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**Problem Statement:**

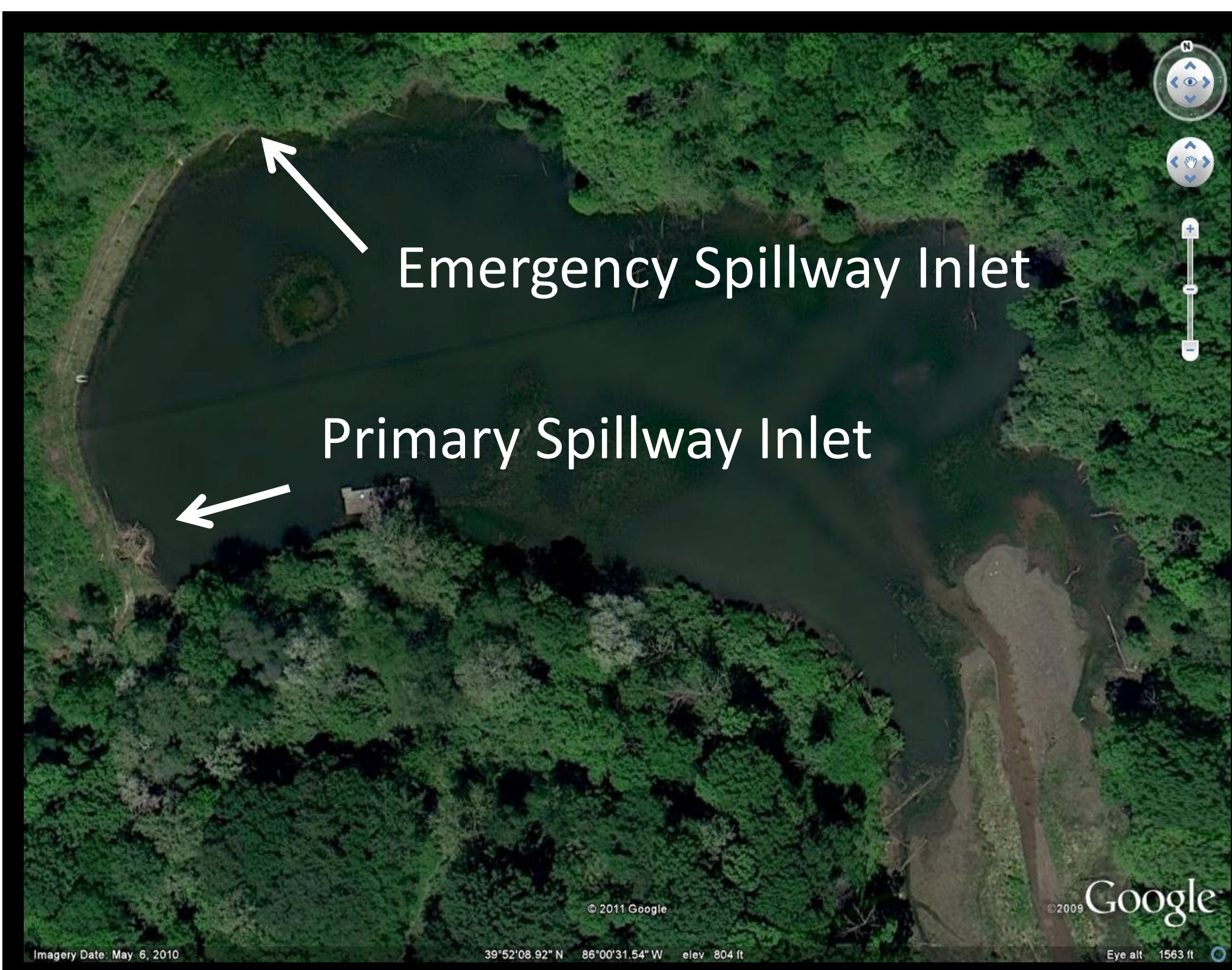
New Lake is located at Fort Benjamin Harrison State Park in Indianapolis, Indiana. The dam and spillways are currently in a state of disrepair. The dam has overtopped multiple times in recent years and is in danger of washing out. These issues can be attributed to the following problems:

- The dam has an uneven crest and has been subjected to a large amount of erosion.
- The lake is far too small. The drainage area is 640 acres and the surface area of the lake is 4.5 acres. The drainage to surface area ratio is 140:1 whereas typical Indiana ratios are 20:1.
- The current drop inlet primary spillway is blocked by large debris and is beginning to collapse by the weight of the dam. The emergency spillway is heavily eroded and is cutting into the toe of the dam.
- Changes in the surrounding watershed have increased the amount of silt in New Lake.



Modeled using L-THIA

New Lake Dam is next to a golf course and has a low hazard rating. Our task is to design a new primary spillway which can handle a 10 year event and an emergency spillway to handle the 50% Probable Maximum Precipitation (PMP) event.



Primary Spillway Inlet, blocked by debris

**Design Procedure:**

Flow routing was conducted using Hydraulics and Hydrology analysis done by the IDNR in 1997 to develop a hydrograph which displays changes in storage, inflow, and outflow during and after storm events.

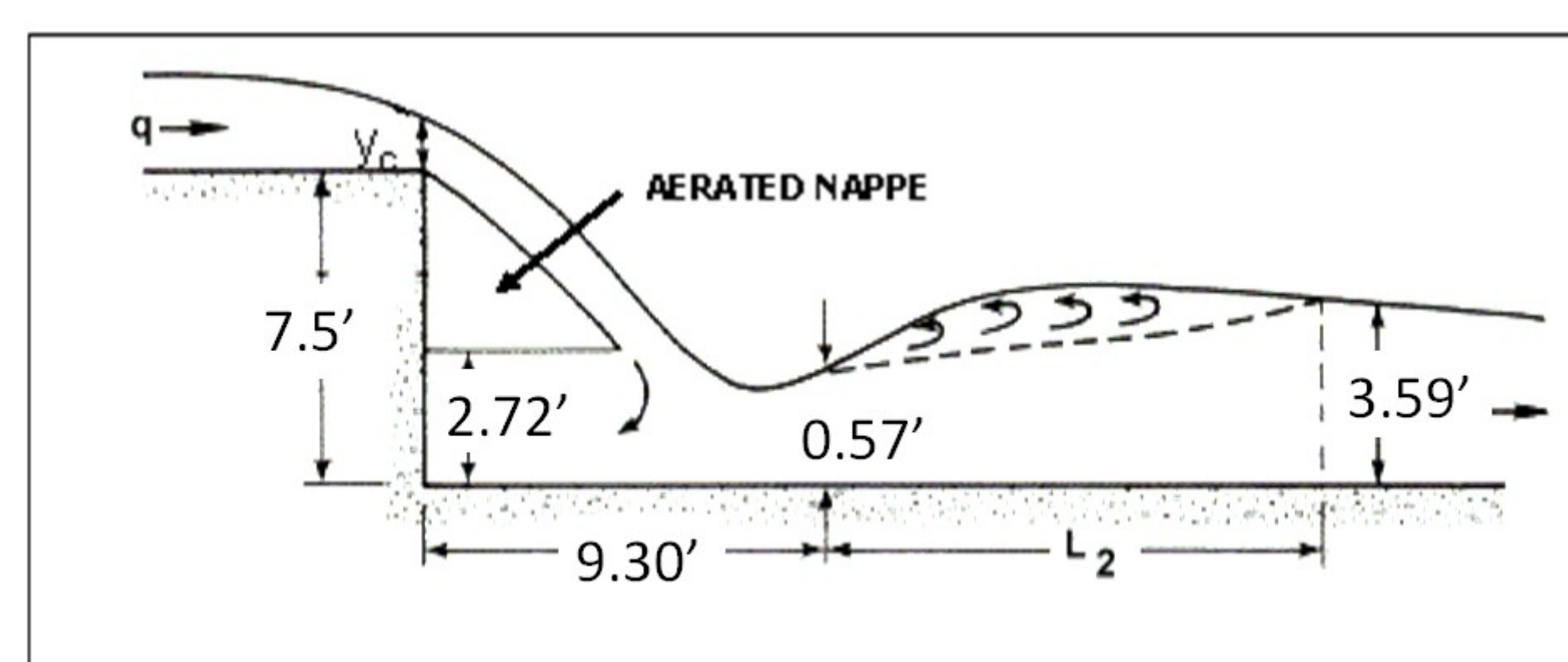
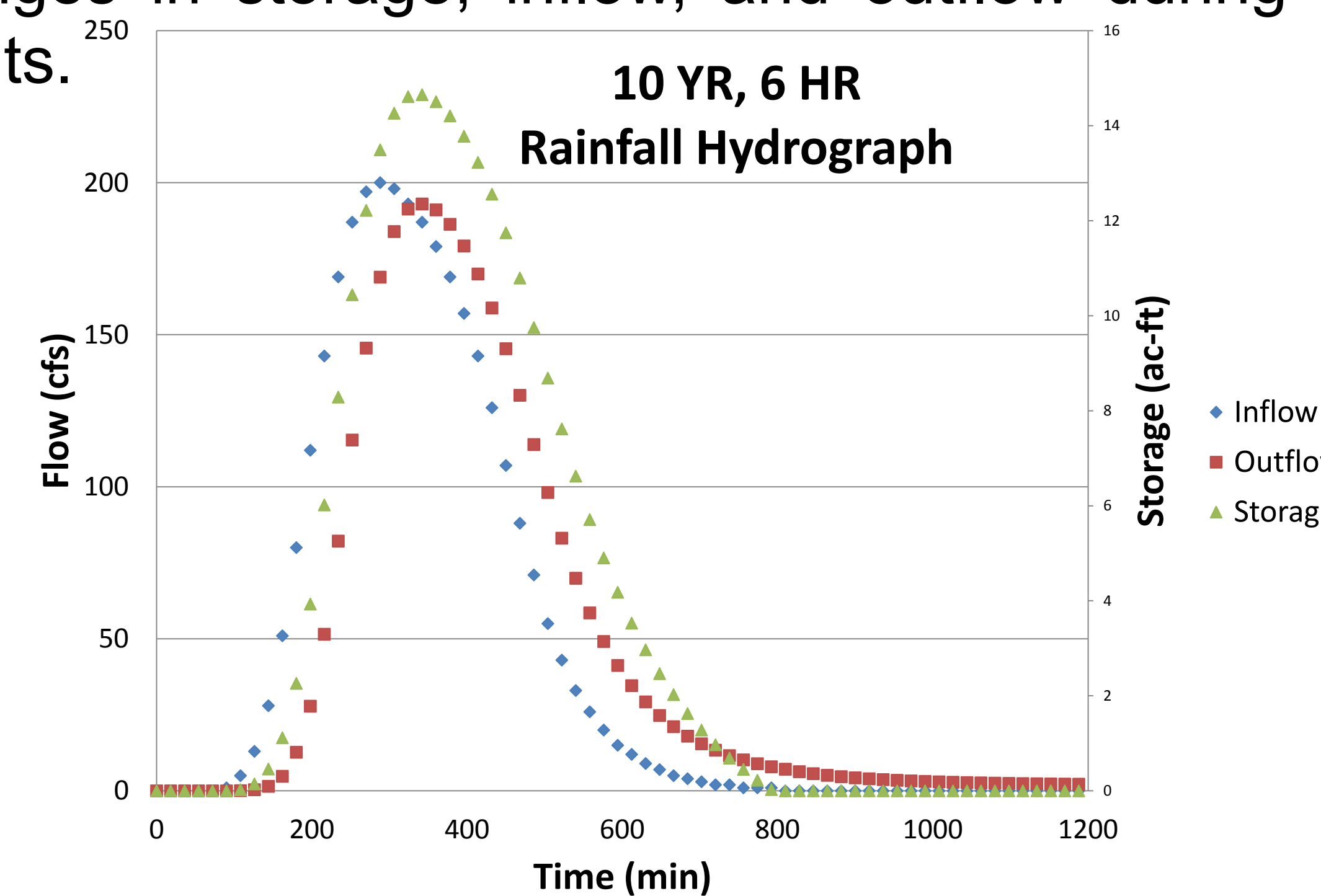
A 35 ft. rectangular weir inlet to the spillway maximizes storage inside New Lake.

**Min Stage:** 800.8 ft.

**Max Stage:**

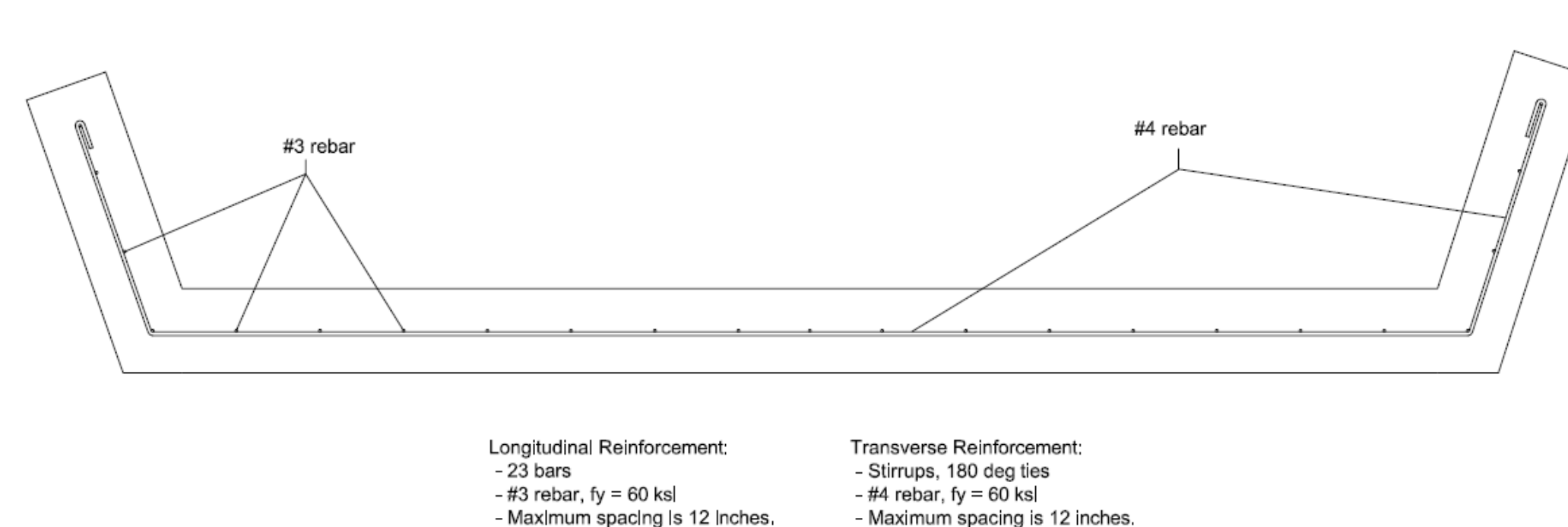
10 YR: 803.3 ft.

50% PMP: 808.5 ft.



Drop structure controls flow and dissipates energy. Flow exits the spillway through a rectangular weir and flows into a flat apron stilling basin.

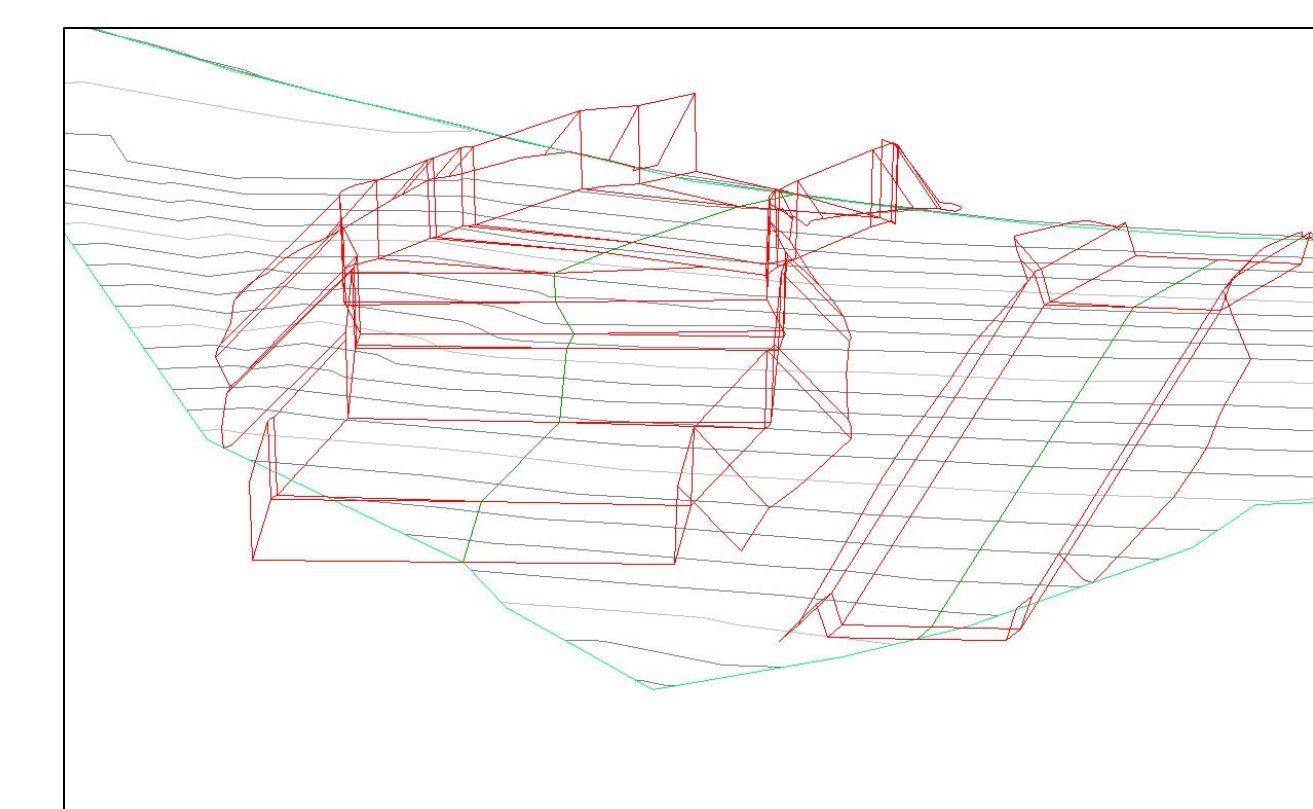
Concrete rebar reinforcements for the primary spillway accounts for open channel flow and crack control.



Longitudinal Reinforcement: - 23 bars - #3 rebar, s = 60 in. - Maximum spacing is 12 inches.  
Transverse Reinforcement: - 56 bars, 180 deg ties - #4 rebar, s = 60 in. - Maximum spacing is 12 inches.

**Alternative Solution:**

Together, the primary and emergency spillways must handle 50% of the PMP rainfall event. Each spillway was designed separately, but required a large area of land. The dam was not wide enough to dedicate so much surface area to the spillways, thus we chose the two-stage spillway design.

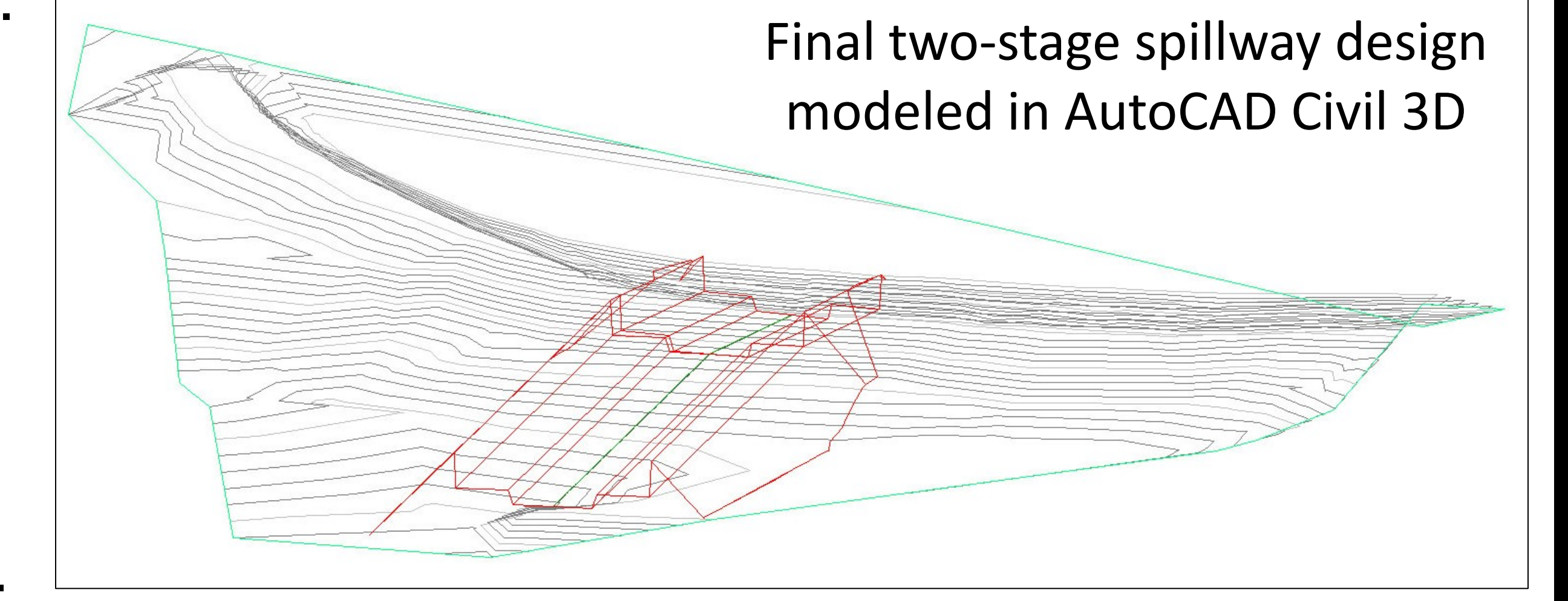
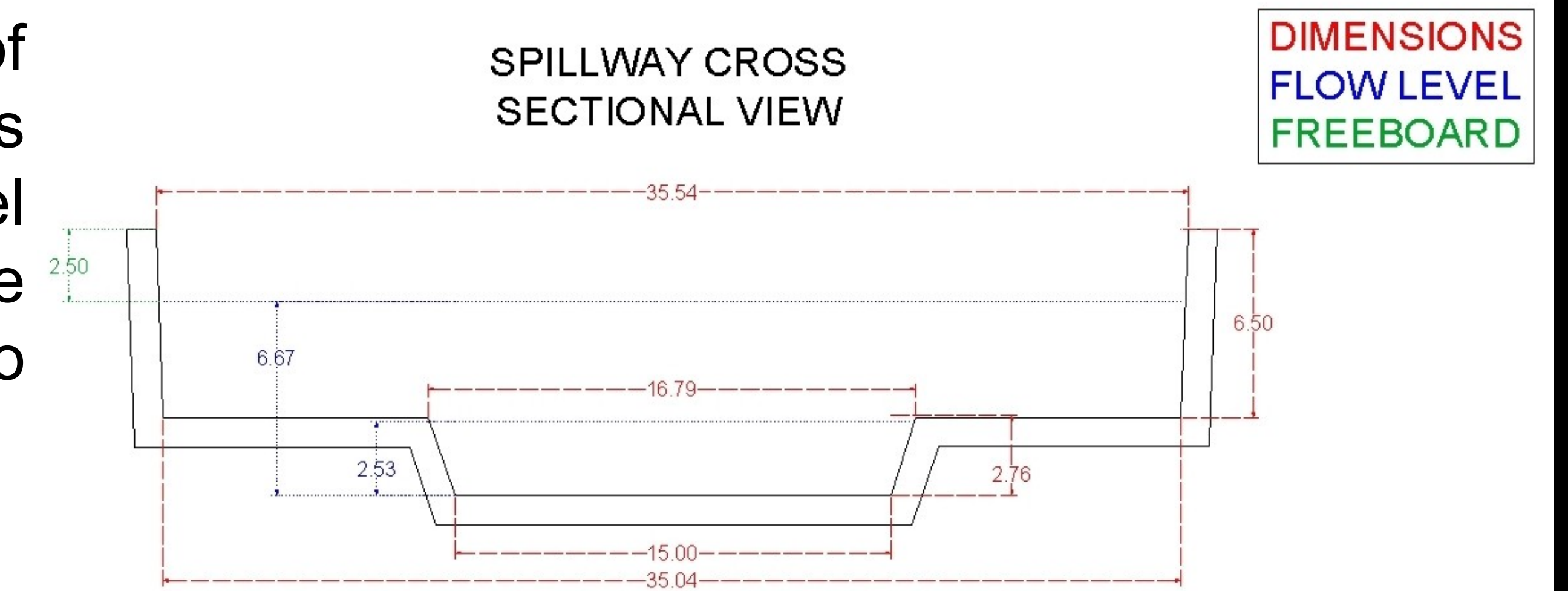


Modeled using AutoCAD Civil 3D

**Final Design:**

A two-stage spillway design was chosen to minimize the surface area taken up by the spillways and save money on cut and fill. The emergency spillway is stacked on top of the primary spillway. The spillway has the following characteristics:

- The top of the dam is made level near the spillway to 810 ft.
- An open channel spillway design was chosen to facilitate maintenance and identification of failures.
- Two-stage design does not change hydraulic qualities of flow. The spillway can handle all flow from a 50% PMP storm event with 2.5 ft. of freeboard.
- High flow through the spillway to account for low storage capacity of New Lake. The spillway system has flows of 1325 and 3245 cfs. for the 10 year and 50% PMP events, respectively.
- Primary spillway is reinforced concrete, emergency spillway is soil-cement.



Final two-stage spillway design modeled in AutoCAD Civil 3D

- Soil-cement is approved for emergency spillway use, and is more cost effective than reinforced concrete.
- The design prevents: flood damage to the golf course, clogged irrigation pumps, and continued erosion of the dam.

Cost Estimate	
Cut	\$1,972.17
Fill	\$102,885.47
Concrete	\$20,800.00
Soil-Cement	\$8,650.00
Rebar	\$5,905.00
<b>Total Cost</b>	<b>\$140,212.64</b>

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