DESIGN METHOD OBJECTIVES

J & L Terra Holdings, Inc. proposes an 80-unit residential condominium development on approximately 21+-acres of land located off Route 9 in Barrington, NH. A drainage analysis of the area (including 2-offsite subcatchments) was conducted for the purpose of estimating the peak rate of stormwater run-off and to subsequently design adequate drainage structures. It should be noted that all roof runoff from the newly proposed buildings will be required to be infiltrated by stone trench drip edges. 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 & 50 Yr – 24 Hr storm event using the USDA SCS TR-20 method within the HydroCAD Stormwater Modeling System environment. Rainfall data is based on the Extreme Precipitation Tables as published by the Northeast Regional Climate Center of Cornell University. 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.

METHODOLOGY

Modeling consists of identifying all surface water flow paths that drain to, across and from the property as applicable. The "watershed area", is divided into discrete subcatchments based on natural drainage patterns. HydroCAD models each drainage structure and subcatchment as an individual interconnected node. Subcatchment nodes are modeled as individual watersheds with unique physical characteristics consisting of surface area, surface condition, overland flow lengths and associated land slope. Appropriate input parameters were determined through field observation, and analysis of field surveyed AutoCAD drawings. Rainfall distribution and depth are standardized inputs, based on geographic location. The Time-of-Concentration, or Tc, is the time required for runoff to travel from the most hydrologically distant point of the subcatchment to the point of collection. The time of concentration (Tc) is determined by summing the travel time (Tt) for each consecutive flow segment along the subcatchment's hydraulic path. This process requires identification of the type of flow occurring in each segment, and application of the appropriate method for calculating the Tc. For sheet flow segments, no longer than 50' is used in the analysis though shorter lengths are used where logical (transition of ground cover e.g. paved to grass, etc.) Tc values for subcatchments that resulted in less than 6-minutes/inch were direct input at 6-minutes as is standard practice. Subcatchment area take-offs are broken out by ground cover type and hydrologic soil group. Each unique area within a subcatchment is given a runoff curve number (CN) and the areas are summed to result in a weighted CN for the overall subcat. As a single roof runoff/infiltration Subcat & pond have demonstrated that the 3' wide x 4.5' deep stone trenches will handle the entire roof runoff for the 50-YR storm without overtopping, the remaining building areas have been eliminated from the model which is the reason the overall area in the proposed model is slightly less than that of the existing.

ANALYSIS	COMPONENT PEAK RATE of DISCHARGE (CFS)					
	2 YR		10 YR		50YR	
	Existing	Proposed	Existing	Proposed	Existing	Proposed
Reach #100	1.08	1.05	6.63	6.52	20.23	20.13
Reach #200	0.00	0.00	0.01	0.01	0.26	0.26

ANALYSIS	COMPONENT VOLUME (AF)	
	2 YR	
	Existing	Proposed
Reach #100	0.327	0.325
Reach #200	0.000	0.000

The existing property is located on a parcel consisting of an existing dwelling, agricultural fields, excavated and natural wetlands, and forested areas. The existing topography is such that the site analysis is divided into three subcatchments. These reaches flow offsite to culverts/swales in the Salmon Falls ROW, southeast to an adjacent parcel, and finally southwest to a very large wetland complex that is the remaining acreage of the parent parcel.

The proposed development includes 1,750 l.f. of proposed 20' wide paved road to serve the new units, underground utilities, onsite well & septic systems, fire suppression, and drainage structures. The proposed layout results in twenty different subcatchments. The overall storm water volume from the site is reduced or equal to existing at both analysis points under the 2-YR storm event. The peak rate of run-off from the proposed development is equal to or decreased from that of the existing conditions at all analysis points. The addition of swales, culverts, bioretention ponds, a wet pond and deep sump catch basins maintain the existing drainage patterns and surface water hydrology to the extent possible. Impervious area runoff receives treatment through bioretention pond and wet pond prior to release toward the analysis points. The proposed bioretention ponds provide for reducing potential pollutants in storm water by: 99% of total suspended solids; 58+% of total petroleum hydrocarbons in the diesel range; 99+% of total zinc; 29% of Dissolved inorganic Nitrogen, and 5+% of total phosphorous. Pre-treatment will be provided by deep sump catch basins and sediment forebays upstream of the ponds. The use of Best Management Practices per the NH Stormwater Manual has 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 abutting property owners will suffer no adversity resulting from this development.

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Design Method Objectives

USGS Quadrangle

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5.0	Conclusion	Page 5

Appendix I - Existing Conditions Analysis

Existing Conditions Analysis
Summary 2 YR - 24 HR rainfall = 3.08"
Complete 10 YR - 24 HR rainfall = 4.64"
Summary 50 YR - 24 HR rainfall = 7.00"
Sheet W-1 Existing Conditions Watershed Plan

Appendix II - Proposed Conditions Analysis

Proposed Conditions Analysis
Summary 2 YR - 24 HR rainfall = 3.08"
Complete 10 YR - 24 HR rainfall = 4.64"
Summary 50 YR - 24 HR rainfall = 7.00"
Sheet W-2 Proposed Conditions Watershed Plan

Appendix III - Charts, Graphs, and Calculations

1.0 RAINFALL CHARACTERISTICS

This drainage report includes an existing conditions analysis of the area involved in the proposed development, as well as proposed conditions, or post-construction analysis of the same location. These analyses were accomplished using the USDA SCS TR-20 Method within the HydroCAD Stormwater Modeling System. The curve numbers were developed using the SCS TR-55 Runoff Curve numbers for Urban Areas. A Type III SCS 24-hour rainfall distribution was utilized in analyzing the data for the 2, 10 & 50 Yr. – 24 Hr. storm events. 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.

ANALYSIS	COMPONENT PEAK RATE of DISCHARGE (CFS)					
	2 YR		10 YR		50YR	
	Existing	Proposed	Existing	Proposed	Existing	Proposed
Reach #100	1.08	1.05	6.63	6.52	20.23	20.13
Reach #200	0.00	0.00	0.01	0.01	0.26	0.26

ANALYSIS	COMPONENT VOLUME (AF)	
	2 YR	
	Existing	Proposed
Reach #100	0.327	0.325
Reach #200	0.000	0.000

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 forested woodlands, woods roads, and natural wetland areas. The existing topography is such that the site analysis is divided into four subcatchments. These reaches flow offsite to the wetland onsite southeast to an adjacent parcel, and ultimately southwest to a large wetland complex that drains into the Mallego Brook.

Classified by SSS Mapping, the land within the drainage analysis is composed of slopes ranging from 0% to 15%, and soils categorized into the Hydrologic Soil Groups (HSG) A, B, C & D. All development is within HSG B soils.

3.0 PROPOSED CONDITIONS

Reference: W-Sheets Proposed Conditions Watershed Plans (Enclosed)
C Sheets Proposed Conditions Plans

The addition of the impervious area from the proposed road, and individual lot development can 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 layout results in twenty different subcatchments. The run-off is directed to swales, catch basins, a bioretention pond and a wet pond modeled through HydroCAD reaches" and "ponds.

The proposed development includes 1,750 l.f. of proposed 20' wide paved road to serve the new units, underground utilities, onsite well & septic systems, fire suppression, and drainage structures. The proposed layout results in twenty different subcatchments. The overall storm water volume from the site is reduced or equal to existing at both analysis points under the 2-YR storm event. The peak rate of run-off from the proposed development is equal to or decreased from that of the existing conditions at all analysis points. The addition of swales, culverts, bioretention ponds, a wet pond and deep sump catch basins maintain the existing drainage patterns and surface water hydrology to the extent possible. Impervious area runoff receives treatment through bioretention pond and wet pond prior to release toward the analysis points. The proposed bioretention ponds provide for reducing potential pollutants in storm water by: 99% of total suspended solids; 58+% of total petroleum hydrocarbons in the diesel range; 99+% of total zinc; 29% of Dissolved inorganic Nitrogen, and 5+% of total phosphorous. Pre-treatment will be provided by deep sump catch basins and sediment forebays upstream of the ponds. The use of Best Management Practices per the NH Stormwater Manual has 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 abutting property owners will suffer no adversity resulting from this development.

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

Reference: P 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 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 or Compost Berm

The plan set demonstrates the location of silt fence or compost berm 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 60 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. 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. Mud and sediment should not be transported onto paved municipal and state roads. If mud and sediment becomes excessive, the Contractor shall be responsible for regular sweeping. 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 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.

4.6 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.

8. 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.

4.7 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.

4.8 Inspection and Maintenance Schedule

1. 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 swales will be removed if it is deeper than six inches.

2. Gravel wetland systems should be inspected at least twice per year and following any rain event of 2.5" or greater in a 24-hr period. Inspect soil and repair eroded areas monthly, & re-mulch void areas as needed. Remove litter and debris at least twice per year. Treat diseased vegetation as needed. Remove and replace dead vegetation twice per year (spring and fall.) Proper selection of plant species and support during establishment of vegetation should minimize—if not eliminate—the need for fertilizers and pesticides. Remove invasive species as needed to prevent these species from spreading into the bioretention area. Replace mulch every two years, in the early spring. Upon failure, excavate bioretention area, scarify bottom and sides, replace filter fabric and soil, replant, and mulch.

3. Deep sump catch basins shall be inspected monthly and cleaned per manufacturer recommendations. At least twice per year and after each storm in excess of 0.5"of rain, sediment should be removed from trapping devices when it has reached one half of the depth of the trap.

4. Inlets should be inspected annually and after every major storm. Accumulated debris and sediment should be removed as needed; Pipes should be inspected and repaired as necessary.

5. Outlets should be inspected annually and after every major storm. The condition of pipes should be noted and repaired as needed. If erosion is taking place, then measures should be taken to stabilize and protect the affected area.

5.0 CONCLUSION

This proposed development off Route 9 in Barrington, 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 from the site toward abutting parcels will be decreased from that of the existing conditions and impervious run-off flow will be treated appropriately prior to discharge. Appropriate steps will be taken to eliminate erosion and sedimentation; these will be accomplished through the construction of a drainage system consisting of swales, catch basins and BMP treatment ponds. 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, PE
Principal