# H&H Modeling for Wetland Restoration in Florida


**Marcy Frick, REM** Senior Water Resources Engineer, Tetra Tech, Inc. Jacksonville, Florida, marcy.frick@tetratech.com

**Madhu Akasapu-Smith, PE, CFM**, Water Resources Engineer, Tetra Tech, Inc., Atlanta, Georgia, madhu.akasapusmith@tetratech.com

**Roderick Cashe, PE, CDT, LEED™ AP**, Senior Project Manager, Tetra Tech, Inc., Orlando, Florida, roderick.cashe@tetratech.com


## Extended Abstract

The U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) contracted with Tetra Tech to prepare wetlands reserve plan of operations (WRPOs) and construction designs for several wetlands reserve easement (WRE) sites in Florida under Easement Restoration Agreements with NRCS. These properties were historically marsh systems that were converted for agricultural purposes. The goal of the WRPOs was to determine structural and ecological measures that could be implemented to restore wetland function and historical site conditions to the extent practicable.

Many of the sites have canals and levees that encircle part or all the properties to reduce flooding. Within the sites, ditches drain water from low-lying areas. The wetland function is restored by altering the existing drainage pattern to retain the water onsite longer without creating any offsite impact. Offsite is considered as all contributing drainage areas upstream of the project area.

To achieve this goal, Tetra Tech performed hydrologic and hydraulic (H&H) modeling scenarios (short-term and long-term) to study the existing and anticipated wetland conditions as a support tool for the WRPO development. Each wetland has unique features in terms of surface hydrology (i.e., rainfall, evapotranspiration, topography, area, soil, vegetation pattern, water quantity and quality etc.) and it is challenging to address these features in the model development. Also, groundwater plays a significant role in the wetland function over the long-term as development of the wetland vegetation vastly depends on groundwater, which fluctuates seasonally in Florida.

Recognizing this fact, Tetra Tech developed two-dimensional Interconnected Channel and Pond Routing version 4 (ICPRv4) models for each WRE site that included surface water and groundwater interactions (Figure 1). ICPRv4 includes a fully integrated one-dimensional/two-dimensional surface water module coupled with a two-dimensional groundwater module with an emphasis on interactions between surficial aquifer systems and surface waterbodies.

The existing conditions model for each site divided the site into pond control volumes (i.e., stage/area nodes) representing the typical condition of the site drainage patterns. The models also included boundary conditions as well as existing dikes, canals, structures, and pipes onsite. For each site, two models (event-based and hydroperiod) were developed. The event model was simulated for eight different storm events: 3-year/24-hour, 3-year/72-hour, 10-year/24-hour, 10-year/72-hour, 25-year/24-hour, 25-year/72-hour, 100-year/24-hour, and 100-year/72-hour. The 3-year/24-hour storm captured the lower end of potential design storms and was used as the initial stage conditions for the storm event modeling. The design storm used for this site, as required by NRCS and the state water management districts, was the 25-year/72-hour storm event, which is defined as the critical storm. The hydroperiod model was simulated for nearly 30 years of rainfall data.

The existing conditions model provided information on the existing groundwater levels, groundwater boundary conditions, initial stages, tailwater conditions, and control elevations found onsite.

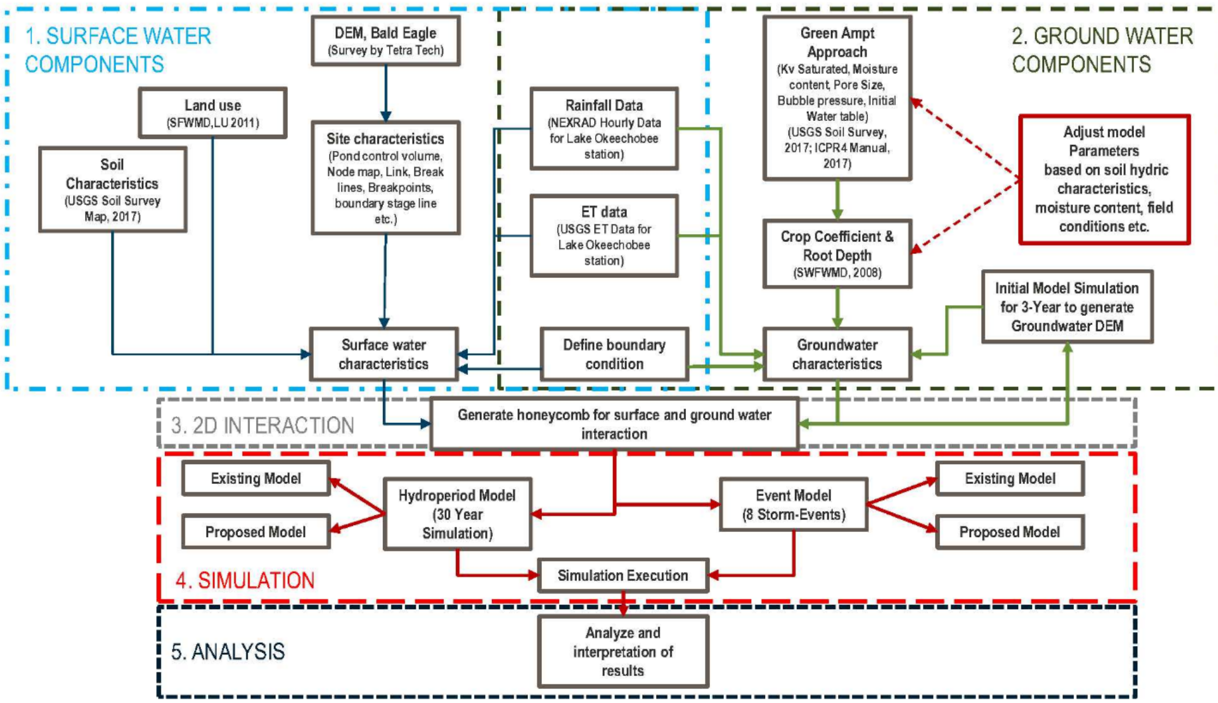


**Figure 1.** ICPRv4 model schematic

Once calibrated, the existing conditions model was used to develop the proposed conditions model, which included the proposed structural modifications to the site to restore the historical hydrology. The structural measures included weirs, embankments, ditches, and ditch blocks, which were coupled with ecological practices to restore the sites.

The proposed conditions model was used to identify the extents of inundation at specific water surface elevations, provide water depth temporal variations at the sites for the required storm events, evaluate the increase in onsite water storage (Figure 2 and Figure 3), ensure there were no offsite impacts to surrounding properties, and identify vegetation habitats based on varying water surface elevations. The model results provided information to our engineers and biologists to find the optimal solution and design for the wetland restoration. The model results included the expected water levels onsite after restoration elements are implemented, which were used to estimate the associated vegetation communities that could be present post-restoration to evaluate the acreage of historical communities that could be restored.

The recommended structural and ecological practices from the WRPOs have been constructed at several of these sites and restoration of the historical communities has been observed.

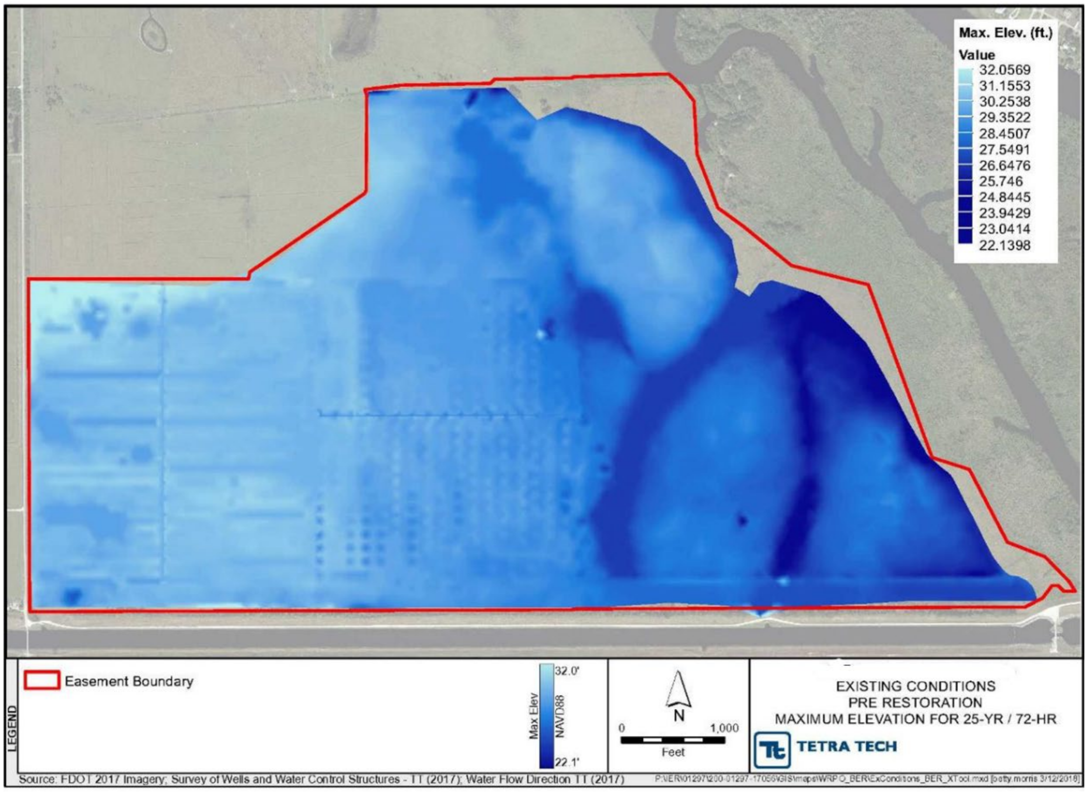


**Figure 2.** Maximum elevation for an example site for the 25-year/72-hour storm (existing condition)

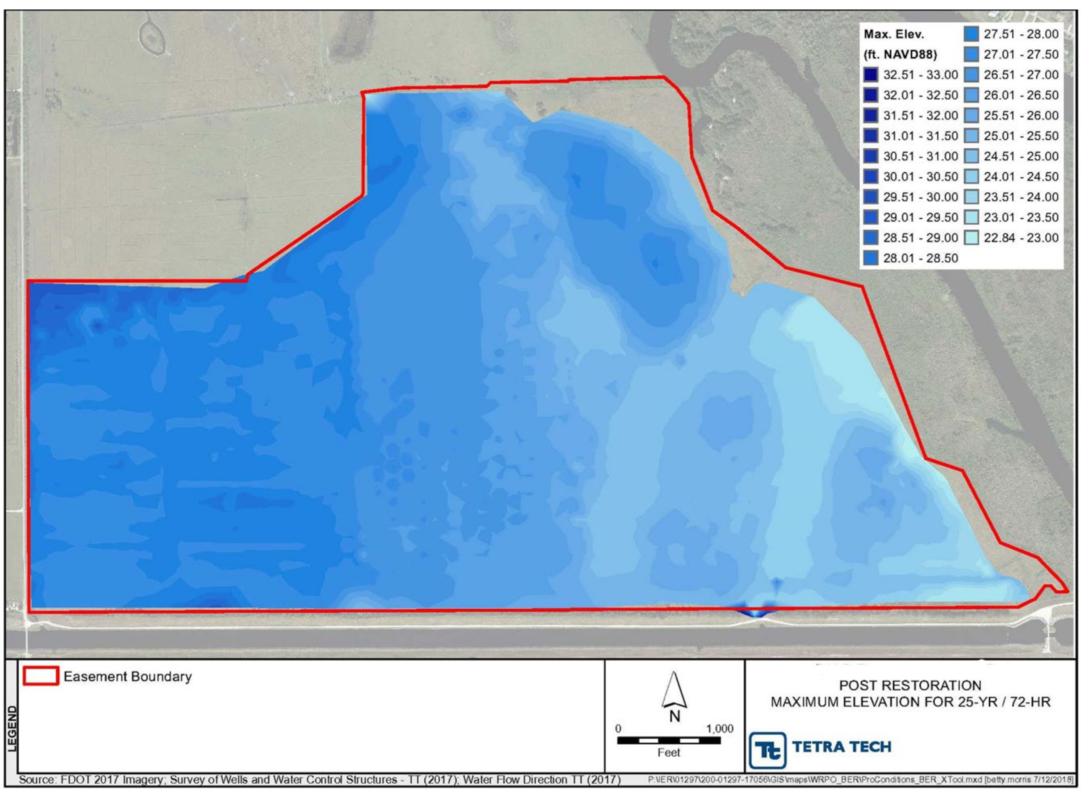


**Figure 3.** Maximum elevation for an example site for the 25-year/72-hour (proposed condition