DRAINAGE ANALYSIS
&
SEDIMENT AND EROSION CONTROL PLAN

Prepared for:

BRIAN GRISET

OPEN-SPACE CONDOMINIUM SUBDIVISION

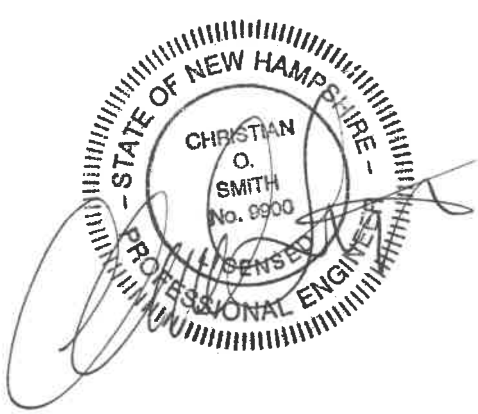
Prepared by:

BEALS ASSOCIATES, *PLLC*
70 PORTSMOUTH AVE.
STRATHAM, NH 03885

Project Number:
NH-1154.1
Tamarind Lane & Cullen Way
Exeter, New Hampshire

January 13, 2020

Revised April 14, 2021



DESIGN METHOD OBJECTIVES

Mr. Griset proposes a 16-unit single family detached condominium development and a single conventional lot on approximately 23.6-acres of land located off of Tamarind Lane & Cullen Way in Exeter, NH. The existing property is located on a parcel (Tax Map 96, Lot 15 consisting of forest, an existing dwelling, a large wet meadow and gravel trails. The proposal (as stated above) includes a 16-unit conservation condominium subdivision with a 20'-24' wide paved private drive ending in a cul-de-sac. The development will include: underground gas, electric, telephone & cable; municipal sewer and water; and Low Impact Development/BMP storm water management and treatment. Proper erosion controls will be proposed where construction could result in sediment transport for the development. A drainage analysis of the proposed development was conducted for the purpose of estimating the peak rate of stormwater run-off and to subsequently design adequate drainage structures. Two models were compiled, one for the area in its existing (pre-construction) condition, and a second for its proposed (post-construction) condition. The analysis was conducted using data for the 2, 10 and 50 Yr – 24 Hr storm events based on the Cornell University Extreme Precipitation tables, using the USDA SCS TR-20 method within the HydroCAD Stormwater Modeling System environment. As Exeter is within the designated "coastal region" by NHDES, all 24-Hr rainfall data was increased by 15% as required. The purpose of this analysis is to estimate the peak rates of run-off from the site for swale adequacy purposes, and to compare the peak rate of run-off between the existing and proposed conditions.

<u>ANALYSIS</u> <u>COMPONENT PEAK RATE of DISCHARGE (CFS)</u>

	2 YR		10 YR		25 YR		50 YR	
	Existing	Proposed	Existing	Proposed	Existing	Proposed	Existing	Proposed
Reach #100	10.42	10.34	16.35	16.25	19.18	19.08	21.88	21.76
Reach #200	3.97	3.95	8.58	8.58	12.15	12.07	16.35	16.15

Channel protection requirements:
Under the 2-year frequency storm event the stormwater volumes are slightly reduced or not increased by more than 0.1 af as shown below.

Analysis Point	2-YR Stormwater Volume	
	Existing	Proposed
Reach 100	2.194 af	2.127 af
Reach 200	0.368 af	0.409 af

The existing property is located on a parcel consisting of forest, trails, open field, wetlands and 1 residential yard with a house structure. The existing topography is such that the site analysis is divided into two subcatchments. The reaches all flow offsite and into a very large wetland complex, which ultimately flows into Scamen Brook, a tributary to Little River.

The proposed 16 unit development includes 1,050'+/- of proposed private roadway ending with a cul-de-sac and intersects Tamarind Lane. This road provides the required access and frontage for the residential units. The proposed layout will divide the parcel into nine different subcatchments. The peak rate of run-off from the proposed development is slightly decreased from that of the existing conditions. The addition of catch basins, culverts, wet ponds, stone weirs direct the treated run off overland to the wetlands. All roadway runoff receives treatment through sediment forebays (deep sump catch basins and the SF in the center of the cul-de-sac), and 2-wet ponds prior to discharge into overland areas and eventually the wetlands. In addition, the potential for increased erosion and sedimentation is handled by way of a stone weirs. The use of Best Management Practices per the NH

Stormwater Manual have been applied to the design of these structures and will be observed during all stages of construction. All land disturbed during construction will be permanently stabilized within 60 days of groundbreaking, and existing wetlands and abutters will suffer no adversity resulting from this development.

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1.0 RAINFALL CHARACTERISTICS

A drainage analysis of the proposed development was conducted for the purpose of estimating the peak rate of stormwater run-off and to subsequently design adequate drainage structures. Two models were compiled, one for the area in its existing (pre-construction) condition, and a second for its proposed (post-construction) condition. The analysis was conducted using data for the 2, 10 and 50 Yr – 24 Hr storm events based on the Cornell University Extreme Precipitation tables, using the USDA SCS TR-20 method within the HydroCAD Stormwater Modeling System environment. As Exeter is within the designated "coastal region" by NHDES, all 24-Hr rainfall data was increased by 15% as required. The purpose of this analysis is to estimate the peak rates of run-off from the site for swale adequacy purposes, and to compare the peak rate of run-off between the existing and proposed conditions.

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2.0 EXISTING CONDITIONS

Reference: Sheet W-1, Existing Conditions Watershed Plan (Enclosed)
Existing Conditions Plans

The existing property is located on a parcel consisting of forest, trails, open field, wetlands and 1 residential yard and house structure. The existing topography is such that the site analysis is divided into two subcatchments. The reaches all flow offsite and into a very large wetland complex, which ultimately flows into Scamen Brook, a tributary to Little River.

Classified by HISS Mapping & SSS mapping, the land within the drainage analysis is composed of slopes ranging from 3% to 15%, and soils categorized into the Hydrologic Soil Groups (HSG) B, C & D.

3.0 PROPOSED CONDITIONS

Reference: W-Sheets Proposed Conditions Watershed Plan (Enclosed)

C Sheets Proposed Conditions Plans

The addition of the impervious area from the paved roadway, and the 16 proposed units cause an increase in the curve number (Cn) and a decrease in the time of concentration (Tc), the net result being a potential increase in peak rates of run-off from the site. The proposed facility divides the site into nine different post-construction subcatchments. The run-off is directed to the wetlands through HydroCAD "reaches" and "ponds". These consist of catch basins, roadway culverts, wet ponds, and stone weirs.

The proposed 16 unit development includes 1,050'+/- of proposed private roadway ending with a cul-de-sac and intersects Tamarind Lane. This road provides the required access and frontage for the residential units. The proposed layout will divide the parcel into nine different subcatchments. The peak rate of run-off from the proposed development is slightly decreased from that of the existing conditions. The addition of catch basins, culverts, wet ponds, stone weirs direct the treated run off overland to the wetlands. All roadway runoff receives treatment through sediment forebays (deep sump catch basins and the SF in the center of the cul-de-sac), and 2-wet ponds prior to discharge into overland areas and eventually the wetlands. In addition, the potential for increased erosion and sedimentation is handled by way of a stone weirs. The use of Best Management Practices per the NH Stormwater Manual have been applied to the design of these structures and will be observed during all stages of construction. All land disturbed during construction will be permanently stabilized within 60 days of groundbreaking, and existing wetlands and abutters will suffer no adversity resulting from this development.

During construction, appropriate BMP's will be applied so as to negate the potential for sediment-laden run-off to discharge into wetlands prior to the final stabilization of the proposed grading. The structures outlined in this proposal provide for adequate treatment of stormwater run-off and for sediment control. Based on the NH Stormwater Manual the wet extended detention ponds provide for 80% removal of total suspended solids, 55% removal of total nitrogen & 68% removal of total phosphorous. These removal efficiencies will be enhanced by the pre-treatment forebay and deep sump catch basins.

Finally, there is a small area of FEMA flood plain that is filled near STA 3+00-3+25 from proposed roadway construction (approximately 1,044 cu.ft.), more flood storage has been provided by construction of wet pond #2 off th3 cul-de-sac (approx. 2,600 cu ft. of storage).

4.0 SEDIMENT & EROSION CONTROL PLANS BEST MANAGEMENT PRACTICES (BMP's)

Reference: C Sheets Proposed Conditions Plan
E Sheet Erosion & Sediment Control Details

The proposed site development is protected from erosion and the roadways and abutting properties are protected from sediment by the use of Best Management Practices as outlined in the NH Stormwater Manual. Any area disturbed by construction will be permanently re-stabilized within 60 days and abutting properties and wetlands will not be adversely affected by this development. All swales and drainage structures will be constructed and stabilized prior to having run-off directed to them.

4.1 Silt Fence / Construction Fence

The plan set demonstrates the location of silt fence for sediment control. In areas where the limits of construction need to be emphasized to operators, construction fence for added visibility will be installed. Sheet E-1, Erosion and Sediment Control Details, has the specifications for installation and maintenance of the silt fence. Orange construction fence will be VISI Perimeter Fence by Conwed Plastic Fencing, or equal. The four-foot fencing to be installed using six-foot posts at least two feet in the ground with spacing of six to eight feet.

4.2 Drainage Swales / Stormwater Conveyance Channels

Drainage swales will be stabilized with vegetation for long term cover as outlined below, and on Sheet E-1 using seed mixture C. As a general rule, velocities in the swale should not exceed 3.0 feet per second for a vegetated swale although velocities as high as 4.5 FPS are allowed under certain soil conditions.

4.3 Vegetated Stabilization

All areas that are disturbed during construction will be stabilized with vegetated material within 30 days of breaking ground. Construction will be managed in such a manner that erosion is prevented and that no abutter's property will be subjected to any siltation, unless otherwise permitted. All areas to be planted with grass for long-term cover will follow the specification and on Sheet E-1 using seeding mixture C, as follows:

Mixture	**Pounds** per Acre	**Pounds per** 1,000 Sq. Ft.
Tall Fescue	20	0.45
Creeping Red Fescue	28	0.65
Total	48	1.10

4.4 Stabilized Construction Entrance

A temporary gravel construction entrance provides an area where mud can be dislodged from tires before the vehicle leaves the construction site to reduce the amount of mud and sediment transported onto paved municipal and state roads. The stone size for the pad should be between 1 and 2-inch coarse aggregate, and the pad itself constructed to a minimum length of 50' for the full width of the access road. The aggregate should be placed at least six inches thick. A plan view and profile are shown on Sheet E1 - Sediment and Erosion Control Detail Plan.

4.5 Level Spreaders

As mentioned above, the proposed site plan includes level spreaders above the filter strip. Level spreaders must be more than six feet in width per the "Best Management Practices for Urban Stormwater Runoff." Level spreaders enable any run-off directed towards them to be spread evenly into sheet flow prior to discharge into wetlands or treatment by a filter strip, thus allowing for better filter strip efficiency and a lesser potential for erosion.

4.6 Filter Strips

Filter strips are areas of land with natural or planted vegetation designed to receive sheet run-off from upgradient development. These natural areas, preferably wooded, are effective in removing sediment and sediment-laden pollutants from such run-off, although their effectiveness is severely diminished when forced to deal with concentrated flow and must therefore be equipped with a level-spreading device. Filter strips should not have a slope exceeding fifteen percent and have a minimum length of seventy-five feet.

4.7 Environmental Dust Control

Dust will be controlled on the site by the use of multiple Best Management Practices. Mulching and temporary seeding will be the first line of protection to be utilized where problems occur. If dust problems are not solved by these applications, the use of water and calcium chloride can be applied. Calcium chloride will be applied at a rate that will keep the surface moist but not cause pollution.

4.8 Construction Sequence

1. Construct and/or install temporary and permanent sediment erosion and detention control facilities (silt fence, vegetated swales, level spreaders, and constructed filter strips), as required. Erosion, sediment and facilities shall be installed and stabilized prior to any earth moving operation, and prior to directing run-off to them.

2. Clear, cut, grub, and dispose of debris in approved facilities.

3. Excavate and stockpile topsoil / loam. All disturbed areas shall be stabilized immediately after grading.

4. Construct the roadway and its associated drainage structures.

5. Begin permanent and temporary seeding and mulching. All cut and fill slopes and disturbed areas shall be seeded and mulched as required, or directed.

6. Daily, or as required, construct temporary berms, drainage ditches, sediment traps, etc. to prevent erosion on the site and prevent any siltation of abutting waters or property.

7. Inspect and maintain all erosion and sediment control measures during construction every two weeks and after every storm event with 0.5" or more rain.

9\. Complete permanent seeding and landscaping.

9\. Remove temporary erosion control measures after seeding areas have established themselves and site improvements are complete. Smooth and re-vegetate all disturbed areas.

10. All swales and drainage structures will be constructed and stabilized prior to having run-off being directed to them.

11. Finish graveling all roadways/parking.

4.9 Temporary Erosion Control Measures

1. The smallest practical area of land shall be exposed at any one time.

2. Erosion, sediment control measures shall be installed as shown on the plans and at locations as required, or directed by the engineer.

3. All disturbed areas shall be returned to original grades and elevations. Disturbed areas shall be loamed with a minimum of 4" of loam and seeded with not less than 1.10 pound of seed per 1,000 square feet (48 pounds per acre) of area.

4. Silt fences and other barriers shall be inspected periodically and after every rainstorm during the life of the project. All damaged areas shall be repaired; sediment deposits shall periodically be removed and properly disposed of.

5. After all disturbed areas have been stabilized, the temporary erosion control measures are to be removed and the area disturbed by the removal smoothed and revegetated.

6. Areas must be seeded and mulched within 5 days of final grading, permanently stabilized within 15 days of final grading, or temporarily stabilized within 30 days of initial disturbance of soil.

4.11 Inspection and Maintenance Schedule

Fencing will be inspected during and after storm events to ensure that the fence still has integrity and is not allowing sediment to pass. Sediment build-up in ponds and CB's. shall be removed if it is deeper than six inches.

5.0 CONCLUSION

This proposed development off Tamarind Lane in Exeter, NH will have no adverse effect on the abutting property owners by way of storm water run-off or siltation. The post-construction peak rate of run-off for the site has been decreased from that of the existing conditions and roadway run-off will treatment by either constructed or natural methods. Appropriate steps will be taken to eliminate erosion and sedimentation; these will be accomplished through the construction of a drainage system consisting of catch basins, culverts, wet ponds, stone weirs. The Best Management Practices developed by the State of New Hampshire have been utilized in the design of this system and these applications will be enforced throughout the construction process.

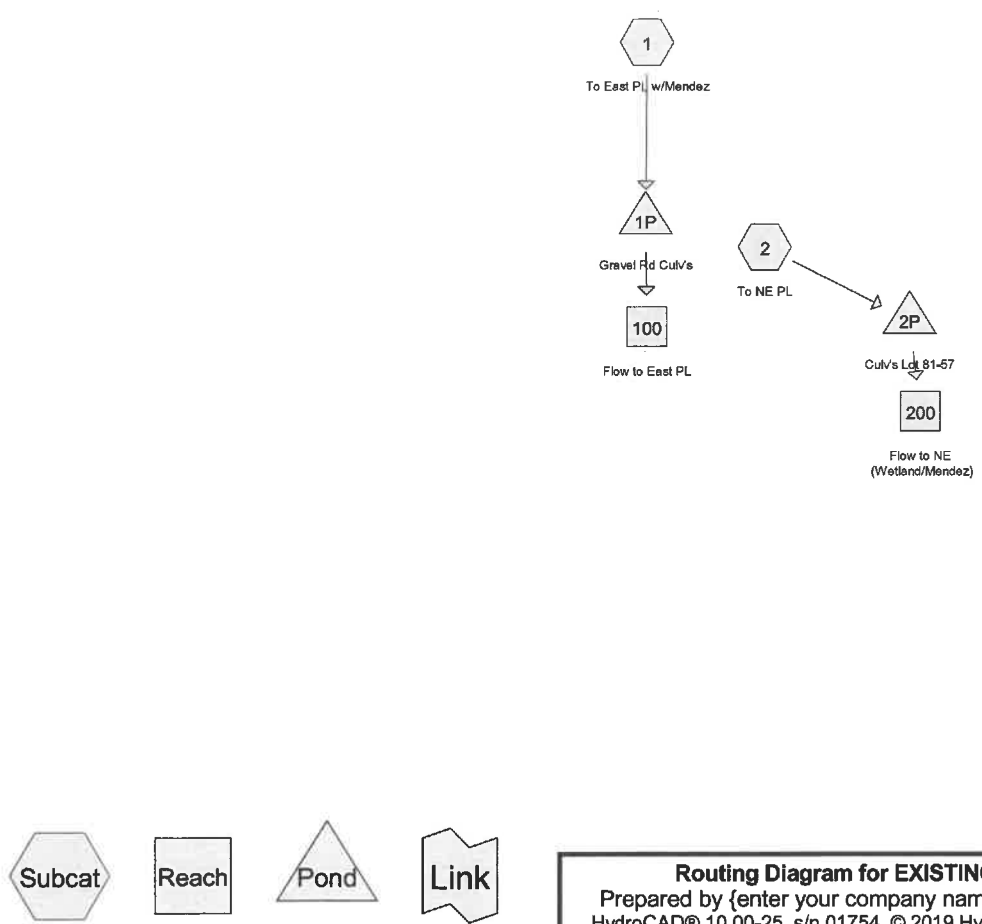
A Site Specific, Terrain Alteration Permit (RSA 485: A-17) is required for this project due to the area of disturbance being greater than 100,000 square feet.

Respectfully Submitted,

BEALS ASSOCIATES, *PLLC.*

Christian O. Smith

Christian O. Smith, PE
Principal



Routing Diagram for EXISTING 1-2020. edit 2hcp
Prepared by {enter your company name here}, Printed 4/14/2021
HydroCAD® 10.00-25 s/n 01754 © 2019 HydroCAD Software Solutions LLC

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 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

Subcatchment 1: To East PL w/Mendez Runoff Area=835,559 sf 6.40% Impervious Runoff Depth=4.05"
Flow Length=1,206' Tc=31.8 min CN=74 Runoff=50.10 cfs 6.475 af

Subcatchment 2: To NE PL Runoff Area=142,623 sf 5.70% Impervious Runoff Depth=4.05"
Flow Length=575' Tc=13.8 min CN=74 Runoff=12.16 cfs 1.105 af

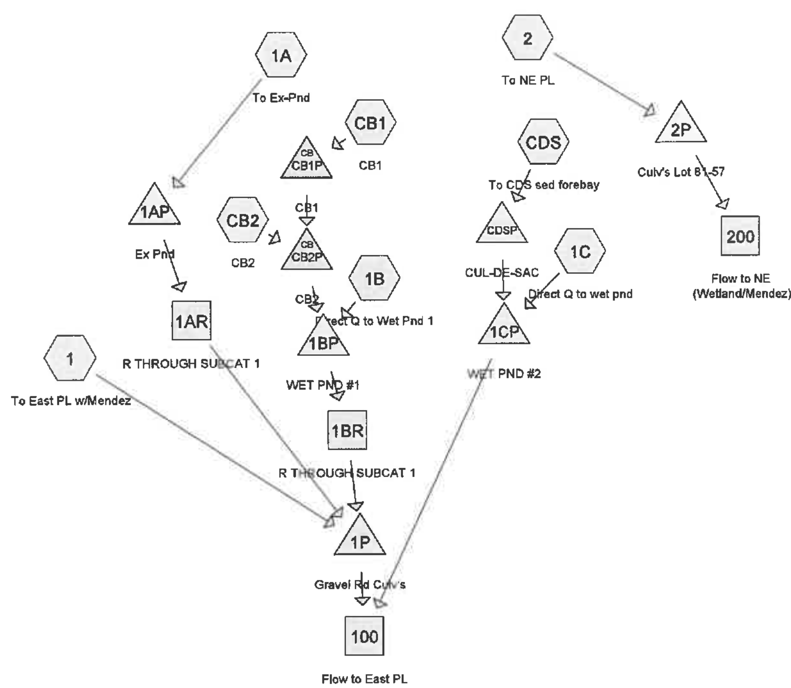
Reach 100: Flow to East PL Inflow=19.18 cfs 6.475 af
Outflow=19.18 cfs 6.475 af

Reach 200: Flow to NE (Wetland/Mendez) Inflow=12.15 cfs 1.099 af
Outflow=12.15 cfs 1.099 af

Pond 1P: Gravel Rd Culv's Peak Elev=31.09' Storage=78,580 cf Inflow=50.10 cfs 6.475 af
Outflow=19.18 cfs 6.475 af

Pond 2P: Culv's Lot 81-57 Peak Elev=31.69' Storage=1,045 cf Inflow=12.16 cfs 1.105 af
Primary=1.95 cfs 0.686 af Secondary=10.20 cfs 0.413 af Outflow=12.15 cfs 1.099 af

Total Runoff Area = 22.456 ac Runoff Volume = 7.580 af Average Runoff Depth = 4.05"
93.70% Pervious = 21.042 ac 6.30% Impervious = 1.414 ac



Subcat Reach Pond Link

Routing Diagram for PROPOSED 1-2020edit 2
Prepared by {enter your company name here}, Printed 4/14/2021
HydroCAD® 10.00-25 s/n 01754 © 2019 HydroCAD Software Solutions LLC

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 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

Subcatchment 1: To East PL w/Mendez Runoff Area=542,899 sf 3.08% Impervious Runoff Depth=3.94"
Flow Length=770' Tc=31.8 min CN=73 Runoff=31.69 cfs 4.096 af

Subcatchment 1A: To Ex-Pnd Runoff Area=215,168 sf 23.04% Impervious Runoff Depth=4.59"
Flow Length=588' Tc=13.2 min CN=79 Runoff=21.01 cfs 1.891 af

Subcatchment 1B: Direct Q to Wet Pnd 1 Runoff Area=4,837 sf 0.45% Impervious Runoff Depth=4.05"
Tc=6.0 min CN=74 Runoff=0.53 cfs 0.037 af

Subcatchment 1C: Direct Q to wet pnd Runoff Area=5,796 sf 31.82% Impervious Runoff Depth=4.93"
Tc=6.0 min CN=82 Runoff=0.76 cfs 0.055 af

Subcatchment 2: To NE PL Runoff Area=150,983 sf 9.78% Impervious Runoff Depth=4.16"
Flow Length=645' Tc=17.4 min CN=75 Runoff=12.08 cfs 1.201 af

Subcatchment CB1: CB1 Runoff Area=23,639 sf 53.61% Impervious Runoff Depth=5.49"
Flow Length=415' Tc=8.7 min CN=87 Runoff=3.07 cfs 0.248 af

Subcatchment CB2: CB2 Runoff Area=7,055 sf 100.00% Impervious Runoff Depth=6.77"
Tc=6.0 min CN=98 Runoff=1.11 cfs 0.091 af

Subcatchment CDS: To CDS sed forebay Runoff Area=27,826 sf 22.43% Impervious Runoff Depth=4.59"
Flow Length=254' Tc=7.9 min CN=79 Runoff=3.20 cfs 0.245 af

Reach 1AR: R THROUGH SUBCAT 1 Avg. Flow Depth=0.38' Max Vel=1.43 fps Inflow=9.49 cfs 1.890 af
n=0.030 L=680.0' S=0.0053 '/' Capacity=17.32 cfs Outflow=9.35 cfs 1.890 af

Reach 1BR: R THROUGH SUBCAT 1 Avg. Flow Depth=0.22' Max Vel=1.13 fps Inflow=4.19 cfs 0.360 af
n=0.030 L=701.0' S=0.0068 '/' Capacity=19.59 cfs Outflow=3.24 cfs 0.360 af

Reach 100: Flow to East PL Inflow=19.08 cfs 6.646 af
Outflow=19.08 cfs 6.646 af

Reach 200: Flow to NE (Wetland/Mendez) Inflow=12.07 cfs 1.194 af
Outflow=12.07 cfs 1.194 af

Pond 1AP: Ex Pnd Peak Elev=35.18' Storage=18,900 cf Inflow=21.01 cfs 1.891 af
12.0" Round Culvert x 2.00 n=0.013 L=41.0' S=0.0122 '/' Outflow=9.49 cfs 1.890 af

Pond 1BP: WET PND #1 Peak Elev=33.60' Storage=8,832 cf Inflow=4.63 cfs 0.377 af
Outflow=4.19 cfs 0.360 af

Pond 1CP: WET PND #2 Peak Elev=31.70' Storage=3,749 cf Inflow=2.21 cfs 0.299 af
Outflow=2.17 cfs 0.299 af

Pond 1P: Gravel Rd Culv's Peak Elev=31.02' Storage=70,063 cf Inflow=43.07 cfs 6.347 af
Outflow=18.60 cfs 6.347 af

Pond 2P: Culv's Lot 81-57 Peak Elev=31.69' Storage=1,044 cf Inflow=12.08 cfs 1.201 af
Primary=1.94 cfs 0.730 af Secondary=10.13 cfs 0.464 af Outflow=12.07 cfs 1.194 af

Pond CB1P: CB1 Peak Elev=35.95' Inflow=3.07 cfs 0.248 af
12.0" Round Culvert n=0.013 L=16.0' S=0.0100 '/' Outflow=3.07 cfs 0.248 af

Pond CB2P: CB2 Peak Elev=35.11' Inflow=4.11 cfs 0.340 af
12.0" Round Culvert n=0.013 L=31.0' S=0.0100 '/' Outflow=4.11 cfs 0.340 af

Pond CDSP: CUL-DE-SAC Peak Elev=37.40' Storage=2,660 cf Inflow=3.20 cfs 0.245 af
8.0" Round Culvert n=0.013 L=163.0' S=0.0245 '/' Outflow=1.73 cfs 0.245 af

Total Runoff Area = 22.456 ac Runoff Volume = 7.864 af Average Runoff Depth = 4.20"
88.87% Pervious = 19.957 ac 11.13% Impervious = 2.500 ac

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points x 3
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