposed model match at 594.16 acres

d. Provide a drainage basin map depicting the modeled area.

Benesch Response: The drainage map from Milone & MacBroom has been marked up to delineate the modeled area.

Please feel free to call (860-494-4359) or email (wwalter@benesch.com) with any questions.

Respectfully Submitted,
Alfred Benesch &Company

Will Walter, PE
Senior Project Manager