HOWARD STEIN HUDSON

June 30, 2020

Chairman John Wiley
Walpole Conservation Commission
135 School Street
Walpole, MA 02081

Re: DEP #315-1227 Site Plan and RFA Narrative Revisions

Dear Chairman Wiley:

Please accept the enclosed amended plans and revised RFA narrative supporting DEP #315-1227. The amended two plan sheets - Drainage Plan 1 of 5 and 2 of 5 – (sheets C.16 and C.17) now show that no work other than Stormwater Management will take place in the RFA Per 310 CMR 10.58 (4).

The previous submission of plans, dated May 1, 2020, showed roughly 4,000 sf of allowed disturbance within the riverfront area which was not associated with stormwater management. The revised grading shown on the amended plans, will eliminate any disturbance not associated with an exempt stormwater practice. The small section of grading located to the north of the dog park and compactor will see the installation of a retaining wall to reduce the grading and remain out of the 200' riparian zone. The previous disturbance to the west of single-family homes 22-28, has been regraded with larger reveals in the rear of the units and feature elevated decks.

The revised sections of the Riverfront Narrative also provide economic analysis showing that none of the physical alternatives to having storm water management in the riverfront are "Practicable and Substantially Equivalent Economic Alternatives".

Please see attached materials:

- HydroCAD Stormwater Printouts.
- Patriot Excavating Corporation Stormwater Chamber quote.
- Revised Grading and Drainage Plan 1 of 5 and 2 of 5.
- Amended RFA Narrative.

Please do not hesitate to call Howard Stein Hudson's Chelmsford Office with any questions or concerns.

Sincerely,

Katie Enright, P.E.
Associate Principal

Enclosures (4)
CC: Andrew Poyant, DEP SE
Southeast Regional Office

HOWARD STEIN HUDSON

Riverfront Area Narrative

Per 310 CMR 10.58 Riverfront areas are likely to be significant to protect the private or public water supply; to protect groundwater; to provide flood control; to prevent storm damage; to prevent pollution; to protect land containing shellfish; to protect wildlife habitat; and to protect the fisheries.

A portion of the proposed project is located within the 100 to 200-foot, outer riparian zone to Cedar Swamp Brook. The project also proposes work within the 100 ft Buffer Zone to the Bordering Vegetated Wetlands adjacent to the perennial, Cedar Swamp Brook.

The existing site is composed almost entirely of undeveloped land which is made up of woodland, wetlands, and a cleared section of land at the entrance to Summer Street. The site is proposed to be developed into 300 units, which include 4 multi-family buildings, 11 townhouse buildings, and 60 single family houses throughout the 54 ± acres of land. All the buildings, parking, utilities, and all other impervious areas have been designed outside of the 200 ft riparian zone apart from exempt stormwater Best Management Practices (BMP's).

No fill has been proposed within Bordering Land Subject to Flooding (BLSF) associated with the River and depicted on the FEMA Maps as flood Plain Zone A.

There is one vernal pool located onsite and two potential vernal pools. The vernal pool islocated just south of the first wetland crossing. Both potential vernal pools are located on the Eastern side of the property, just West of the existing railroad tracks.

Mapped Priority and Estimated Habitats associated with the extensive, off-site Atlantic White Cedar Swamp extends to partially overlay the extreme northern part of the Site. No work is proposed within the habitat polygon. Correspondence received from the Massachusetts Natural Heritage and Endangered Species Program indicates that the Project will not result in a prohibited "Take" of State-listed wildlife, as defined in 321 CMR 10.02, nor conflict with the performance standards at 310 CMR10.59.

Per 310 CMR 10.58 (4) and (5):

(4) General Performance Standard

(a) Protection of other Resource Areas.

The work being proposed is intended to meet all other performance standards for all other resource areas associated with the Riverfront Area.

(b) Protection of rare species.

The proposed project development is shown to not impact the habitat area as specified within Natural Heritage Habitat Mapping which are shown to be present adjacent to Cedar Swamp Brook.

(c.) Practicable and Substantially Equivalent Economic Alternatives

The development proposed at 55 Summer Street has been designed to follow the existing features of the land and minimize impacts to the Riverfront Areas as much as possible. The development has been laid out to avoid both the existing wetlands, the 25' local wetland no disturbance buffers to the maximum extent practicable, and suitable buffers to the vernal pool and potential vernal pools located on site. All impervious development has remained outside of the Riverfront Area. Since the natural flow of the land is from the entrance to the property, at Summer Street, to Cedar Swamp Brook located at the rear of the property it makes the most sense to retain the natural flow of water and have the drainage infrastructure located at the rear of the site.

<u>Practicable and Substantially Equivalent Economic Alternatives</u>

Per 310 CMR 10.58 1. Definition of Practicable is an alternative that is substantially equivalent economically if it is available and capable of being done after taking into consideration costs, existing technology, proposed use, and logistics, in light of overall project purposes. Available and capable of being done means the alternative is obtainable and feasible.

The four factors to be considered are:

a.) Costs

Costs include expenditures for the project within the Riverfront Area, such as land acquisition, site preparation, design, construction, landscaping, and transactional expenses.

Given that this is an affordable housing project with greater development constraints regarding costs, they pose a significant impact on this project and have been given special consideration throughout the layout of the development. As was previously mentioned, the site drops roughly 40 feet from the entrance of the site at Summer Street to Cedar Swamp Brook at the rear of the property. The development was laid out and designed to follow the existing conditions and runoff flow paths of the site to both align with the affordability objectives of the CH. 40B program and reduce impact to the surrounding wetlands. Designing the development in this way is beneficial for both the overall usability and feel of the site, but also helps lower the overall cost of offsite material to be imported and construction costs associated with these additional materials.

Using the slope of the land to dictate where the stormwater infrastructure should be placed is the most logical and cost-efficient option. All proposed rooftops have been designed with infiltration at all drip edges, therefore immediately placing clean runoff back into the ground in close proximity to where it falls, and collecting all run off from pavement in infrastructure created to treat, detain and infiltrate runoff requiring pretreatment. Since only grading and stormwater infrastructure has been located inside of the outer riparian zone, it was designed so that only what was needed for Best Management Practices would be located within this area. All stormwater features have been located outside of the 100 ft inner riparian zone, outside of the 100 ft wetland buffer zone and outside of BLSF associated with Cedar Swamp Brook.

There are three representative physical alternatives that demonstrate that alternative stormwater management designs are not "Practicable and Substantially equivalent Economic Alternatives".

***Alternative 1**- the "no build" scenario, **Alternative 2**- Creating a like volume of underground storage outside the RFA and **Alternative 3**- Create space outside the RFA for a combination of surface and underground detention by replacing 12 rental town homes with 12 additional multi-family units by adding a 5th story to one multi-family building and by moving one multifamily building to the front of the site where the town homes were originally situated.*

***Alternative 1 – The no Build scenario** - The no-build alternative would not amortize the $1,650,000 cost of the land, or the $60,000 of annual real estate taxes owing on the land.*

***Alternative 2- Like volume of underground storage outside the RFA** – HSH estimated that Detention Pond 3 could be replaced by 175 MC-3500 Stormtech underground storage chambers, Pond 4 could be replaced by 150 SC-740 Stormtech underground storage chambers and Pond 5 by 400 SC-740 Stormtech underground storage chambers. An executive of Patriot Excavating Corporation estimated an expenditure of $486,475 would be required procure and install the underground storage to replace ponds 3, 4 and 5. Patriot excavating is a capable and reputable site work firm that regularly does all the site work including installing underground storage on projects of similar size and scope. The estimate assumes the cost of excavation and backfill is equivalent with the construction and shaping of Ponds 3, 4, and 5. The estimate does not include any of the additional engineering costs which might be required to re-locate utilities on the plan or the cost of retaining walls that would likely be required in some locations to make the underground storage work with the plan. The material specs and cost estimate are appended to this letter. Alternative -2 is not a "Practicable and Substantially equivalent Economic Alternative.*

Alternative 3 - Create space outside the RFA at the topographically downslope part of the site for a combination of surface and underground detention. This could be accomplished by replacing 12 rental town homes (3 buildings) with 12 additional multi-family units by adding a 5th story to one multi-family building and by moving one multifamily building to

the front of the site where the town homes were originally situated. *- The town homes are well suited and economical for families as they can all be entered directly without sharing a hallway with other families and all would have a garage space. Yet Alternative 3 would eliminate 25% percent of the rental town homes. In fact, six three bedroom and six two-bedroom town homes would be eliminated by alternative 3. Three of the eliminated town homes would be affordable units. On the other hand, the developments Multi-family units are one- and two-bedroom rental units. Each floor in the multi-family buildings has 7 one-bedroom units and 5 two-bedroom units. Therefore, an additional floor of 12 multifamily units would consist of 7 one-bedroom units and 5 two-bedroom units, thereby eliminating 6 units of 3- bedroom family housing and one unit of 2-bedroom family housing. In addition, DHCD regulations require 10% of the rental units to be 3-bedroom units. Given that there are 240 rental units 24 must be 3- bedroom units. Alternative 3 would result is only 18, 3-bedroom units which would push the project out of compliance with this regulation.*

In addition to diminishing the purpose of the project, five story buildings are more expensive to construct than 4 story buildings. A senior executive of Pilot Construction, Inc., a reputable general contractor who has built many multifamily buildings over the last 40 years stated that "As a generalization, we have found that 5-story structures, whether of a single level of parking or not, typically cost about 7.5% more per unit to construct than a 4-story structure. To put this into real numbers, a typical 4-story, 48-unit building, slab-on-grade, currently costs about $126,000 per unit (excluding any sitework). A 5-story, 60-unit building, slab-on-grade currently runs about $135,450 per unit. The main driving factor is going from a Type V Construction (up to 4-stories) to a Type III Construction (over 4-stories). Type III construction requires that all exterior, load bearing walls have a fire rating of 2-hours. This means fire treated materials for framing and sheathing, as well as changes the characteristics of the floor truss systems to a more expensive design & material. If you are considering decks on the building, this added requirement is further complicated by the need for fire treated/pressure treated framing members. Additionally, the added height adds costs to miscellaneous items such as longer/higher reaching lifts and the labor associated with the installation of the exterior finishes." Alternative 3 was not pursued because it would diminish the purposed use of the project which is to "create a wide variety of safe and economically affordable housing options for consumers that meet the regional demographic housing demand" and because it would be more expensive to construct.

The preferred approach, which is currently under review by the Town, preserves 86% of on-site riverfront area and preserves the inner riparian zone (0-100') in an intact and contiguous condition. As provided for in the Regulations, the stormwater facilities will not be fenced and will not pose a barrier to wildlife movement within the RFA. The proposed stormwater management facilities configuration

maintains the site's sub-watershed distributions while also complying with the allowances provided for these facilities in the Regulations.

b.) Existing technology

There are currently no stormwater treatment practices on the property. New infiltration basins in combination with structural BMP's have been designed to maximize removal of total suspended solids, infiltrate and detain stormwater, to mimic the existing drainage conditions on the subject site.

Since the site has been designed in its current configuration to avoid existing wetlands and observe the 25-foot do not disturb policy buffer, this has not left any room between the proposed features and the 25-foot buffers for stormwater features. One alternative is the use of pocket stormwater management throughout the site to capture and infiltrate the stormwater at the cost of the 25-buffer. Stormwater would either enter though catch basins or sheet flow to shallow infiltration basins throughout the site. Due to the proximity to the wetland and the assumed depth to seasonal high-water table, the site would need to be raised a couple feet in some areas. This would add significant cost to the design as well as leave much of the 25-foot buffer impacted, whereas the current design leaves 94% undisturbed.

c.) Proposed Use

The proposed use of the site is a) to increase the supply of high quality affordable and market housing; b) to create a wide variety of safe and economically affordable housing options for consumers in order to help meet the regional demographic housing demand. The proposed use includes options that vary by tenor and size to provide consumers with both rental and ownership options in a variety of unit sizes, formats and styles. The proposed use includes 112 one-bedroom, 104 two-bedroom and 84 three-bedroom residential units. The housing options also vary by building type including 60, "ownership" three-bedroom single family homes, 24 two-, and 24 three-bedroom direct entry townhomes in 11 buildings, as well as 240 one- and two- bedroom units within 4, four-story multi-family buildings, equipped with elevators. Therefore, the project's proposed use and purpose is to provide a variety of high quality affordable and market housing options to demographic groups from aging empty nesters to young families.

To accomplish the stated purpose, the site will be subdivided into two lots, the Eastern lot (Lot 1) will be composed of rental townhouse units and 4 apartment buildings. The Western lot (Lot 2) is composed entirely of 60 for sale single family houses. Both lots are connected via a looped system of roads and shared drainage facilities to minimize length of road.

All the proposed buildings, roads, and parking areas have been located completely beyond the riverfront area. The proposed roadways and parking facilities have been designed with curbs and grading so that all the stormwater can be collected, treated, and significantly infiltrated prior to

entering the area adjacent to Cedar Swamp Brook.

d.) Logistics

Logistics refers to the presence or absence of physical characteristics that may influence development.

Since there are many variations of buildings located throughout this development, the placement of the buildings was designed to minimize both the impact to the surrounding wetlands, vernal pools, habitat, riparian areas, and existing residential housing adjacent to the site. The five single family homes adjacent to Summer Street are of similar density, height, and aspect of the surrounding neighborhood. The multi-story apartment buildings were situated as far to the rear of the property as possible to reduce their visibility from Summer Street. These site constraints left most of the development occurring on the northern half of the property toward the rear of the property outside of but adjacent to Cedar Swamp Brook.

Due to site constraints and the fact that the existing net site drainage is from Summer Street, northward to the Cedar Swamp Brook wetland system, the practical solution for stormwater management is most preferentially located at the lower site elevations in proximity to Cedar Swamp Brook while avoiding any disturbance within inner riparian zone.

(e.) No Significant Adverse Impact

1. Within the 200 foot riverfront areas, the issuing authority may allow the alteration of up to 5,000 square feet or 10% of the Riverfront Area within the lot, whichever is greater, on a lot recorded on or before October 6, 1997 or lots recorded after October 6, 1997 subject to the restrictions of 310 CMR 10.58(4)(c.)2.b.vi., or up to 10% of the riverfront area within a lot recorded after October 6, 1997 provided that:

a. "At a minimum, a 100- foot wide area of undisturbed vegetation is provided. Replication and compensatory storage required to meet other resource area performance standards are allowed within this area; structural stormwater management measures may be allowed only when no practicable alternative.

The subject site contains 470,366 sf of riverfront area. Of this area, the only alteration of RFA, and all of this limited to the outer riparian zone (100-200' from MAHW), is 67,986 sf, or 14%, of the RFA located within the property. The installation of stormwater management facilities is afforded exemption to the applicable performance standards section at 310 CMR 10.58, 4 (d) 1. d.

The proposed project shows no vegetation removal in the 100 ft inner riparian zone. The proposed project utilizes the area outside of the resource area buffer zones for the proposed structures and

parking. Due to topographical and project constraints, stormwater has been proposed downhill from the improvements. This area is located between the 100 and 200-foot outer riparian zone is utilized only for stormwater best management practices and two small sections of development grading.

310 CMR 10.58 (4) (c) 3. (d) 1. d.
d. Proposed work shall not impair groundwater or surface water quality by incorporating erosion and sedimentation controls and other measures to attenuate nonpoint source pollution. The calculation of square footage of alteration shall exclude areas of replication or compensatory flood storage required to meet performance standards for other resource areas, or any area of restoration within the Riverfront Area. The calculation also shall exclude areas used for structural stormwater management measures, provided there is no practicable alternative to siting these structures within the Riverfront rea and provided a wildlife corridor is maintained (*e.g.* detention basins shall not be fenced).

The proposed work in the 100-200 ft Riverfront Area has been designed with infiltration basins to provide enhanced removal of total suspended solids by incorporation of multiple pretreatment devices, infiltration and detention while using as little land area as possible. Each infiltration pond will remain unfenced to promote wildlife passage through the riparian zones.

These basins are located within the 100-200 ft outer riparian zone due to constraints from the layout of the site topography and abutting properties which requires the stormwater management systems to be located downhill from all site improvements. The infiltration basins and other devices have been designed close to the proposed development, but with suitable underlying soil profiles based on extensive exploratory testing and within areas of appropriate topography to accept stormwater while preserving the more sensitive portions of the Riverfront Area.

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Pond 10P: STORMTECH INFILTRATION Peak Elev=200.72' Storage=16,525 cf Inflow=14.84 cfs 52,365 cf
Discarded=0.26 cfs 18,081 cf Primary=6.80 cfs 29,781 cf Outflow=7.06 cfs 47,862 cf

Pond 11P: STORMTECH INFILTRATION Peak Elev=200.59' Storage=17,192 cf Inflow=15.34 cfs 54,873 cf
Discarded=0.28 cfs 19,409 cf Primary=6.63 cfs 30,328 cf Outflow=6.91 cfs 49,737 cf

Summary for Pond 10P: STORMTECH INFILTRATION POND #3

Inflow Area = 79,150 sf, 77.06% Impervious, Inflow Depth > 7.94" for 100YR event
Inflow = 14.84 cfs @ 12.09 hrs, Volume= 52,365 cf
Outflow = 7.06 cfs @ 12.27 hrs, Volume= 47,862 cf, Atten= 52%, Lag= 10.8 min
Discarded = 0.26 cfs @ 8.25 hrs, Volume= 18,081 cf
Primary = 6.80 cfs @ 12.27 hrs, Volume= 29,781 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 200.72' @ 12.27 hrs Surf.Area= 4,731 sf Storage= 16,525 cf

Plug-Flow detention time= 99.4 min calculated for 47,862 cf (91% of inflow)
Center-of-Mass det. time= 55.8 min (816.3 - 760.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	195.00'	7,084 cf	**37.08'W x 127.59'L x 5.75'H Field A** 27,206 cf Overall - 9,495 cf Embedded = 17,711 cf x 40.0% Voids
#2A	196.00'	9,495 cf	**ADS_StormTech MC-3500 d +Cap** x 85 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 85 Chambers in 5 Rows Cap Storage= +14.9 cf x 2 x 5 rows = 149.0 cf
		16,579 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	193.00'	**24.0" Round Culvert X 2.00** L= 56.0' Ke= 0.500 Inlet / Outlet Invert= 193.00' / 191.88' S= 0.0200 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Device 1	197.00'	**6.0" W x 20.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Discarded	195.00'	**2.410 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.26 cfs @ 8.25 hrs HW=195.06' (Free Discharge)
↑—**3=Exfiltration** (Exfiltration Controls 0.26 cfs)

Primary OutFlow Max=6.78 cfs @ 12.27 hrs HW=200.71' TW=192.01' (Dynamic Tailwater)
↑—**1=Culvert** (Passes 6.78 cfs of 78.36 cfs potential flow)
↑—**2=Orifice/Grate** (Orifice Controls 6.78 cfs @ 8.13 fps)

Pond 10P: STORMTECH INFILTRATION POND #3 - Chamber Wizard Field A

Chamber Model = ADS_StormTech MC-3500 d +Cap (ADS StormTech® MC-3500 d rev 03/14 with Cap volume)
Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf
Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap
Cap Storage= +14.9 cf x 2 x 5 rows = 149.0 cf

77.0" Wide + 9.0" Spacing = 86.0" C-C Row Spacing

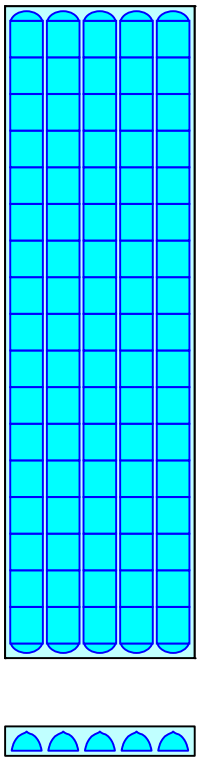
17 Chambers/Row x 7.17' Long +1.85' Cap Length x 2 = 125.59' Row Length +12.0" End Stone x 2 = 127.59' Base Length
5 Rows x 77.0" Wide + 9.0" Spacing x 4 + 12.0" Side Stone x 2 = 37.08' Base Width
12.0" Stone Base + 45.0" Chamber Height + 12.0" Stone Cover = 5.75' Field Height

85 Chambers x 110.0 cf + 14.9 cf Cap Volume x 2 x 5 Rows = 9,494.9 cf Chamber Storage

27,205.9 cf Field - 9,494.9 cf Chambers = 17,711.0 cf Stone x 40.0% Voids = 7,084.4 cf Stone Storage

Chamber Storage + Stone Storage = 16,579.3 cf = 0.381 af
Overall Storage Efficiency = 60.9%
Overall System Size = 127.59' x 37.08' x 5.75'

85 Chambers
1,007.6 cy Field
656.0 cy Stone



Summary for Pond 11P: STORMTECH INFILTRATION POND #3

Inflow Area = 97,621 sf, 65.65% Impervious, Inflow Depth > 6.75" for 100YR event
Inflow = 15.34 cfs @ 12.09 hrs, Volume= 54,873 cf
Outflow = 6.91 cfs @ 12.27 hrs, Volume= 49,737 cf, Atten= 55%, Lag= 11.2 min
Discarded = 0.28 cfs @ 8.25 hrs, Volume= 19,409 cf
Primary = 6.63 cfs @ 12.27 hrs, Volume= 30,328 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 200.59' @ 12.27 hrs Surf.Area= 4,997 sf Storage= 17,192 cf

Plug-Flow detention time= 101.5 min calculated for 49,737 cf (91% of inflow)
Center-of-Mass det. time= 53.7 min (818.1 - 764.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	195.00'	7,476 cf	**37.08'W x 134.76'L x 5.75'H Field A** 28,735 cf Overall - 10,045 cf Embedded = 18,690 cf x 40.0% Voids
#2A	196.00'	10,045 cf	**ADS_StormTech MC-3500 d +Cap** x 90 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 90 Chambers in 5 Rows Cap Storage= +14.9 cf x 2 x 5 rows = 149.0 cf
		17,521 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	192.50'	**24.0" Round Culvert X 2.00** L= 18.0' Ke= 0.500 Inlet / Outlet Invert= 192.50' / 192.00' S= 0.0278 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Device 1	197.00'	**6.0" W x 20.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Discarded	195.00'	**2.410 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.28 cfs @ 8.25 hrs HW=195.06' (Free Discharge)
↑—**3=Exfiltration** (Exfiltration Controls 0.28 cfs)

Primary OutFlow Max=6.61 cfs @ 12.27 hrs HW=200.57' TW=192.02' (Dynamic Tailwater)
↑—**1=Culvert** (Passes 6.61 cfs of 80.44 cfs potential flow)
↑—**2=Orifice/Grate** (Orifice Controls 6.61 cfs @ 7.93 fps)

Pond 11P: STORMTECH INFILTRATION POND #3 - Chamber Wizard Field A

Chamber Model = ADS_StormTech MC-3500 d +Cap (ADS StormTech® MC-3500 d rev 03/14 with Cap volume)
Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf
Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap
Cap Storage= +14.9 cf x 2 x 5 rows = 149.0 cf

77.0" Wide + 9.0" Spacing = 86.0" C-C Row Spacing

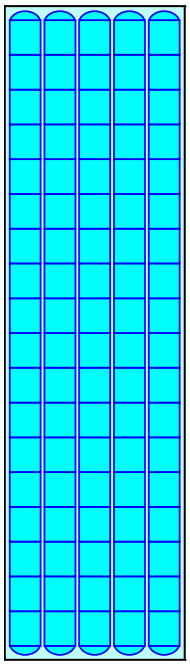
18 Chambers/Row x 7.17' Long +1.85' Cap Length x 2 = 132.76' Row Length +12.0" End Stone x 2 = 134.76' Base Length
5 Rows x 77.0" Wide + 9.0" Spacing x 4 + 12.0" Side Stone x 2 = 37.08' Base Width
12.0" Stone Base + 45.0" Chamber Height + 12.0" Stone Cover = 5.75' Field Height

90 Chambers x 110.0 cf + 14.9 cf Cap Volume x 2 x 5 Rows = 10,044.7 cf Chamber Storage

28,734.8 cf Field - 10,044.7 cf Chambers = 18,690.1 cf Stone x 40.0% Voids = 7,476.0 cf Stone Storage

Chamber Storage + Stone Storage = 17,520.7 cf = 0.402 af
Overall Storage Efficiency = 61.0%
Overall System Size = 134.76' x 37.08' x 5.75'

90 Chambers
1,064.3 cy Field
692.2 cy Stone



Pipe Listing (selected nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	P206	197.70	197.00	35.0	0.0200	0.013	15.0	0.0	0.0

Summary for Pond P206: STORMTECH INFILTRATION POND #4

[87] Warning: Oscillations may require smaller dt or Finer Routing (severity=2)

Inflow Area = 78,505 sf, 54.69% Impervious, Inflow Depth > 6.21" for 100YR event
Inflow = 11.82 cfs @ 12.09 hrs, Volume= 40,647 cf
Outflow = 3.32 cfs @ 12.45 hrs, Volume= 40,645 cf, Atten= 72%, Lag= 21.3 min
Discarded = 1.05 cfs @ 11.55 hrs, Volume= 32,981 cf
Primary = 2.27 cfs @ 12.45 hrs, Volume= 7,664 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 200.80' @ 12.45 hrs Surf.Area= 5,485 sf Storage= 11,366 cf

Plug-Flow detention time= 42.3 min calculated for 40,560 cf (100% of inflow)
Center-of-Mass det. time= 42.2 min (823.1 - 780.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	197.50'	4,922 cf	**25.25'W x 217.22'L x 3.50'H Field A** 19,197 cf Overall - 6,891 cf Embedded = 12,306 cf x 40.0% Voids
#2A	198.00'	6,891 cf	**ADS_StormTech SC-740 +Cap** x 150 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 150 Chambers in 5 Rows
		11,813 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	197.70'	**15.0" Round Culvert** L= 35.0' Ke= 0.500 Inlet / Outlet Invert= 197.70' / 197.00' S= 0.0200 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#2	Device 1	199.00'	**5.0" W x 12.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Discarded	197.50'	**8.270 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=1.05 cfs @ 11.55 hrs HW=197.54' (Free Discharge)
└**3=Exfiltration** (Exfiltration Controls 1.05 cfs)

Primary OutFlow Max=2.27 cfs @ 12.45 hrs HW=200.79' TW=0.00' (Dynamic Tailwater)
└**1=Culvert** (Passes 2.27 cfs of 9.29 cfs potential flow)
└**2=Orifice/Grate** (Orifice Controls 2.27 cfs @ 5.44 fps)

Pond P206: STORMTECH INFILTRATION POND #4 - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-740 +Cap (ADS StormTech® SC-740 with cap length)
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

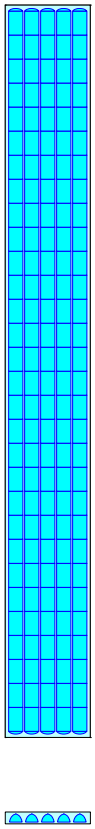
30 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 215.22' Row Length +12.0" End Stone x 2 = 217.22' Base Length
5 Rows x 51.0" Wide + 6.0" Spacing x 4 + 12.0" Side Stone x 2 = 25.25' Base Width
6.0" Stone Base + 30.0" Chamber Height + 6.0" Stone Cover = 3.50' Field Height

150 Chambers x 45.9 cf = 6,891.0 cf Chamber Storage

19,196.5 cf Field - 6,891.0 cf Chambers = 12,305.5 cf Stone x 40.0% Voids = 4,922.2 cf Stone Storage

Chamber Storage + Stone Storage = 11,813.2 cf = 0.271 af
Overall Storage Efficiency = 61.5%
Overall System Size = 217.22' x 25.25' x 3.50'

150 Chambers
711.0 cy Field
455.8 cy Stone



Project Notes

Rainfall events imported from "19097 PreDevelopment.hcp"
Rainfall events imported from "19097 PostDevelopment-prelim.hcp"

Pipe Listing (selected nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	P205	201.00	200.63	75.0	0.0049	0.013	24.0	0.0	0.0

Summary for Pond P205: INFILTRATION POND #5

Inflow Area = 254,301 sf, 42.05% Impervious, Inflow Depth > 5.56" for 100YR event
Inflow = 29.89 cfs @ 12.12 hrs, Volume= 117,801 cf
Outflow = 16.82 cfs @ 12.40 hrs, Volume= 105,864 cf, Atten= 44%, Lag= 16.4 min
Discarded = 0.82 cfs @ 10.40 hrs, Volume= 47,109 cf
Primary = 16.00 cfs @ 12.40 hrs, Volume= 58,755 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 206.25' @ 12.40 hrs Surf.Area= 14,784 sf Storage= 36,174 cf

Plug-Flow detention time= 114.0 min calculated for 105,643 cf (90% of inflow)
Center-of-Mass det. time= 66.5 min (869.5 - 803.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	202.00'	19,261 cf	**101.25'W x 146.02'L x 4.50'H Field A** 66,529 cf Overall - 18,376 cf Embedded = 48,153 cf x 40.0% Voids
#2A	203.00'	18,376 cf	**ADS_StormTech SC-740 +Cap** x 400 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 400 Chambers in 20 Rows
		37,637 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	201.00'	**24.0" Round Culvert** L= 75.0' Ke= 0.500 Inlet / Outlet Invert= 201.00' / 200.63' S= 0.0049 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Device 1	204.00'	**15.0" W x 20.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	204.50'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Discarded	202.00'	**2.410 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.82 cfs @ 10.40 hrs HW=202.05' (Free Discharge)
└**4=Exfiltration** (Exfiltration Controls 0.82 cfs)

Primary OutFlow Max=15.99 cfs @ 12.40 hrs HW=206.25' TW=201.46' (Dynamic Tailwater)
└**1=Culvert** (Passes 15.99 cfs of 30.74 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 11.76 cfs @ 5.64 fps)
  └**3=Orifice/Grate** (Orifice Controls 4.23 cfs @ 5.38 fps)

Pond P205: INFILTRATION POND #5 - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-740 +Cap (ADS StormTech® SC-740 with cap length)
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 9.0" Spacing = 60.0" C-C Row Spacing

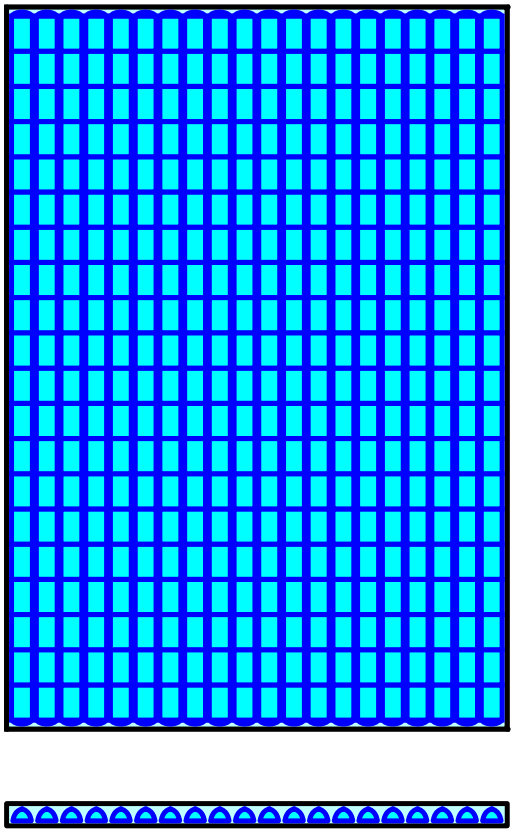
20 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 144.02' Row Length +12.0" End Stone x 2 = 146.02' Base Length
20 Rows x 51.0" Wide + 9.0" Spacing x 19 + 12.0" Side Stone x 2 = 101.25' Base Width
12.0" Stone Base + 30.0" Chamber Height + 12.0" Stone Cover = 4.50' Field Height

400 Chambers x 45.9 cf = 18,376.0 cf Chamber Storage

66,528.8 cf Field - 18,376.0 cf Chambers = 48,152.8 cf Stone x 40.0% Voids = 19,261.1 cf Stone Storage

Chamber Storage + Stone Storage = 37,637.1 cf = 0.864 af
Overall Storage Efficiency = 56.6%
Overall System Size = 146.02' x 101.25' x 4.50'

400 Chambers
2,464.0 cy Field
1,783.4 cy Stone



From:	patriotexcavating
To:	Paul Morris; Patrick Bogle; david@davidehale.com; "David E Hale"; "Leslie French"; "Mark Brooks"; patriotexcavating@comcast.net
Cc:	Katie Enright
Subject:	RE: Walpole alternative drainage
Date:	Tuesday, June 23, 2020 5:14:57 PM

Sorry for the delay. Please see below. We just installed 2 systems in Westwood with same size Chambers and similar quantities. I had to guess at the header pricing as it needs to be designed by the manufacturer. Everything else should be very accurate. The only thing that would have to be added to each system is a water quality unit to keep the Chambers clean and prevent material from entering them. Those vary in price but carrying about $12,000 for each one should cover the price to buy and install them. Any questions feel free to call.
Thanks
Phil
Cell 978-375-2085

Pond #3
175 MC-3500 Chambers
$425/Chamber Total $74,325
Fabric/Header System $12,000
Stone 2400 tons $43,200
Labor and Equipment $40,000
Pond #3 Total $169,525

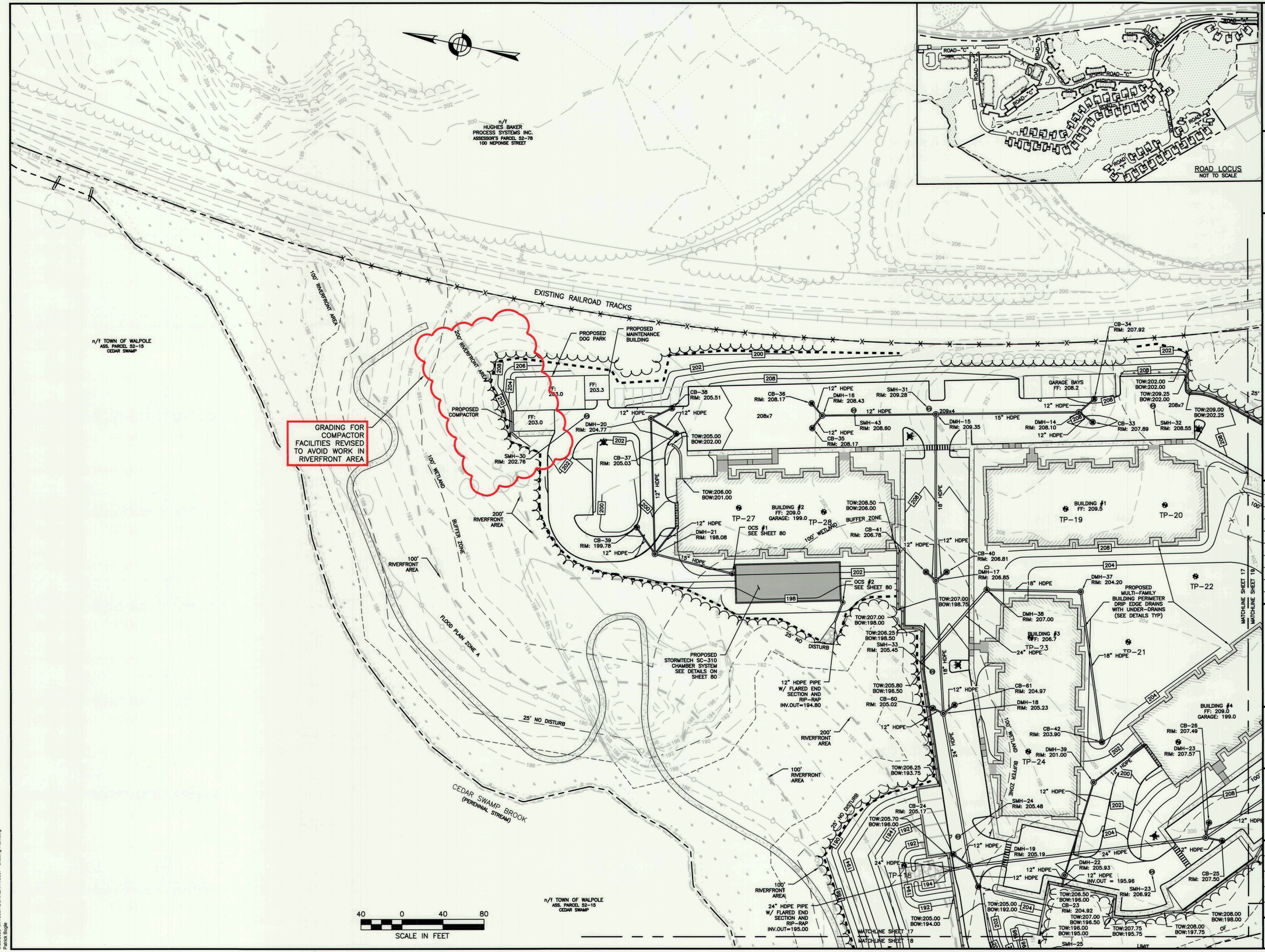
Pond #4
150 SC-740 Chambers
$232/Chamber Total $34,800
Fabric/Header System $6,000
Stone 835 tons $15,030
Labor and Equipment $30,000
Pond #4 Total $85,830

Pond #5
400 SC-740 Chambers
$232/Chamber Total $92,800
Fabric/Header System $18,000
Stone 2240 tons $40,320
Labor and Equipment $80,000
Pond #5 Total $231,120

Pond 3, 4, and 5 Total $486,475

Sent from my Verizon, Samsung Galaxy smartphone

-------- Original message --------
From: Paul Morris <rpm@pinnco.com>
Date: 6/23/20 3:23 PM (GMT-05:00)



HOWARD STEIN HUDSON
114 Turnpike Road, Suite 2C
Chelmsford, MA 01824
www.hshassoc.com

PREPARED FOR:

55 BH LLC
6 LYBERTY WAY, SUITE 203
WESTFORD, MA 01886

PROPOSED MULTIFAMILY DEVELOPMENT
SUMMER STREET
WALPOLE, MA

REVISIONS:

NO	BY	DATE	DESCRIPTION
1	PB	5/1/20	REV. SITE PLANS
2	PB	6/29/20	REV. 200' GRADING

COMMONWEALTH OF MASSACHUSETTS
KATIE L. ENRIGHT
CIVIL
No. 46111
REGISTERED PROFESSIONAL ENGINEER
6/29/20

SITE PLAN

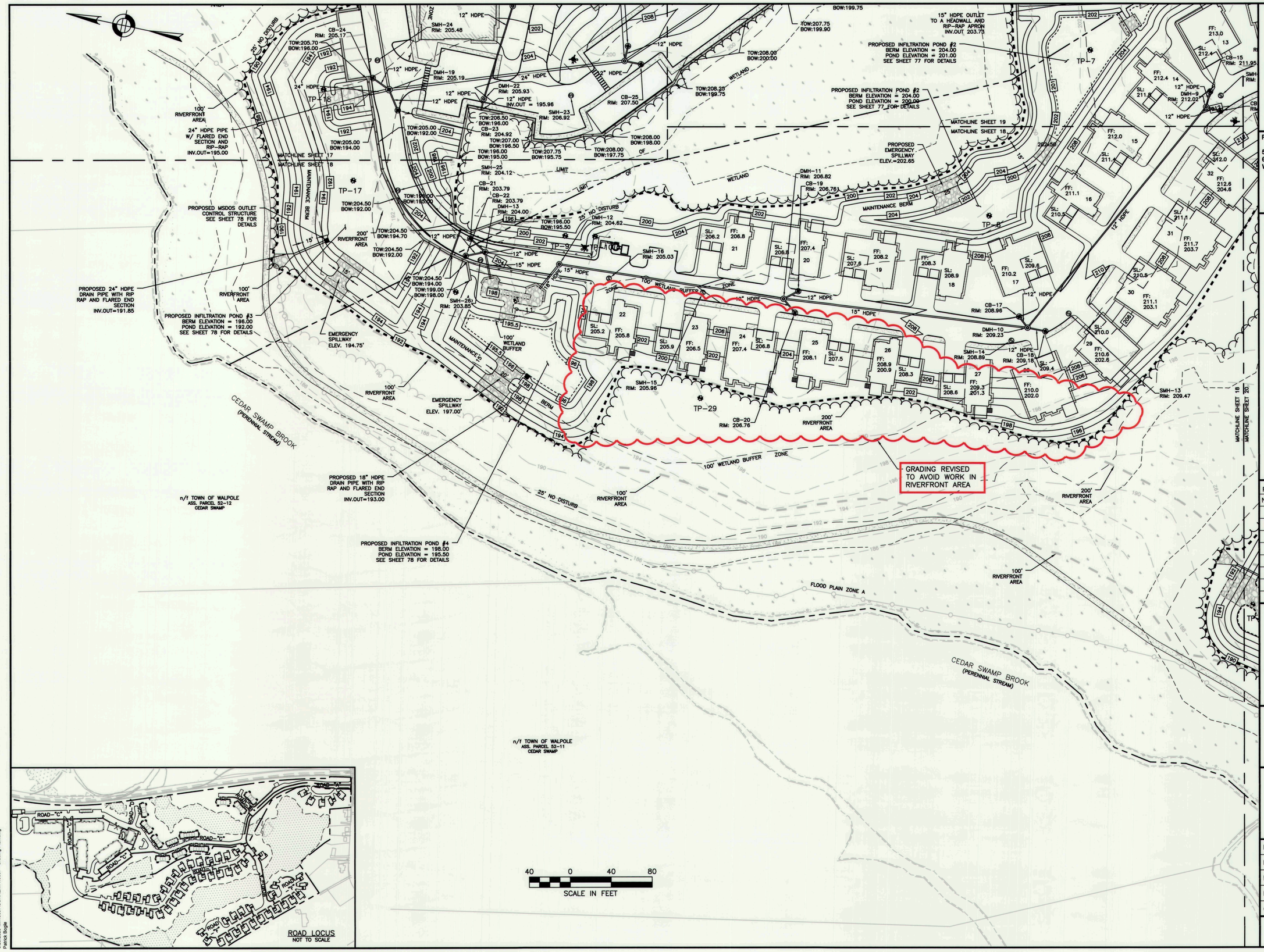
GRADING AND DRAINAGE PLAN
1 OF 5

DATE:	JANUARY 10, 2020
PROJECT NUMBER:	19097
DESIGNED BY:	PB/KE/KF
DRAWN BY:	PB/KF
CHECKED BY:	KE

C.17

SHEET 17 OF 86

6/29/2020 M:\19097\CURRENT\19097 - Grading Plan.dwg
Patrick Bogle



6/29/2020 M:\19097\CURRENT\19097 - Grading Plan.dwg
Patrick Begin

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KATIE L. ENRIGHT CIVIL No. 46111 REGISTERED PROFESSIONAL ENGINEER
6/29/20

SITE PLAN

GRADING AND DRAINAGE PLAN
2 OF 5

DATE:	JANUARY 10, 2020
PROJECT NUMBER:	19097
DESIGNED BY:	PB/KE/KF
DRAWN BY:	PB/KF
CHECKED BY:	KE

C.18