# Isolated Wetlands - The Groundwater Connection
# 1. Water Table Monitoring

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## Abstract

This phase of the project focused on spatial and temporal dynamics of shallow groundwater from the isolated wetland (IW) to the nearby connected waterbody. These are results from two studies, one from mid-2009 to mid-2010 , the second from mid-2010 to present. All wetlands showed subsurface hydrologic connectivity to adjacent surface water although the connection had different characteristics among IW and varied seasonally at each IW. Subsurface hydrology was dependent on precipitation patterns and position on the landscape. While most IW had a temporally continuous subsurface connection to the adjacent surface water, for two IW at one location it only existed during very wet conditions. Radial flow was detected at some sites and in one case the subsurface water flowed through the IW from upslope land on one side toward the lower elevation adjacent surface water on the opposite side. There were two droughts, one severe, during the studies. Water table elevation was severely depressed but in most cases the subsurface connection did not break. The water table elevation rises rapidly in response to precipitation in the IW and the sandy upland soils of the Coastal Plain. Sustained recovery from drought requires wet conditions for several weeks.

## Marion County, South Carolina
## Site MA2

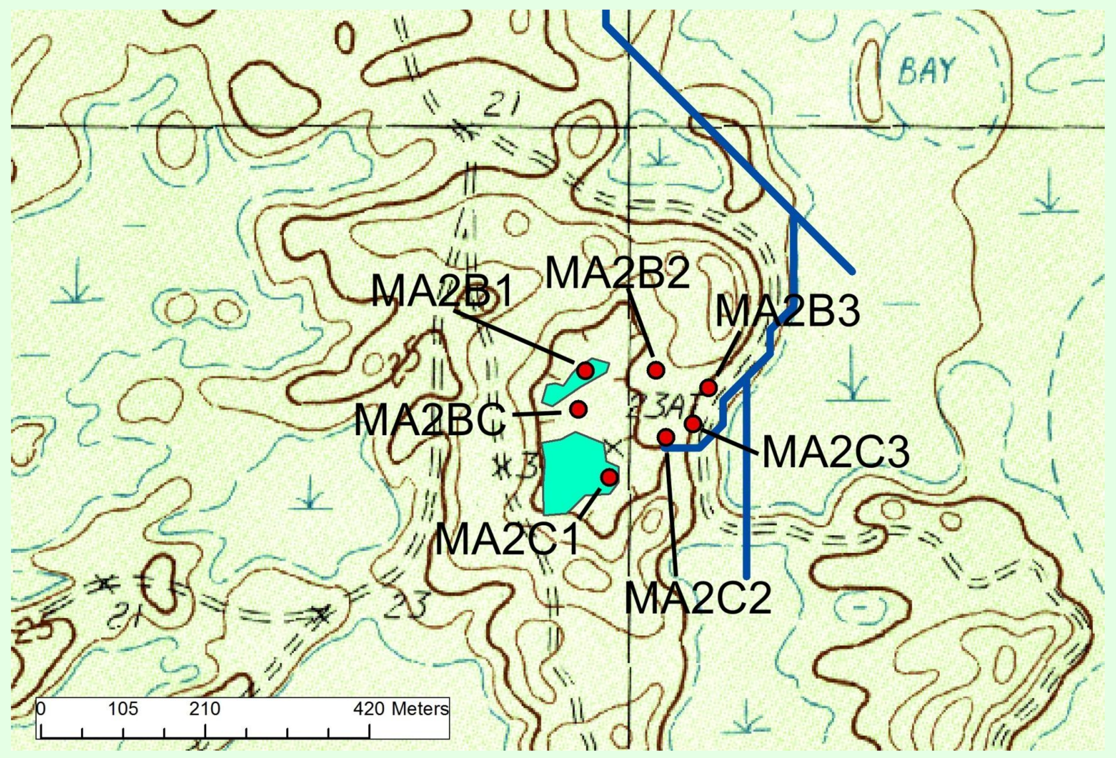


Figure 1. Site MA2 and surrounding area.

We deployed two transects of wells with water depth loggers from two small IW (MA2B and MA2C) to a nearby slough (Fig. 1). There also was a well between the two wetlands. These two wetlands are at the bottom of a topographic bowl (Fig. 2) although there is a break in the direction of the slough. The elevation of the MA2C wetland is slightly higher than MA2B. Upland soils are sand. This site is in Woodbury Wildlife Management Area.

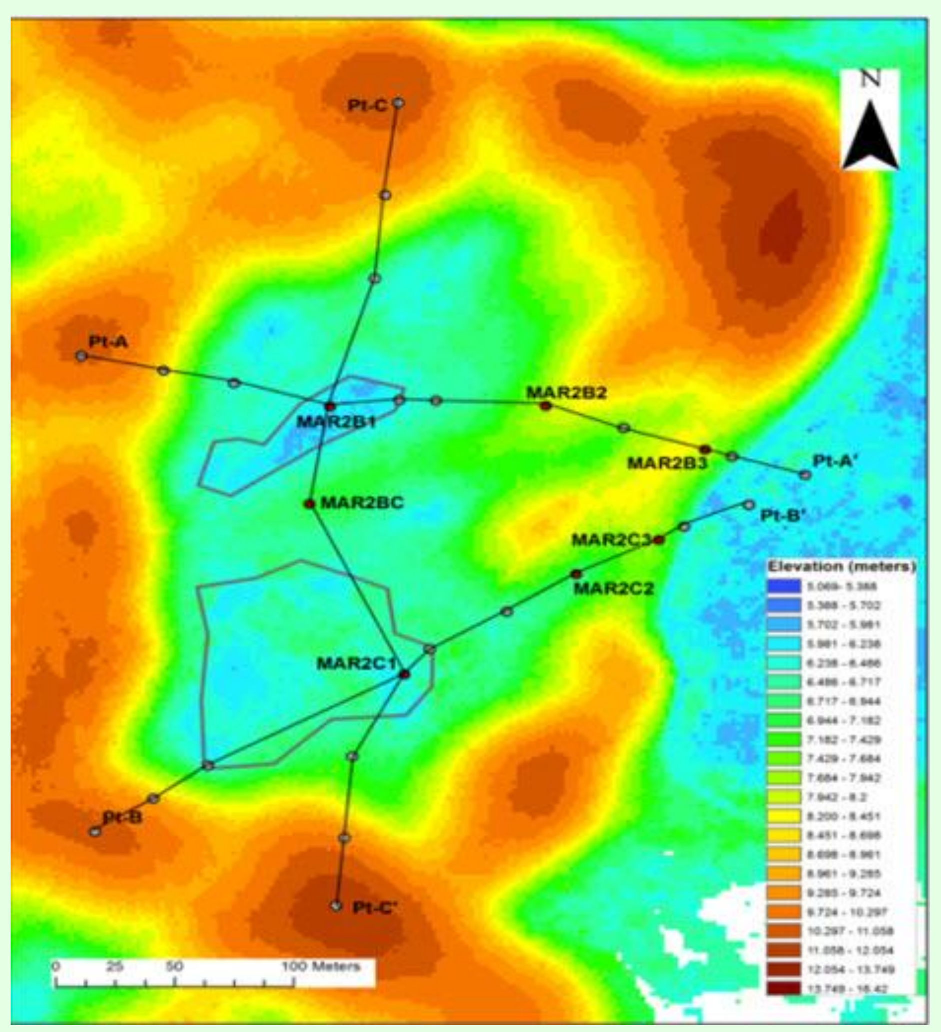


Figure 2. Image made using LiDAR elevation data clearly reveal the bowl-like characteristics of the surrounding upland. The monitoring well transects are in the elevation breaks.

## Site MA2 continued

Figure 3. IW MA2B in February 2010 (left) and October 2010 (right). Precipitation was below normal during the first half of 2010, then above normal the rest of the year..

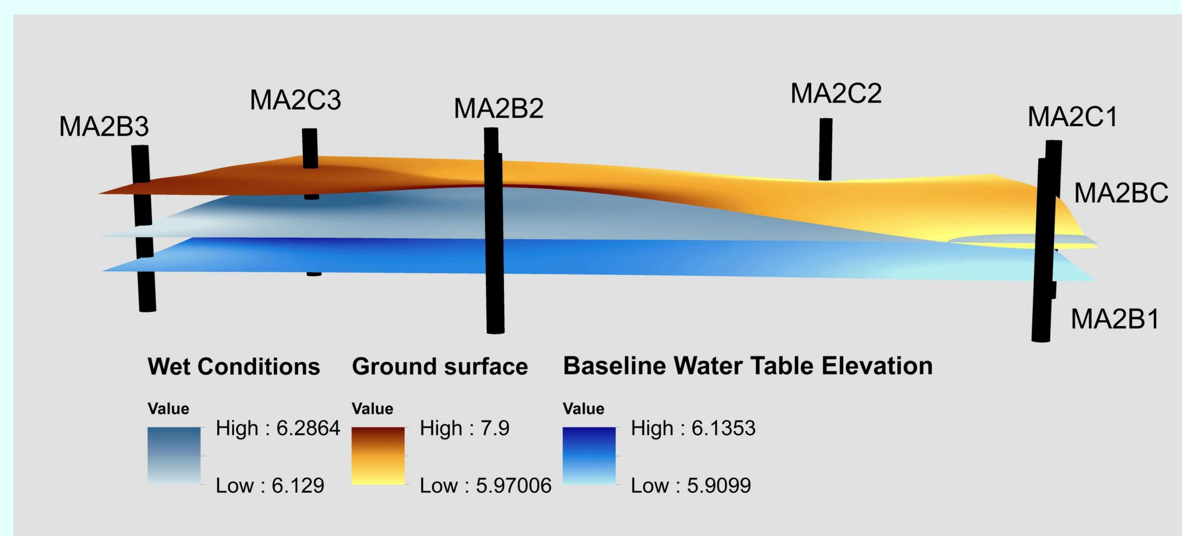


Figure 4. This is a composite showing the land surface and water table elevation during a relatively dry period (bottom layer) and a wet period (middle layer). A vertical displacement of 1 m was added to the water table layers to aid visual interpretation. Actual differences are approximately 0.25 m. Note the orientation of this image is rotated 180-degrees from Figs. 1 and 2. In this image the slough is off–image on the left.

During most periods the MA2B IW acted as a sink on the landscape. It received water from the MA2C IW and the surrounding higher elevation uplands (see bottom water table layer). During much of the study year there was no surface water in either wetland although surface and near-surface saturation were common.

For short intervals when the water table is high due to above normal precipitation the potential exists for subsurface flow from the IW toward the slough (see middle layer). There was a drought during this study that limited our opportunity to measure high water events. Thus we do not know whether this flow condition persists under some conditions or is always transient. Groundwater simulation models or transects of nested piezometers could bring additional clarity to this issue.

## Horry County, South Carolina
## Site LB

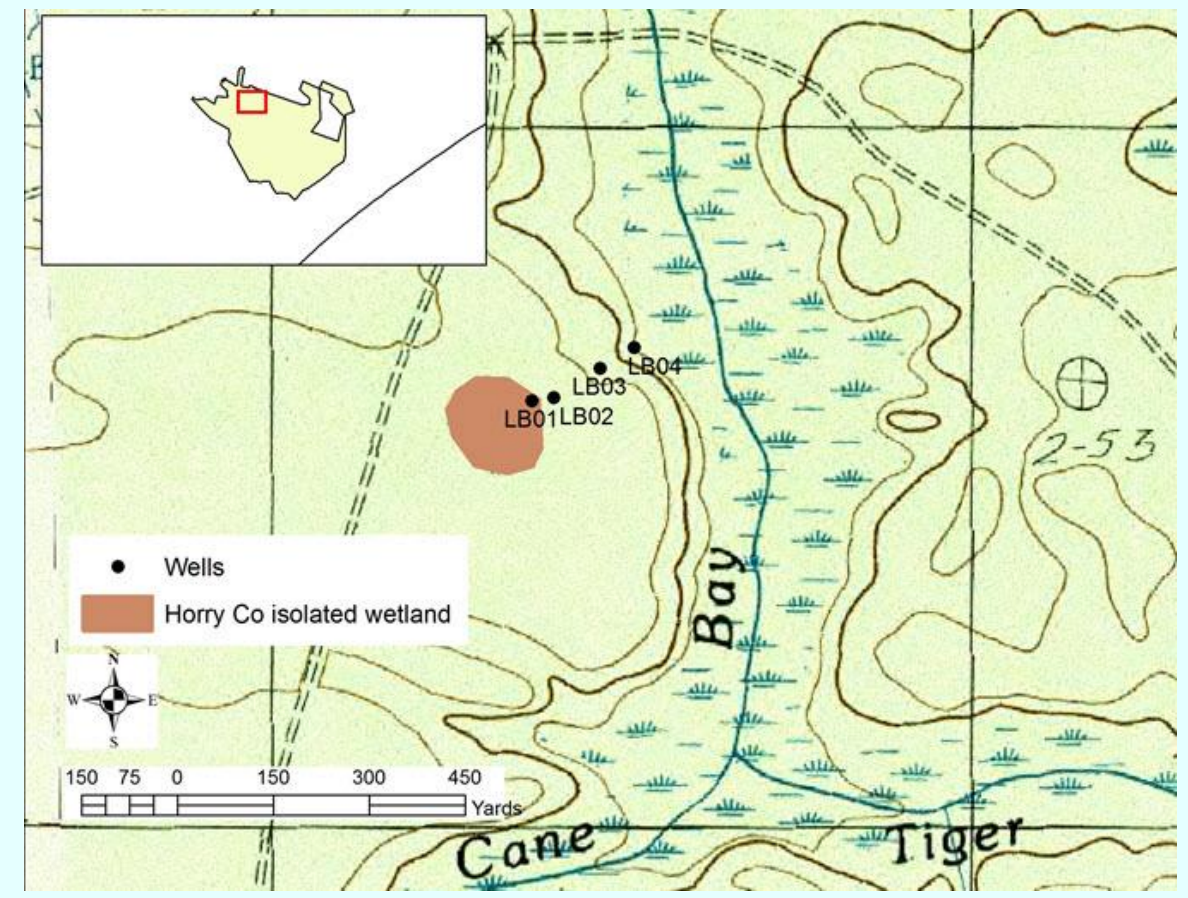


Figure 5. Site LP and surrounding area.

This IW is a small Carolina Bay (Fig. 5). There is a slight though steady elevation gradient leading downslope to the nearby stream. Soil is a fairly permeable sand/silt that overlays a much less permeable dense silt layer that functions as an aquatard. Four shallow wells and continuous loggers were deployed along a transect that followed a slight draw. The site has significant micro-topographic variability along the transect and elsewhere, likely the result of prior anthropogenic activity. This site is in Lewis Ocean Bay heritage Preserve.

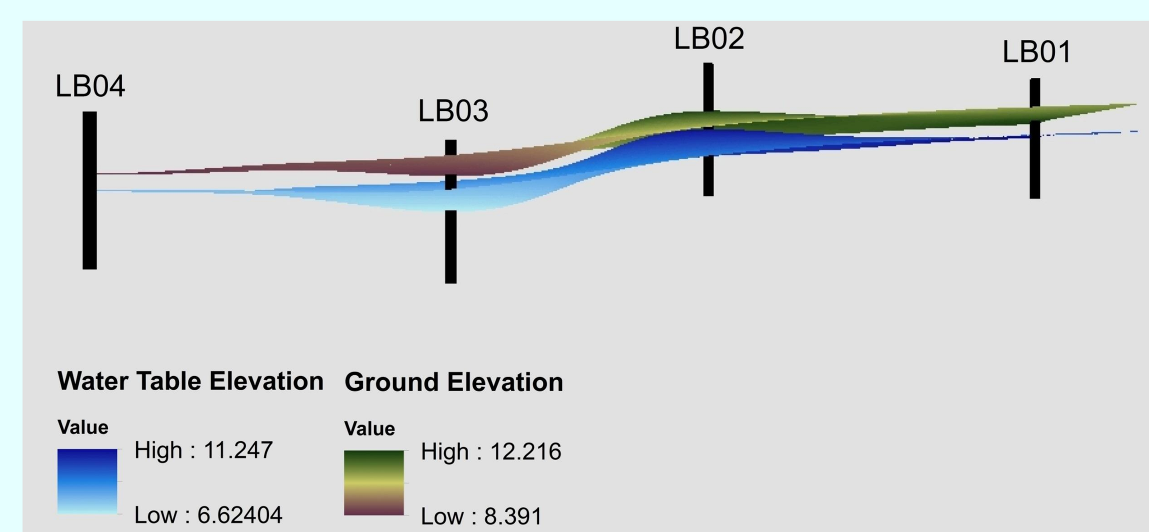


Figure 6. Land surface and water table at LB. Note the orientation of this image is rotated 180-degrees from Fig. 5. In this one the stream is off –image on the left.

Overall water table dynamics were essentially the same regardless of precipitation conditions. It moved vertically but was never far below the land surface. Micro-topography indicates the potential for local sinks (e.g. LB03) between the IW and the stream, but the overall elevation gradient along the transect and absence of "filling" at LB03 suggest relatively uninterrupted flow from the higher elevations in and near the IW toward the stream.

## Precipitation response

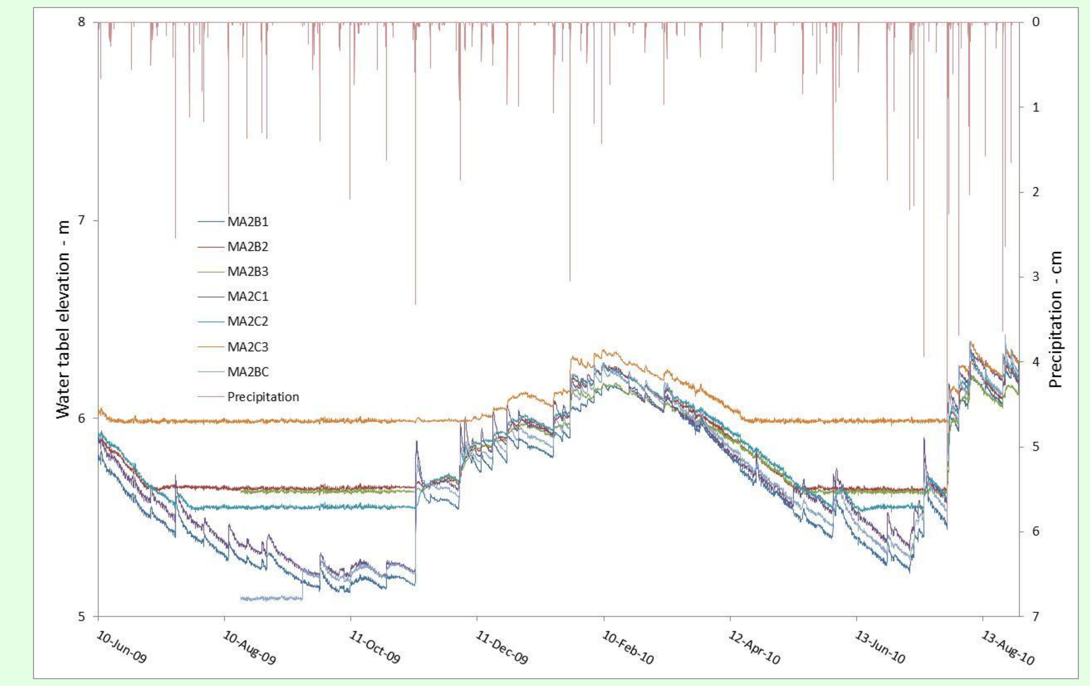


Figure 6. Hourly precipitation and water table elevations at the MA2 site. Flat lines are intervals when the water table was below the depth of the logger.

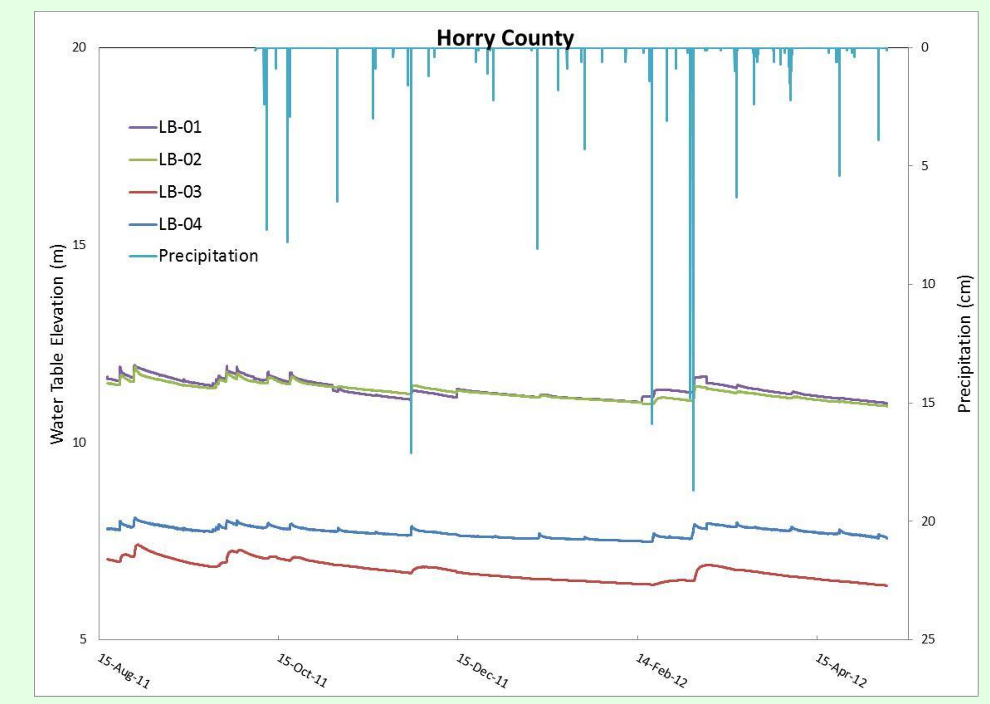


Figure 7. Hourly precipitation and water table elevations at the LB site

The water table at all wells at the MA2 site responds very quickly to precipitation (Fig. 6), both small and large events. (Note the rise of up to 0.75 m twice during the study.) The water table at the upland wells appears to respond almost as quickly as the wetland wells, reflecting the rapid infiltration in the sandy soil. For most of the study interval, during which precipitation was well below normal, the MA2B wetland appears to be a sink in the local area. Late in the study interval this dynamic changes (see also Fig. 4), but whether or not there is a persistent change during wet conditions we cannot say from these data.

The water table at the LB site was much more stable both in terms of response to precipitation events and in relative elevations among wells. The event response is likely caused by slower infiltration resulting from the sand/silt content of the soils. Although the water table elevation at LB03 was always below LB04, which is topographically down-gradient, the head differential from LB01 and LB02 probably maintains groundwater flow toward the stream. Simulation modeling could help clarify this dynamic.

## Conclusions

We conducted two studies of subsurface hydrologic connectivity between geographically isolated wetlands and nearby surface water on the Coastal Plain of North and South Carolina (second study still in progress). The results from two example sites are presented here. There is substantial variability in both the spatial and temporal characteristics of the groundwater connection. In these two examples, the MA2 site is considerably closer to the nearby surface water than is the LB site, yet the connection at MA2 appears to be discontinuous in time and may only be significant during extended periods of above normal precipitation. Local topography and soils appear to be determining factors in the subsurface dynamics. Regulatory and resource management decision-making need to recognize and account for this variability.

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