May 26, 2020

Jeremy Ginsberg, Director
Planning & Zoning
Darien Town Hall
2 Renshaw Road
Darien, CT 06820

RE: Review of Engineering Response
Ox Ridge Elementary School

Dear Mr. Ginsberg,

Our review of the Ox Ridge Elementary School engineering drawings and drainage report is complete with minor comments and suggested plan revisions. We find the drainage design conforms with the requirements of Section 880 of the Darien Zoning Regulations.

We reviewed the following documents prepared by Benesch:

1. Ox Ridge Elementary School Engineering Report revised May 2020
2. Ox Ridge Elementary School Engineering Plans (C101, C102, C300) dated March 20, 2020
3. Ox Ridge Elementary School Underslab Drainage Layout Concept Plan dated March 20, 2020
4. Response to Engineering Review Comments dated May 22, 2020
5. Supplemental Engineering Report materials received via email May 22, 2020
6. Proposed Conditions Ox Ridge and Stony Brook HydroCAD Models received May 26, 2020

The drainage design of the Ox Ridge Elementary School project provides peak flowrate attenuation and water quality treatment consistent with the requirements set forth in Section 880 of the Town of Darien Zoning Regulations. The drainage design ensures that peak flows leaving the site are reduced from "fresh meadow" conditions through the 50-year storm.

All the developed site is captured and conveyed to a StormTrap detention system consisting of 3'-0" SingleTrap units that is situated at the western end of the site, downhill of the proposed school. The detention system is sized to treat the on-site Water Quality Volume and Recharge Volume in the 2.5' crushed stone base and the first 1.5" of the StormTrap units. Runoff generated by the parking and drives is directed to an oil-grit separator that provides pretreatment upstream of the detention system.

Under existing conditions, runoff from most of the site discharged via two daylighting pipes directly into the wetlands at the northwest corner of the site. The proposed development replaces the two pipes with a single 30" pipe that discharges through a wing type endwall onto a preformed scour hole. The scour hole is designed to stabilize the soil around the outlet and minimize erosion immediately downstream of the discharge point.

The majority of the comments issued over the course of the review were satisfied by the applicant. The remaining comments are minor in nature and could be addressed prior to the issuance of a Zoning Permit for the project. Listed below are the comments and responses issued during the review. Outstanding comments to be addressed are highlighted in **bold.**

1. Engineering Plans

    a. 5/5/20: 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.

    5/26/20: The detention system has been shifted to the west and elevated such that existing grade within the footprint falls between elevation 196-200 and the bottom of stone is set at 191.67. Additionally, a 6" perforated pipe curtain drain is proposed 15' upgradient of the system and set two feet below the system. The intent of the design is to lower the elevation of groundwater, providing adequate separation below the system.

    b. 5/5/20: 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.

    5/26/20: Additional test pits are no longer needed given the steps taken in response to comments a.

    c. 5/5/20: 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.

    5/26/20: The perforated pipe underdrain around the perimeter of the detention has been removed and replaced by the curtain drain proposed 15' upgradient of the system.

    d. 5/5/20: The detention system should be sized to treat the Water Quality Volume for all tributary areas, including the 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.

5/26/20: Additional storage within the detention system has been provided by increasing the thickness of the stone bedding, adding additional StormTrap units, and picking up the invert out of the system. The proposed detention system currently treats 21,213 cf of runoff, exceeding the required WQV generated by the tributary on-site basins of 19,308 cf. The original comment was updated to no longer include the WQV generated by the off-site residential basin since it was treated for Water Quality Flow.

e. 5/5/20: 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.

   5/26/20: The design was updated to provide the required storage within the detention system and mitigate the groundwater via the curtain drain.

f. 5/5/20: The Hydroworks Hydrogaurd 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.

   5/26/20: The Hydroworks Hydrogaurd was upsized to provide adequate pretreatment of the tributary area, including the off-site basin.

g. 5/5/20: 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.

   5/26/20: No credit is taken for the bioretention/bioswale areas. Perforated pipe is only utilized in the parking lot bioretention area where there is adequate separation above the restrictive layer. The other two are adjacent to the proposed building and its underslab/footing drains. All three areas are designed with area drains set at the low point to prevent prolonged ponding.

   Outstanding: Use perforated pipe below bioswale areas to avoid the potential for soggy conditions.

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

5/26/20: See response to comment g.

i. 5/5/20: 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.

   5/26/20: A radiused curtain drain was added parallel to the walk located in the southeast corner of the property. A curtain drain detail was provided on Sheet C300.

j. 5/5/20: 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.

   5/26/20: The grading was updated to pitch grade away from the building and to the outside edge of the walk. The pipe system has been upsized to ensure larger storms can be passed and to help prevent clogging. The design team considered adjusting floor elevations but decided against it due to several architectural components influencing the height of the building.

   Outstanding: Update the grading in the vicinity of the S-9 yard drain (northwest of the courtyard). The grate of the structure is set 1.5" below the first-floor elevation with surrounding grade pitching towards the building. The grading should direct stormwater to a structure farther from the building that allows for greater freeboard between the grate and the first floor. Update the rim elevation of S-38 and S-24 to match the revised grading.

k. 5/5/20: 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 the runoff from a 3.71-acre drainage basin. Due to the low rim elevations 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.
5/26/20: The trunk line outside of the building has been upsized. Additionally, twin 18" have been provided from the courtyard. The provided Hydraflow Report shows adequate capacity and no bubbling out during the 50-year storm.

l. 5/5/20: 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.

5/26/20: The pipes have been upsized to pass the 50-year storm.

m. 5/5/20: 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 roof top 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.

5/26/20: The storm routing has been updated to accurately capture the roof. The drainage basin map was also updated to reflect the changes.

n. 5/5/20: Provide the footing drain discharge locations. Due to the large areas of cut, groundwater baseflows should be calculated and included in the hydroCAD model.

5/26/20: The design was updated to show the footing drain discharge. The pipe collecting groundwater bypasses the detention system and is represented in the HydroCAD report.

Outstanding: Coordinate the footing drain outlet with the underslab drainage layout. No outlet was provided for the lower underslab drainage along the eastern end of the building. The current invert out is set higher than the underslab drainage.

o. 5/26/20 – Outstanding: Raise the invert out of one of the 30" pipes leaving the detention system by 0.10' to 194.40. This will result in a peak flow reduction in the 10-year storm. Storage is exceeded in the 100-year storm by less than 2", indicating the system still safely handles the storm.

2. Hydrologic and Hydraulic Calculations

a. 5/5/20: 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.

5/26/20: The groundwater recharge volume is provided.

b. 5/5/20: 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)(.25"/(12"/ft)) = 3,566 cf
   ii. C Soils = (1.46 ac)(43,560 sf/ac)(.10"/(12"/ft)) = 529 cf
   iii. Total = 4,095 cf

   5/26/20: The groundwater recharge volume is provided.

c. 5/5/20: Check the Water Quality Flow calculations. There are discrepancies in the WQV Applied Impervious Area and Time of Concentration.

   5/26/20: The Water Quality Flow is provided.

d. 5/5/20: Provide sizing calculations for the rain gardens.

   5/26/20: The rain gardens are not used in the stormwater design.

e. 5/5/20: The underdrain around the underground detention system should be modeled as a separate outlet since it bypasses the weir in the outlet control structure.

   5/26/20: The underdrain around the underground detention system was removed from the design.

f. 5/5/20: 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 reaches the Detention 1 invert out of 192.50. The model currently depicts water discharging the system at elevation 191.00.

   5/26/20: The outlet control structure was removed from the design. The twin 30" culverts are correctly modeled as the outlets of the system.

g. 5/5/20: Provide the elevation-storage table for Detention 1 and include hydrographs for the 50-year storm.

   5/26/20: All the requested HydroCAD Report items were provided.

h. 5/5/20: 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.

5/26/20: Benesch has added an upgradient curtain drain to lower the elevation of groundwater and provide adequate separation below the system. As such, the exfiltration rate is still applied in the model.

i. 5/5/20: Provide the 100-year model to ensure the system does not fail in that event.

5/26/20: The 100-year model confirms that the system will safely pass the 100-year storm.

j. 5/5/20: Review the time of concentrations used in the existing conditions model. All on-site sheet flows should reflect the meadow conditions and use a Manning's Number of 0.24 and a velocity factor of 15.0 fps for shallow concentrated flow.

5/26/20: The existing time of concentrations were updated to reflect the meadow conditions.

k. 5/5/20: 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.

5/26/20: The offsite basin was modeled correctly.

l. 5/5/20: Update the Manning's Roughness Coefficient for the concrete pipe channel in the E2A Basin to n=0.015.

5/26/20: The Manning's Roughness Coefficient was updated.

m. 5/5/20: Check the pipe lengths used in the proposed time of concentrations. All of them appear to extend beyond the detention basin.

5/26/20: The pipe lengths have all been updated to end at the detention system.

n. 5/5/20: Review the sizing of the pipes conveying roof runoff. The HGL exceeds grade in pipes P-62 through P-64.

5/26/20: The drainage system was updated to ensure the 50-year storm is safety conveyed without bubbling out of any structures.

o. 5/5/20: Provide sizing calculations for the preformed scour hole and rip-rap.

5/26/20: The sizing calculations were provided.

p. 5/5/20: Updated the HydroCAD and Hydraflow model to reflect any changes resulting from any of the previous comments.

5/26/20: Both the HydroCAD and Hydraflow model accurately reflect the proposed design.

3. Stony Brook Analysis

   a. 5/5/20: Update the Stony Brook analysis to only include WS SB-010, WS SB-020, WS SBT1-10, and WS SB-031.

      5/26/20: The model was updated to only include the four basins indicated.

   b. 5/5/20: 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.

      5/26/20: Following further coordination with Benesch, it was decided to only break out the proposed site.

   c. 5/5/20: The total areas should be consistent between the existing and proposed model.

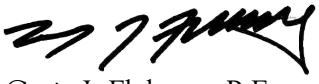
      5/26/20: The total areas were updated to be consistent between the existing and proposed models

   d. 5/5/20: Provide a drainage basin map depicting the modeled area.

      5/26/20: The drainage basin map depicting the modeled area was provided.

Sincerely,

Patrick Shurr, P.E



Craig J. Flaherty, P.E.

Cc: Alfred Benesch & Company