Livermore, NH Resort Development and Dam Design Feasibility Project

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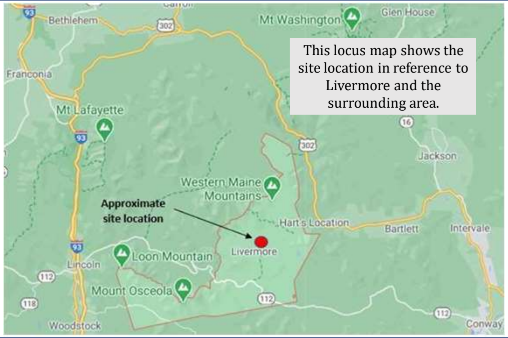
Introduction

BACKGROUND:

Livermore, NH is a town in the White Mountain National Forest. It was sustained by the logging industry until flooding in the 1920s deemed it economically unsustainable and it became a ghost town.

The overall objective of the project was to ***analyze the technical feasibility of developing a ski resort in the White Mountain National Forest in Livermore, NH, in which the construction of a dam on the Sawyer River will take place to impound a 35-foot-deep lake as the centerpiece of the development.***

There are four overall areas of the project being hydrology and hydraulics, geotechnical, roadway, and site development.



This locus map shows the site location in reference to Livermore and the surrounding area.

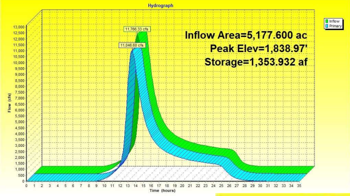
Hydrology and Hydraulics

Hydrology and hydraulics are dependent on each other and consisted of information gathering, spill way design, and a breach analysis.

COMPUTED INFORMATION

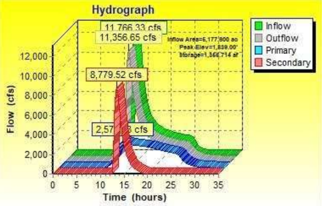
- Watershed area = 8.06 square miles
- Curve number estimation = 68
- Time of concentration = 1.606 hours
- Impoundment storage = 60 million cubic feet
- Design flood = 10,448 cfs = 2.5x100 year storm

Based on the design flood, a weir and and Orifice outlet structure were modeled in HydroCAD.



The weir was modeled as a 185-foot-long sharp crested weir. It was designed for the peak elevation of water to remain one foot below the dam crest. The hydrograph to the left shows the design flows.

The orifice requires 3 total structures, 2 primary outlet structures to handle flows up the 25-year storm and a secondary 330-foot-long weir as the auxiliary spillway for the design flood. The hydrograph to the right shows the design flood flows.

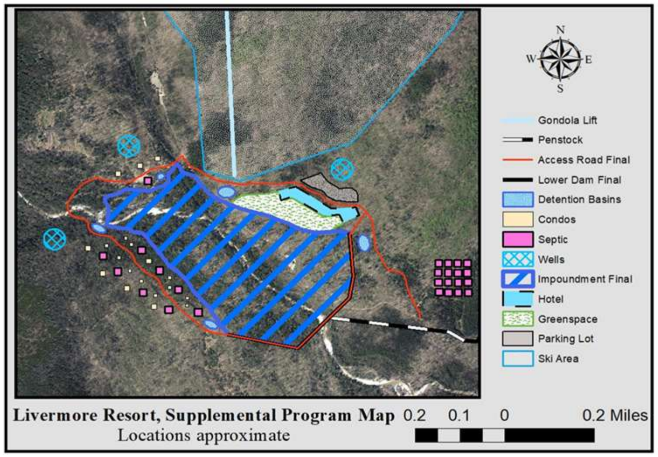


Site Design

The site design is based on New Hampshire regulations. Stormwater calculations, water usage requirements, wastewater requirements, and pumping requirements were analyzed.

SITE PLAN INFORMATION:

- Total stormwater runoff volume to detention basins = 8.122 acre feet
- Total leach field area = 178,000 s.f.
- Alternative option to leach fields: Package system - acts as a miniature water treatment plant. Requires more maintenance.
- Total water flow supplied by wells = 61,450 GPD
- Alternative option to well supply: Treat impoundment water.

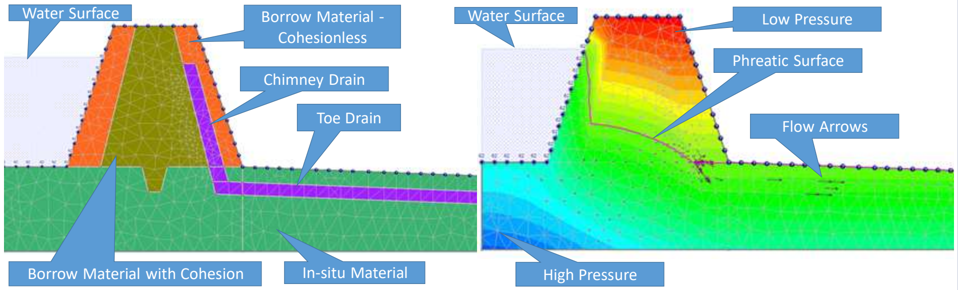


PUMPING: Pumping for snow making: Total water volume = 4,050,000 cubic feet; Elevation head = 860 feet. This can be achieved by the industry standard vertical turbine pump by Flowserve.

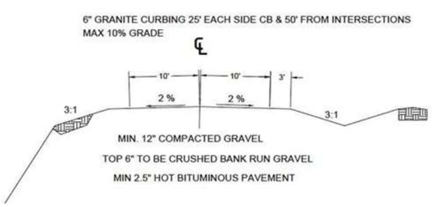
Pumping for Fire Flow: Option 1: use a pump to achieve the fire flow of 1,250 gpm. Option 2: use a smaller pump to a water tower. This requires water to be pumped 250 feet in elevation from the impoundment elevation. A system curve will be used to specify the pump. Energy losses were calculated with Darcy-Weisbach energy equation.

Geotechnical

The geotechnical tasks for the dam consisted of calculating material properties for the in-situ material at the location of the dam based on boring logs as well as from borrow pit material to design a dam cross section through an iterative process in Rocscience as seen below.



Roadway



Typical roadway cross section based on Lincoln, NH Subdivision Regulations.

At a section of the road with steep side slopes, there is concern with slope stability. Based on boring logs, a Rocscience model shows that it fails at heavy traffic loads. Stability options are:

- Concrete retaining wall
- Timber retaining wall
- Concrete interlock block system

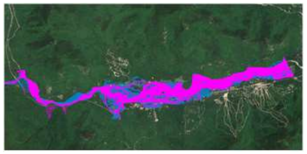
There is a location in the roadway with standing water on both side of the road. This will require wetland mitigations and permits. A culvert was designed based on the 50-year storm to be an 18" HDPE pipe. This was based on:

Watershed = 500,000 s.f.

Runoff flow = 11.4 cfs based on rational method.

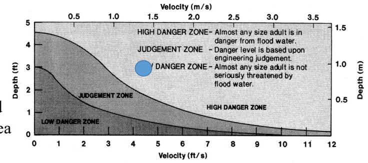
Culvert: inlet control

Breach Analysis



Map of water surface elevations in the Saco River during the 100-year storm (pink) and a breach during the 100-year storm (blue) events. Mapping performed in HEC-RAS software.

Hazard diagram for adults in a residential area affected by a breach. Based on a velocity of 4.5 ft/s and water depth of 3 ft, area would be high hazard.



Future Recommendations

Cost analysis: It is recommended that cost analyses be performed for the comparison of different options presented in this project including different wastewater treatment options, fire pump options, dam cross section options, and roadway retaining options.

Permitting: The federal permits required will at minimum include the general construction permit, an EPA NPDES permit, and the US Army Corps of Engineers Permit. The state permits required, at minimum, will include the wetlands dredge and fill permit, alteration of terrain permit, dam permit, community well permit, and a groundwater discharge permit. It is anticipated that the permitting process will be complex. Upon completion of the conceptual design, it is recommended that the project is reviewed by a permitting specialist.

Plans: Complete site plans and dam construction plans are required to get a cost estimate of the project. Plans will include the items included in the preliminary site plan with greater detail including materials specifications and pipe locations. They will also include dam construction methods.

Investigation: Hydroelectric capabilities must be investigated and compared to the cost to connect to the Grid. Additional boring holes upstream and down stream are also required for a greater understanding of the in-situ soils. Percolation tests and deep holes are also required for the septic system design.

Acknowledgements

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