The LA GROUP
Landscape Architecture & Engineering P.C.

40 Long Alley
Saratoga Springs
NY 12866

p: 518-587-8100
f: 518-587-0180
www.thelagroup.com

Stormwater Management Report

for:

Terramor Catskills
at
Catskills-Woodstock Road
Catskills, NY 12477
Ulster County

Owner/Operator(s):

Terramor Outdoor Resort
550N 31st Street
Billings, MT 59101
Contact: Ahmed Helmi
(202) 689-7771

SWM Report Contact(s):

The LA Group, PC
40 Long Alley
Saratoga Springs, NY 12866
1-518-587-8100
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Table of Contents

Attachment

A Soil Investigations
Soil Survey
Natural Resource Map

B Existing Conditions Watershed Map and HydroCAD Calculations

C Proposed Conditions Watershed Map, HydroCAD Calculations

D Storm Data

1.0 INTRODUCTION

The following is a Stormwater Management Report (SWM Report) developed for the Operator, Terramor Outdoor Resort, Terramor Catskills, herein referred to as the "Project." It is prepared in accordance with the New York State Department of Environmental Conservation (NYSDEC) Stormwater Management Design Manual, dated January 2015.

The Project has been designed in accordance with Chapter 4 of the NYSDEC Stormwater Management Design Manual (SWMDM), and NYSDEC's General Permit GP-0-20-001 for construction activities. Stormwater calculations were performed utilizing widely accepted engineering methodologies, including TR-55, and the stormwater modeling computer program HydroCAD (version 10.00) produced by HydroCAD Software Solutions, LLC.

2.0 PROJECT DESCRIPTION

2.1 Site Location

The Project is located off Saugerties-Woodstock Road (NYS RT-212), Ulster County, NY 12477. Access to the site is off Saugerties-Woodstock Road.

2.2 Project Description

The Project includes the construction of a camping facility. The remainder of the proposed site improvements includes construction of a main access road, site lighting, landscaping, stormwater controls, and water and sewer infrastructure. The Project Site represents the area that will be disturbed as a result of the Project. The project is considered new development project per Chapter 4 of the SWMDM. The Project Site represents the area that will be disturbed as a result of the Project.

2.3 Soil Conditions/Soil Testing

According to the Natural Resources Conservation Service (NRCS) Web Soil Survey, the area including and surrounding the Project Site is comprised Arnot channery silt loam, Castile gravelly loam, Morris-Tuller-Rock outcrop complex, Oquaga-Arnot Rock Outcrop, Atherton silt loam, and Tunkhannock gravelly loam. The hydrological soil group (HSG) classifications are 'D' except for Tunkhannock which has a HSG of 'A'.

Test pits and percolations tests were completed by Dente Engineering in August 2017 as part of a pervious proposed development on the property. Results of the tests are provided in Attachment A of the Stormwater Management Report (Appendix B).

2.4 Curve Numbers and Rainfall Data

The surface cover for the project area is grass, woods and an impervious driveway/buildings. The curve numbers utilized in the modeling were assigned based on cover type and HSG soil classification.

The design storms used for the pre-development versus post-development comparison were the 1, 10, and 100-year, 24-hour duration, SCS Type II events. The rainfall amounts for these storms are 2.50, 4.40, and 8.00 inches, respectively.

3.0 EXISTING CONDITIONS

The Project area existing condition, for which this stormwater management plan is based, consists of undeveloped woodlands. Under the watershed's existing condition, runoff from the site flows to existing wetlands onsite (Analysis Points 1-4). Analysis Points 1-4 were utilized in comparing all pre- versus post-runoff conditions. Refer to drawing "W-1 Existing Conditions Watershed Map," located in Attachment B for more information.

Table 3-1 below provides a summary of the existing conditions peak discharge rates for the Project's watershed.

Table 3-1
Existing Conditions Peak Discharge Rates

Analysis Point	AP-1	AP-2	AP-3	AP-4
Design Storm	(cfs)	(cfs)	(cfs)	(cfs)
10-Year	53.18	95.40	33.50	13.72
100-Year	132.48	246.99	82.66	33.64

Refer to Attachment B for more information on the existing conditions watershed modeling.

4.0 PROPOSED CONDITIONS

Under the watershed's Proposed Condition, stormwater from the Project will continue to discharge to the same points as in the Existing Condition (Analysis Points 1-4). The total watershed has generally remained unchanged, as is shown on the drawing "W-2 Proposed Conditions Watershed Map" contained in Attachment C. To meet NYSDEC requirements (see Section 5.0 NYSDEC Design Criteria of this report) pocket ponds and bioretention basins have been incorporated into the stormwater management design to mitigate the quality and quantity of stormwater runoff discharged from the Project Site.

Table 4-1 below provides a summary of the existing conditions versus proposed conditions peak discharge rates for the Project's watershed.

Table 4-1
Existing Conditions Versus Proposed Conditions Peak Discharge Rates

Analysis Point	AP-1		AP-2		AP-3		AP-4	
	Existing	Proposed	Existing	Proposed	Existing	Proposed	Existing	Proposed
Design Storm	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
10-Year	53.18	52.94	95.40	85.28	33.50	33.44	13.72	13.72
100-Year	132.48	131.47	246.99	246.96	82.66	80.59	33.64	33.64

Refer to Attachment C for more information on the proposed conditions watershed modeling.

5.0 NYSDEC DESIGN CRITERIA

The New York State Stormwater Management Design Manual, dated January 2015 (The Manual) has been utilized to develop the stormwater management plan. The Manual includes a five-step process that involves site planning and stormwater management practice selection. The five steps include;

- Site planning to preserve natural features and reduce impervious cover,
- Calculation of the Water Quality Volume (WQv) for the Site,
- Incorporation of green infrastructure techniques and standard SMPs with Runoff Reduction Volume (RRv) capacity,
- Use of standard SMPs where applicable, to treat the portion of WQv not addressed by green infrastructure techniques and standard SMPs with RRv capacity, and
- Design of volume and peak rate control (where required)

The approach of the stormwater management plan was to address the stormwater requirements separately. The five steps were reduced to Site Planning to Preserve Natural Features, Water Quality Volume, Runoff Reduction Volume, Channel Protection Volume, and Overbank Flood and Extreme Storm Attenuation, as discussed in the following sections.

Attachment D of this report contains detailed calculations for determining and summarizing the required and provided volumes for Water Quality and Runoff Reduction. In general, the required design criteria (WQv and RRv) were calculated for all areas where site disturbance or green infrastructure techniques are proposed.

5.1 Site Planning to Preserve Natural Features

Within Chapter 3 of The Manual, Table 3.1 Green Infrastructure Planning General Categories and Specific Practices includes a list of planning practices utilized in the planning and design of a project. There are two categories, Preservation of Natural Resources and Reduction of Imperious Cover.

Preservation of Natural Resources includes:

- Preservation of Undisturbed Areas
- Preservation of Buffers
- Reduction of Clearing and Grading
- Locating Development in Less Sensitive Areas
- Open Space Design
- Soil Restoration

Reduction of Impervious Cover includes:

- Roadway Reduction
- Sidewalk Reduction
- Driveway Reduction
- Cul-de-sac Reduction
- Building Footprint Reduction
- Parking Reduction

A Natural Resource Map for Green Infrastructure Planning has been developed which indicates natural resource areas and critical environmental areas to be protected (where feasible). As required in Section 3.6 of The Manual, the map includes (where applicable):

- Jurisdictional Wetlands
  - There are Army Corp jurisdictional wetlands located on the project site. The project has been designed to limit wetland impact
- Waterways
  - No waterways are impacted by the Project.
- Wetland Adjacent Area
  - There are no NYSDEC jurisdictional wetlands and associated buffers located on the project site.
- Floodplains
  - The project is not within the flood plain.
- Forest, vegetative cover
  - Project is designed to maintain as much of the woods as feasible.
- Topography/Steep slopes

  - There are steep slopes located throughout the project. The project has been designed to minimize development of these areas.
- Existing soils, including hydrologic soil groups and soil erodibility
  - See Section 2.3 of this Report.
- Drainage Patterns
  - See Section 3.0 of this Report.
- Bedrock/Significant geological features
  - See Section 2.3 of this Report.

The Natural Resource Plan indicates the areas to be avoided and depicts the area most suitable for development.

5.2 Water Quality Volume (WQv)

The Water Quality Volume (WQv) requirement is designed to improve water quality sizing to capture and treat 90% of the average annual stormwater runoff volumes. The WQv is directly related to the amount of impervious cover created at a site. The following equation is used to determine the water quality storage volume.

$$WQv = \frac{(P)(Rv)(A)}{12}$$

Where:

WQv = Water quality volume (acre/feet)
P = 90% Rainfall Event (1.60" for Catskills)
Rv = 0.05 + 0.009(I) where I is percent impervious cover
A = Site area in acres

The required WQv will be provided by pocket ponds, porous asphalt and a bioretention basin designed in accordance with the SWMDM. The total required WQv for the project is 0.629 ac-ft. Refer to Table 5-1 for a summary of the provided water quality volumes for the Project.

Table 5-1
Water Quality Volume (WQv) Summary

SMP	Type	Provided
		(ac-ft)
SMP1	Pocket Pond	0.033
SMP2	Pocket Pond	0.057
SMP3	Porous Pavement	0.055
SMP4	Pocket Pond	0.201
SMP5	Pocket Pond	0.168

SMP6	Porous Pavement	0.024
SMP7	Porous Pavement	0.020
SMP8	Pocket Pond	0.022
SMP9	Bioretention Basin	0.081
TOTAL		**0.661**

Refer to Attachment D for detailed WQv calculations.

5.3 Runoff Reduction Volume (RRv)

Section 4.3 of the Manual states, "Runoff reduction shall be achieved by infiltration, groundwater recharge, reuse, recycle, evaporation/evapotranspiration of 100 percent of the post-development water quality volumes to replicate pre-development hydrology by maintaining pre-construction infiltration, peak runoff flow, discharge volume, as well as minimizing concentrated flow by using runoff control techniques to provide treatment in a distributed manner before runoff reaches the collection system."

The Project does not achieve 100% runoff reduction of the on-site WQv of the project due to poor soils and shallow depths to groundwater. Utilizing green infrastructure and stormwater management practices with RRv capabilities throughout the project an RRv of 0.142 acre-feet is provided which is greater than the minimum required RRv of 0.132 acre-feet. See Table 5-2 for a summary of the provided runoff reduction volumes for each green infrastructure practice.

Table 5-2
Runoff Reduction Volume (RRv) Summary

SMP	**Provided**
	(unit)
5.3.1 Conservation of Natural Areas	-
5.3.2 Sheetflow to Riparian Buffers/Filter Strips	-
5.3.3 Vegetated Open Swales	-
5.3.4 Tree Planting/Tree Box	-
5.3.5 Disconnection of Rooftop Runoff	-
5.3.6 Stream Daylighting	-
5.3.7 Rain Garden	-
5.3.8 Green Roof	-
5.3.9 Stormwater Planters	-
5.3.10 Rain Tanks/Cisterns	-

5.3.11 Porous Pavement	0.099
Bioretention Basin (SMP-9)	0.043
TOTAL	**0.142 (ac-ft)**

Refer to Attachment D for detailed RRv calculations.

5.4 Channel Protection Volume (CPv)

The channel protection volume is reduced using green infrastructure practices (bioretention basins).

5.5 Overbank Flood (Qp) and Extreme Flood (Qf) Attenuation

The primary purpose of the Overbank Flood (Qp) control sizing criterion is to prevent an increase in the frequency and magnitude of out-of-bank flooding generated by urban development. It requires storage and attenuation of the 10-year, 24-hour storm to ensure post-development peak discharge rates do not exceed the pre-development condition.

The intent of the Extreme Flood (Qf) criteria is to (a) prevent the increased risk of flood damage from large storm events, (b) maintain the boundaries of the pre-development 100-year floodplain, and (c) protect the physical integrity of stormwater management practices. It requires storage and attenuation of the 100-year, 24-hour storm to ensure post-development peak discharge rates do not exceed the pre-development condition.

During the 10-year and 100-year 24-hour storm the post-development peak discharge rates do not exceed the pre-development rates. See Table 4-1 of this Report for detailed comparison of pre- and post-development peak rates.

6.0 PROPOSED STORMWATER FACILITIES

The Project is proposing the installation of pocket ponds and bioretention basins throughout the site to treat runoff for the asphalt roads and parking lots. The walking paths, tent sites will not be impervious surfaces and therefore do not require stormwater treatment.

6.1 Pretreatment

Pretreatment of runoff contributing to all stormwater management practices will be provided through the installation of sediment forebays.

6.2 Treatment

Treatment for runoff entering the pocket ponds will be treated within the permanent pool of the ponds. Treatment in the bioretention basin is provided by capturing and treating the entire WQv though infiltration into the bioretention soils.

7.0 POST-CONSTRUCTION MAINTENANCE REQUIREMENTS

Terramor Outdoor Resorts will be responsible for the continuous upkeep and maintenance of all stormwater management facilities. Maintenance includes, but is not limited to, cleaning of sediment from drainage inlet sumps, removal of sediment from SMPs, cleaning conveyance piping and channels of obstructions, inspection and repair as required of any outlet control mechanisms, and repairing any other detriments in the design that is resulting in the facilities to not function as intended in the design.

7.0 REFERENCES

1. Urban Hydrology for Small Watersheds. Published by the U.S. Soil Conservation Service, Washington, D.C., June 1986.
2. HydroCAD 10.00 Computer Program, by HydroCAD Software Solutions, LLC.
3. NYSDEC Stormwater Management Design Manual. Published by the New York State Department of Environmental Conservation, Updated January 2015.

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