April 30, 2020

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

**RE: Engineering Review**
**Ox Ridge Elementary School**

Dear Mr. Ginsberg,

We reviewed the following documents prepared by Tighe & Bond:

1. Ox Ridge Elementary School Engineering Report dated March 2020
2. Ox Ridge Elementary School Engineering Plans (7 sheets) dated March 20, 2020
3. Ox Ridge Elementary School Landscape Plans (L301 & L201) dated March 20, 2020

The scope of the review is limited to the design of the stormwater management systems including the collection, conveyance, mitigation, and discharge of stormwater runoff and compliance of the design and proposal with section 880 of the Darien Zoning Regulations.

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.

    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.

    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.

d. 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.

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.

f. 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.

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.

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

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.

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.

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 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.

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.

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 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.

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.

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.

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)(.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

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

d. Provide sizing calculations for the rain gardens.

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

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 reaches the Detention 1 invert out of 192.50. The model currently depicts water discharging the system at elevation 191.00.

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

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.

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

j. 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.

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.

l. Update the Manning's Roughness Coefficient for the concrete pipe channel in the E2A Basin 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.

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

o. Provide sizing calculations for the preformed scour hole and rip-rap.

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

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.

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.

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

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

The comments listed above need to be addressed before we can comment on compliance with the cited regulations. Additional comments may be generated after the comments above are addressed. We are available to clarify or discuss the comments provided at the applicant's convenience.

Sincerely,

Patrick Shurr, P.E

Craig J. Flaherty, P.E.

Cc: Alfred Benesch & Company