



October 20, 2023

The Board Of Trustees
OP Condo Association, LLC
PO Box 1513
Sagamore Beach, MA 02562

Subject: Engineering Peer Review
 Ocean Pines Condominium Development
 Bourne, MA
 CEC Project 335-785

Dear Trustees:

In accordance with our proposal for professional engineering services, Civil & Environmental Consultants, Inc. (CEC) has prepared this summary of our findings from a site visit on October 16, 2023 and review of the available materials provided in support of the ongoing development of the condominium development proposed along Wildwood Lane as part of the Ocean Pines development in Bourne, Massachusetts (the Site).

The OP Condo Association, LLC (the Association) has identified numerous drainage concerns and issues that have been observed at the Site since the original development. CEC reviewed available documents, exhibits, and publicly available record and GIS information to evaluate the existing development as well as portions of the Site that are actively under construction with respect to the design of the drainage and stormwater management systems for compliance with the standard engineering and design practices and MassDEP Stormwater Management Standards. The following is a summary of the documentation reviewed, a brief project overview and our findings and recommendations.

EXECUTIVE SUMMARY

Based on our review of the provided drainage calculations, exhibits and available record information, a number of design items have been identified that are likely contributing to poor performance of the drainage and stormwater management systems at the Site. The key items include the following:

- The original design of the drainage systems in Ocean Pines Drive appear to have been sized with a storm event of undetermined size utilizing an intensity of 2.0 inches/hour, which is significantly less than would be expected under current design standard. This may be leading to insufficient capacity to convey larger storm events.
- Record Plans of the development of the Site were not available for review and an Operations and Maintenance Plan was not provided. Without these documents, the Town and Association will not be able to accurately verify what was installed and/or maintain the stormwater management system effectively.

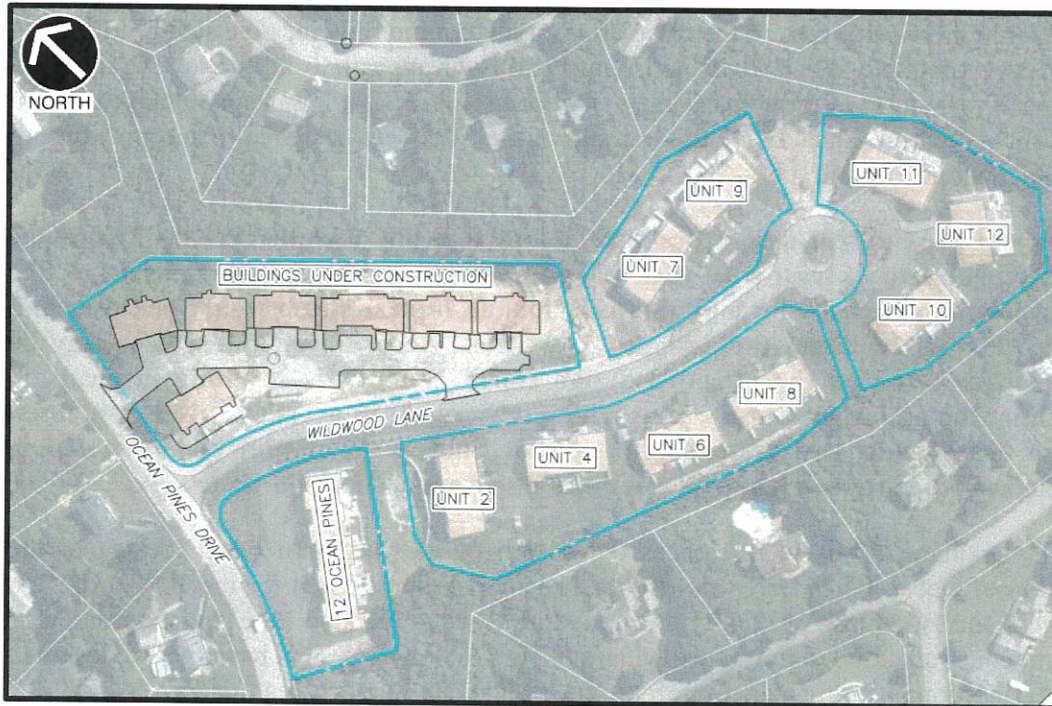
- The various components of the stormwater system within the Site were analyzed for varying storm event frequencies (1-inch, 10-year and 25-year events). The analysis also appears to only include building roof and pavement areas without consideration for pervious onsite and off-site tributary areas. A comprehensive analysis should be performed that includes an analysis including the entire tributary area, modeling the overall stormwater management system utilizing consistent storm events up to and including the 100-year storm event.
- The detention basin located to the east of Unit 12 Ocean Pines appears to be significantly smaller than the original analysis modeled. The analysis also includes 1.7 acres of tributary drainage areas; where it appears that closer to 5.5 acres of area drains to this basin. The basin also has no means for emergency overflow should the Site experience large storm events. It is recommended that the design of the basin be reviewed to confirm that the basin has sufficient capacity to control runoff from storm events up to and including the 100-year storm event, and the basin design should incorporate an overflow that provide a means for stormwater to safely drain from the basin should the site experience stormwater flows in excess of the design capacity. If the analysis indicated that the basin may not provide sufficient freeboard from residential units, the basin should be enlarged or design modified to protect the existing Unit 12 building from localized flooding.
- The construction of the pavement areas at the driveway and parking areas for the units under construction does not appear to result in drainage patterns consistent with the drainage analysis and should be corrected.
- The design of the units under construction appears to propose fill that will reduce the storage capacity of an existing natural depression along the northerly property line shared with existing residential properties and may result in an increase in localized ponding on existing properties. This condition should be reviewed and a means for emergency overflow should be incorporated into the design.
- The current development includes numerous deviations from the design included in the original 1987 Special Permit Approval. These should be reviewed for conformance with the original permit approval to ensure the design conforms with the necessary town requirements.
- There is localized ponding along the rear of several of the existing units that has resulted in wet soils and backflows into basements. The design of the overflow paths from stormwater systems in the rear yards should be reviewed to ensure backflows from the systems are directed away from the units and do not enter the existing or proposed units.
- There are a limited amount of erosion controls provided for the development and no inlet protection was provided in the catch basins within the development or along Ocean Pines Drive. A search of active EPA Notice of Intents in Bourne did not appear to indicate a NOI has been issued for this Site. The Developer should confirm that coverage has been obtained and a Stormwater Pollution Prevention Plan has been prepared and an NOI has been filed.

PROJECT OVERVIEW

The Developer is currently constructing a condominium development located on five (5) development parcels identified as 6-125-0, 6-128-1, 6-127-3, 7-99-2, 7-100-0 totaling approximately 6.8 acres, along with work on a 7.2-acre open space parcel. The development parcels are located in the R40 Zoning District, and the open space parcel is located within both the R40 and the B2 zoning districts. A portion of the development parcels is also located within the Water Resource District. The project includes construction of a roadway identified as Wildwood Lane. To date, ten (10) buildings have been constructed (Units 2, 4, 6, and 7 through 12 on Wildwood Lane and Unit 12 on Ocean Pines) and seven (7) additional buildings are currently under construction. Refer to Figure 1 below for a depiction of the existing site and immediate surrounding area.

Based on information provided by the Client, the project is being constructed under a Special Permit issued by the Bourne Planning Board on May 4, 1987 for development of a 74.1-acre parcel of land for a project referred to as “Ocean Pine at North Sagamore”. The Special Permit Approval was extended in September 1988 to a new expiration date of May 19, 1989. It is assumed that work began on the development prior to the expiration date in 1989. It is unknown if the work has continued uninterrupted since the original approval and extension in 1988.

Figure 1 – Site Aerial



Source: MassMapper GIS

PROJECT DOCUMENTS

The following is a list of Project documentation and materials, provided by members of the OP Condominium Association (the Association), which will serve as the basis for our review:

- Drainage Analysis – Job 361.01, dated February 5, 1987, prepared by Wilson Hill Associates (the 1997 Drainage Analysis);
- Drainage Analysis – Ocean Pines Subdivision, Bourne, MA, dated December 2, 1998, prepared by Flaherty, Stefani & Bracken, Inc. (the 1998 Drainage Analysis);
- Lot Drainage Analysis Prepared for Ocean Pines, LLC, Dated May 31, 2007, prepared by Existing Grade, Inc (the 2007 Drainage Analysis);
- Narrative for Stormwater Summary – Lot 61, dated November 9, 2022, prepared by Existing Grade, Inc. (the 2022 Drainage Analysis).

FINDINGS & RECOMMENDATIONS

Based on our review of the above referenced documentation, CEC offers the following findings and recommendations relative to the documentation reviewed. Additionally, the design was reviewed for common engineering practices.

1. The 1997 Drainage Analysis references the design of the culverts and drainage system for the overall Ocean Pines subdivision utilizing the Rational Method. It appears that an intensity value of 2.0 in/hr was utilized for the calculations to determine flow for pipe sizing. Based on intensity/duration curves for Barnstable County, 2.0 in/hr appears to fall below the intensity value for a 2-year storm event with a Time of Concentration (T_c) of less than 30 minutes. The pipe network in Ocean Pines Drive to the south of the Site were designed to accept flows up to 4.4 cubic feet per second (cfs).

Comment 1: Current design practices would typically include design of drainage infrastructure to at least a 10-year storm event (often 25-year storm event). The corresponding intensity for a 6-minute T_c for the 10-year storm would be closer to 5 in/hr which is 2.5 times the designed flow rate. Accordingly, the system may be undersized based on the intended design storm, potentially resulting in localized ponding during larger storm events which may result in overflows into residential properties when located below the street grade, such as the existing homes on Alpine Circle near the intersection of Ocean Pines Drive and Wildwood Lane .

2. The 1998 Drainage Analysis references the design of the detention basin located at the intersection of Ocean Pines Drive and Route 3A. This basin is sized for the 10-year design storm event and is in close proximity to an existing isolated wetland. The “existing drainage area is not constructed in conformance with the approved plans”. This basin was redesigned to provide additional stormwater control, filtration and water quality treatment.

Comment 2: Current design practices require that detention basins provide storage and mitigation for all storm events up to and including the 100-year storm event; therefore, this basin is undersized based on current design standards and the volume of runoff exceeds the storage capacity for design storms larger than the 10-year storm event.

3. The 2007 Drainage Analysis includes the sizing of stormwater infiltration systems for a 10-year storm event. We reviewed the design of the following existing stormwater infiltration systems along Wildwood Lane:

- 15 Cultec R330 Stormwater Chambers for Building 1 Roof Areas (3,000 sf);
- 27 Cultec R-330 chambers for the parking area for Building 1-3;
- 42 Cultec R-330 chambers for the parking area for Buildings 2-4;
- 18 Cultec R-330 chambers for the parking area for Building 10;
- 39 Cultec R-330 chambers for the parking area for Building 11-15;
- 21 Cultec R-330 chambers for the parking area for Building 12; and
- 54 Cultec R-330 chambers for the parking area for Building 14-17.
- Several leaching pits at various buildings

These systems generally fill up with approximately 3.0 to 3.3-ft of stormwater within a 4.38-ft high stone section that includes the 30-inch tall Cultec R-330 chambers. The size of the chambers were sized conservatively, assuming no infiltration into the soil. This analysis references a Stormwater Pond from portions of the Site which includes 72,398 square feet (sf) (1.7 acres) of tributary area which is a mix of pervious and impervious areas. This pond provides approximately 69,015 cubic feet (cf) of available storage from elevation 84 to 94-ft (10-ft of depth). The model does not account for infiltration. The stormwater basin was sized utilizing a 25-year storm event with 5.70-inches of runoff. Note that no supporting exhibits or plans are provided that show this Stormwater Pond; but we assume it is the stormwater pond located behind the Unit 12 Ocean Pines Building.

Comment 3: Site Plans and/or figures depicting the tributary drainage and detention areas included in the analysis were not able to be located. It is recommended that a set of Record Site Plans for the Wildwood Lane development be provided to the Town and Association along with an Operations and Maintenance (O&M) Plan that would allow for a complete understanding of the installed stormwater infrastructure as well as the proper inspection and maintenance procedures that need to be performed to keep the infrastructure operating properly.

Comment 4: The analysis included modeling of the chambers at the bottom of the 4.38-ft envelope at elevation 0.0. The model would typically be prepared to account for a stone bedding at least 6-inches thick, starting the chamber storage at elevation

0.50. With the chambers analyzed starting the storage at elevation 0.0, the model indicates that more storage volume is available at lower elevations than will exist in the constructed condition, incorrectly resulting in a lower than actual modeled water surface elevations in the chambers. It should be noted that the analysis conservatively does not account for infiltration. In order to more accurately represent the expected operation of the systems, the chamber elevations within the stone envelopes would need to be corrected and re-analyzed.

Comment 5 : The design of the infiltration systems appears to only account for runoff associated with impervious parking and roof areas and does not account for any runoff from landscape and other pervious areas within the Site or from tributary off-site drainage areas. Without accounting for runoff from all tributary areas, the systems will experience more runoff than the analysis indicates and will more frequently exceed the design storage and infiltration capacity overflowing to the surface. Additionally, as the systems are designed for the 10-year storm event (4.80-inches of rainfall in a 24-hour period), it is expected that tributary runoff from larger storm events (i.e. greater than 10-year event) will exceed the capacity of the chambers and will backflow through the lowest point of relief. Plans were not able to be located that show where this point of relief will be located and how this impacts the residential units.

Comment 6: A number of small inlets were observed within the building window wells, which would appear to be a lower point of relief than roof drain connections. Provided the roof drains are connected to infiltration chambers, stormwater flows that exceed the design capacity of the infiltration chambers would overflow back through the inlets at the window wells and drain into the unit basements. It is our understanding that the basement for Unit 11 has experienced flooding from runoff entering through the window wells, which may be associated with this condition. Caps were placed at the overflows for Unit 11; however its not clear if these will provide the required water-tight seal required to keep runoff from backflowing in this location. It is recommended this condition be reviewed and an alternate overflow path be provided that would minimize the potential for flooding the unit basements.

Comment 7: The tributary area that was modeled to the stormwater pond includes approximately 1.7 acres of area; however the total tributary area is likely closer to 5.5 acres or more when including the building and parking areas. See figure SP04 for a graphical depiction of the tributary drainage area and ponding limits of the existing detention pond. Although some of the areas included in the 5.5-acre overall tributary area have been modeled to drain to the Cultec systems, the runoff exceeding the 10-year storm events that these systems we designed for would ultimately overflow these systems and drain to the existing stormwater basin resulting in more flows in the basin than modeled. Based on available GIS information, it appears that the basin, as it currently exists, is approximately eight (8)-ft deep with an approximate footprint of 1,900 sf within the stone walls that define the basin. Up to the defined limit of the

basin, there is approximately 7,000 cf of stormwater storage volume. Above the defined limits of the basin, there is approximately three (3) additional feet of storage capacity up to the elevation of the rear of the Unit 12 Ocean Pines building before stormwater would be to overflow on the surface adjacent to the Unit 12 building toward Ocean Pines Drive. Up to this overflow elevation there appears to be a total of approximately 32,200 cf of stormwater storage volume capacity. This maximum storage volume is approximately 50% of the total available storage volume modeled in the 2007 Drainage Analysis.

The pond is located in a low point behind the Unit 12 building and does not appear to have an emergency overflow that would allow for stormwater to drain without impacting the Unit 12 building. It was observed by the Association during recent storm events that this pond was full up to fence line of the 12 Ocean Pines homes and in danger of overtopping. See below for photographs of the basin if this condition.



It is recommended that the Developer review the tributary area draining to the basin and overall sizing of the detention basin to confirm that the basin has sufficient capacity to control runoff from storm events up to and including the 100-year storm event. Additionally the basin design should incorporate an overflow that provide a means for stormwater to safely drain from the basin should the site experience stormwater flows in excess of the design capacity.

4. The 2022 Drainage Analysis provides a summary of the design of proposed stormwater infrastructure located on Lot 61 including the buildings currently under construction. The analysis identifies that the stormwater infiltration chambers are sized for the 25-year design storm event and the chambers (Cultec R330XLHD) are sized to recharge the 1" storm event.

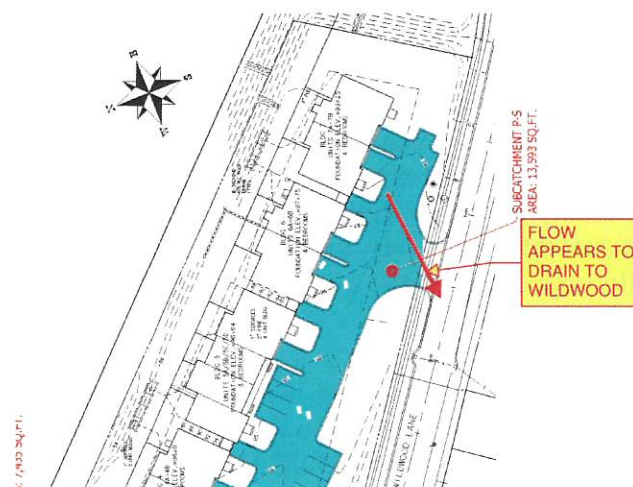
The model includes infiltration at a rate of 8.27 inches per hour which corresponds to sand per the Massachusetts Stormwater Management Standards.

Comment 8: Stormwater infiltration systems that provide infiltration at a rate in excess of 2.4 inches/hour are considered rapid infiltration rates and are subject to 44% TSS removal pre-treatment prior to infiltration according to the Massachusetts Stormwater Management Standards. Deep Sump Hooded catch basins are considered to provide 25% TSS removal, and without additional water quality treatment prior to infiltration, the system as designed would not meet the MassDEP stormwater management standards.

Comment 9: The analysis only accounts for runoff associated with impervious paved areas and does not account for runoff from pervious site areas that are tributary to the same systems. This results in more flow going to the stormwater system than modeled. The analysis for comparison of the pre-development vs. post-development conditions should include the entire tributary drainage area and including proposed changes in land coverage.

Comment 10: The analysis assumes all runoff will be captured by the catch basins including catch basins placed on-grade (vs. in a sump condition). It should be confirmed that the catch basins will capture the stormwater as modeled and/or noted how much of the runoff will bypass the catch basins ultimately draining to the low point in Ocean Pines Drive near the intersection of Wildwood Lane.

Comment 11: The runoff from the pavement drains directly to Wildwood Lane as opposed to being channelized in the centerline of the access drive and collected in catch basins as depicted on the drainage exhibits. See below for an excerpt of the drainage exhibit for reference. This will alter the drainage performance as the runoff will bypass the controls proposed as part of this phase of development and increase flows to the stormwater basin behind Unit 12 Ocean Pines and should be reviewed.



Comment 12: The analysis for the recharge of the building roof areas includes recharge of the 1" volume; however these systems exceed their design capacities for larger storms resulting in surcharge back through the system. The stormwater chambers generally are located in the rear of the units and surcharge into the backyards. It is recommended that overflows be incorporated in to the project design such that the overflow would be located away from the building foundations and have a path to drain away from the buildings.

Comment 13: The development of this current phase of the construction project will result in filling along the adjacent properties and open space parcel. This will fill an existing depression that currently accepts runoff from a significant area including the adjacent residential development. The low point currently overflows through the development parcel to Ocean Pines Drive, and the construction will significantly reduce the available storage in this natural depression and eliminate the low point where runoff currently overflows. This will change the drainage path of this area potentially impacting the flooding at the adjacent residential home. See Figures SP01 and SP02 for graphical depictions of this condition.

General Comment: The current development of the condominium units along Wildwood Lane includes several deviations from the original plan in the 1987 Special Permit approval. There are seven (7) buildings proposed within the parcel currently under construction where five (5) were originally proposed. The proposed buildings contain larger footprints than originally proposed and the current design includes numerous modifications to the overall layout of parking and circulation areas resulting in additional impervious areas from the original design plan. The Unit 12 Ocean Pines building consists of a single larger building where two (2) separated buildings were previously proposed, which eliminates a potential overflow path from the detention basin. Refer to figure SP03 for an exhibit that depicts the current design overlaid on the original design plans.

General Comment: The existing detention basin within the site includes pipes that discharge runoff into the basin several feet above the bottom of the basin with no measures designed to reduce the velocity of discharging runoff or otherwise mitigate the flow into the basin which is causing erosion of the basin. An angled section of HDPE pipe was attached to one of the discharges; however has fallen off and is loose in the basin. Discharges of PVC pipe (presumably from the roof leader systems) also discharge to the surface and are routed into the basin with multiple angled segments exposed at the surface. See below for representative photographs.



In addition to the overall review of the design of the basin for the potential need for expansion and introduction of an emergency overflow measure, these conditions should be corrected to reduce the potential for scour and erosion of the basin and potential dislodgement of pipes resulting in future maintenance issues.

General Comment: There is an existing depression in the open space area between units 8 and 10 that was wet and is subject to some localized ponding. Additionally, the area behind units 6 and 8 has very little pitch and is subject to localized ponding during larger storm events. These areas should be reviewed to identify if additional pitch can be provided that would allow for improved drainage in these areas minimizing potential for localized ponding on the patios of the existing homes.


General Comment: The back yard behind unit 11 has been noted to experience some localized ponding and flooding into the basement. It appears there is minimal slope away from the building and little pitch towards any potential overflow points away from the residence. A swale was cut into the hill providing improved drainage, however the configuration of the stormwater chambers (if any) in the rear yard should be reviewed and an alternate overflow path should be provided.

General Comment: There are a limited amount of erosion controls provided for the development and no inlet protection was provided in the catch basins within the development or along Ocean Pines Drive. This will result in a significant amount of sediment that will be carried to downgradient stormwater infrastructure and properties. This should be corrected. Additionally, the overall project is expected to disturb more than 1-acre of area and a Notice of Intents is required to be filed with the Environmental Protection Agency for coverage under the Construction General Permit. A search of active NOIs in Bourne did not appear to indicate one is active for this Site. The Developer should confirm that coverage has been obtained and a Stormwater Pollution Prevention Plan has been prepared and an NOI has been filed.

We hope that you find these comments helpful in your review of the completed and ongoing construction at the Site. Please feel free to contact us with any questions.

Sincerely,

CIVIL & ENVIRONMENTAL CONSULTANTS, INC.



Karlis P. Skulte, P.E.
Principal



Brian Potvin, P.E.
Principal

Figures: SP01 – Northerly Ponding Area (Existing)
SP02 – Northerly Ponding Area (Proposed)
SP03 – Plan Overlay Exhibit
SP04 – Site Detention Pond Drainage Exhibit



LOCAL DEPRESSION
PONDING LIMITS
(NATURAL DETENTION)
(± 1.9 AC-FT OF STORAGE)

EXISTING OVERFLOW
LOCATION AT
ELEVATION 86

APPROXIMATE TRIBUTARY
DRAINAGE AREA (7.4 ACRES)

REFERENCE

- 1. TOPOGRAPHIC INFORMATION BASED INFORMATION PROVIDED VIA MASSGIS.



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OCEAN PINES CONDOMINIUM
BOURNE, MA
NORTHERLY PONDING AREA (EXISTING)

DRAWN BY:	KPS	CHECKED BY:	KPS	APPROVED BY:	KPS	FIGURE NO.:	
DATE:	OCTOBER 2023	DWG SCALE:	1" = 100'	PROJECT NO.:	335-785		SP01

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NATURAL DETENTION AT EXISTING PONDING LIMITS (ELEVATION 86)
(±1.2 AC-FT OF STORAGE
LOSS OF 0.7AC-FT OF STORAGE)

NEW OVERFLOW LOCATION
AT ELEVATION 86 WITH
EXPANDING POTENTIAL
PONDING AREA SHOWN FOR
REFERENCE

APPROXIMATE TRIBUTARY
DRAINAGE AREA

PORTION OF SITE
UNDER CONSTRUCTION

REFERENCE

1. TOPOGRAPHIC INFORMATION BASED INFORMATION PROVIDED VIA MASSGIS.
2. PROPOSED DEVELOPMENT DEPICTED BASED ON EXHIBIT INCLUDING IN 2022 DRAINAGE ANALYSIS PREPARED BY EXISTING GRADE.



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OCEAN PINES CONDOMINIUM
BOURNE, MA

NORTHERLY PONDING AREA (PROPOSED)

DRAWN BY:	KPS	CHECKED BY:	KPS	APPROVED BY:	KPS	FIGURE NO.
DATE:	OCTOBER 2023	DWG SCALE:	1"=100'	PROJECT NO:	335-785	SP02

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7 BUILDINGS WHERE 5 WERE
ORIGINALLY PROPOSED

BUILDINGS GENERALLY
APPEAR TO BE LARGER
(TYP.)

MORE GRADE ALONG REAR
OF BUILDINGS IN ORIGINAL
DESIGN

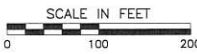
EXTENTS OF IMPERVIOUS AREA
DIFFERENT THAN ORIGINAL
APPROVED PLAN (TYP.)

BUILDINGS GENERALLY
APPEAR TO BE LARGER
(TYP.)

POTENTIAL OVERFLOW PATH
FROM BASIN IN ORIGINAL
DESIGN ELIMINATED WITH
SINGLE LARGER BUILDING

REFERENCE

1. TOPOGRAPHIC INFORMATION BASED INFORMATION PROVIDED VIA MASSGIS.
2. PROPOSED DEVELOPMENT DEPICTED BASED ON EXHIBIT INCLUDED IN 2022 DRAINAGE ANALYSIS PREPARED BY EXISTING GRADE.
3. PLANS SHOWN IN BACKGROUND REFERENCED AS ORIGINAL DESIGN ASSOCIATED WITH 1987 SPECIAL PERMIT WERE PROVIDED BY TOWN OF BOURNE AND ARE AN EXCERPT FROM A PLAN SET ENTITLED "OVERALL DEVELOPMENT PLAN - OCEAN PINES" DATED APRIL 1, 1987.



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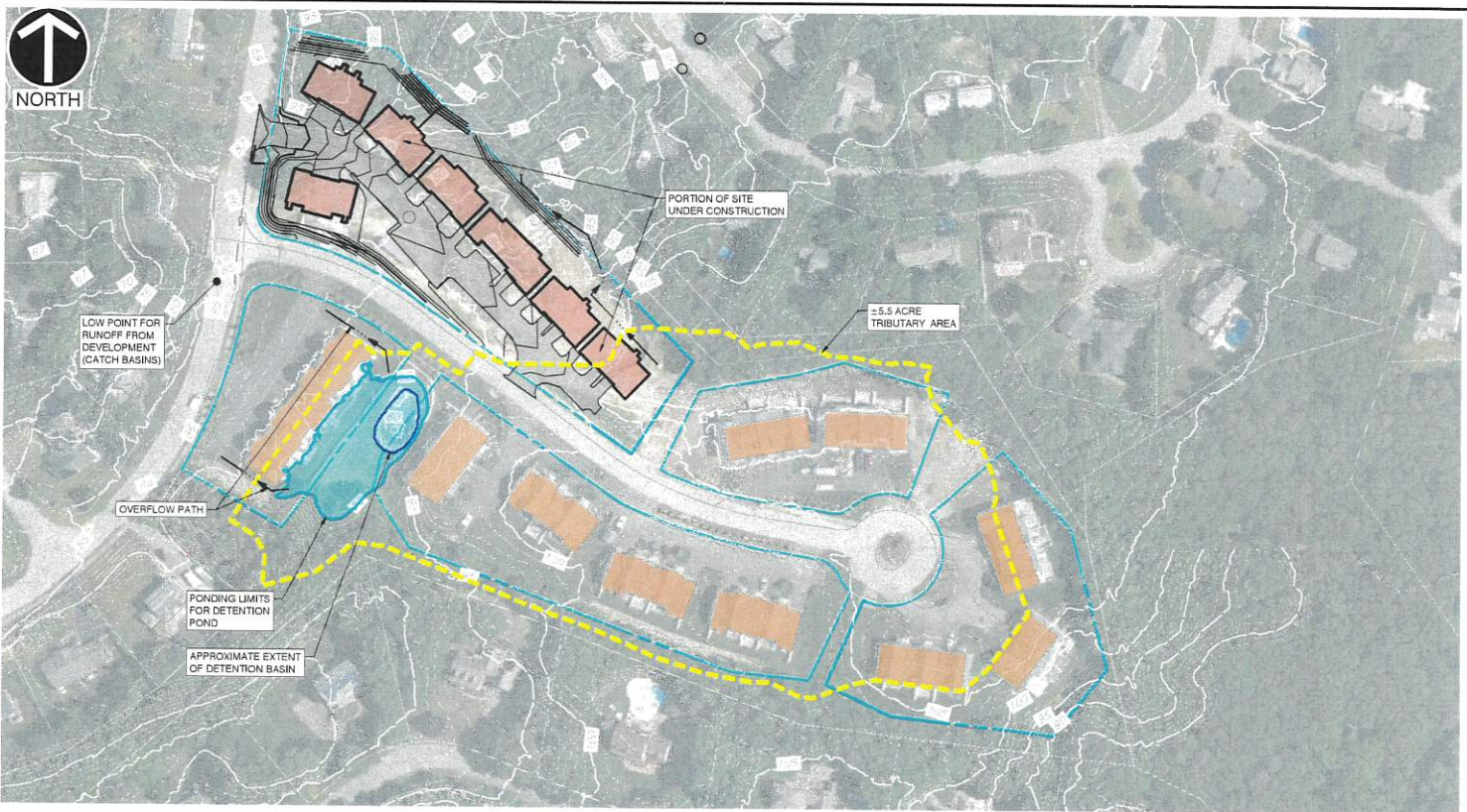
PLAN OVERLAY EXHIBIT

DRAWN BY: KPS	CHECKED BY: KPS	APPROVED BY: KPS	FIGURE NO.: KPS
DATE: OCTOBER 2023	DWG SCALE: 1"=100'	PROJECT NO: 335-785	SP03

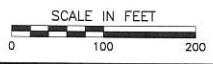
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- REFERENCE**
1. TOPOGRAPHIC INFORMATION BASED INFORMATION PROVIDED VIA MASSGIS.
 2. PROPOSED DEVELOPMENT DEPICTED BASED ON EXHIBIT INCLUDED IN 2022 DRAINAGE ANALYSIS PREPARED BY EXISTING GRADE.



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	SITE DETENTION POND DRAINAGE EXHIBIT
DRAWN BY: KPS CHECKED BY: KPS APPROVED BY: KPS FIGURE NO. KPS	DATE: OCTOBER 2023 DWG SCALE: 1"=100' PROJECT NO: 335-785 SP04