Isolated Wetlands - The Groundwater Connection
2. Hydrogeology

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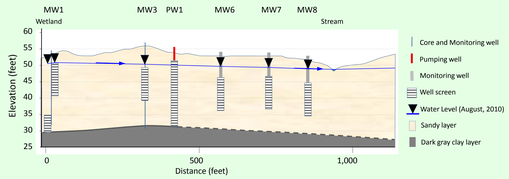
Abstract

Results of this investigation show that all the isolated wetlands (IWs) in the study are connected to downgradient surface water via groundwater without intervening confining units or aquitards. Each IW in the study is thus a depression where the land surface and water table intersect when the water table is high enough. The IWs are part of a system including the IW, an upland area and a downgradient surface water body. Geologic differences between the systems studied are expressed hydrologically as perched water tables, partially confined aquifers and systems with layers of varying hydraulic conductivity. This poster examines how stratigraphic differences affect the hydrologic regime of these IWs.

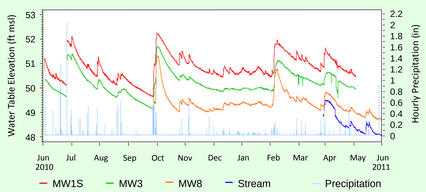
Homogenous system
Site BL7

Cross-section



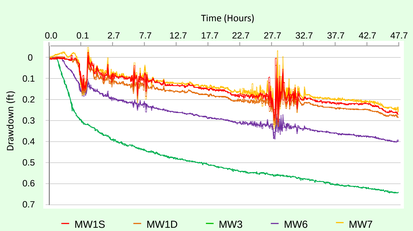
Site BL7 is the simplest system included in this study. There is a layer of sand approximately 20 feet thick overlying a dense clay layer of unknown thickness (greater than 2 feet). Water flows from the upgradient area through the wetland to the stream. (Left to right in all cross-section diagrams)

Water Levels



Automated datalogger data from observation wells and the stream indicate that the water table rises quickly with rainfall and slowly drops off when rainfall ends and that all wells respond nearly simultaneously. This indicates that there is sufficient permeability to allow drainage. There is also a suggestion of seasonal variability.

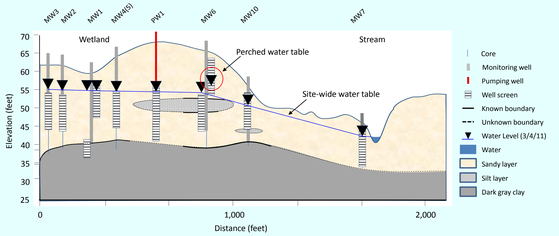
Aquifer Pumping Test



Aquifer test data indicate no significant barriers to horizontal groundwater flow - the curves all have similar shapes. Even the "shaking" occurs simultaneously. We cannot explain the shaking.

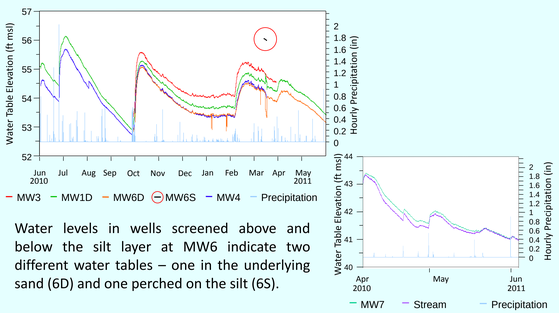
Perched system
Site BL1

Cross-section



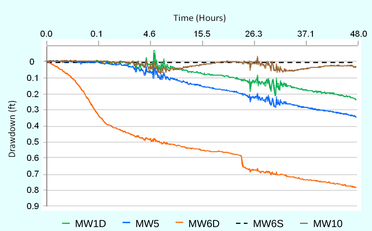
This site illustrates why this level of stratigraphic analysis is important. In one core there was a 4' thick layer of silt in between two 15' layers of sand. We did not know what the effect of this silt was on the hydrology – how much of a barrier did it form? Thin, discontinuous silt and clay lenses were observed in cores at other sites as well.

Water Levels



Water levels in wells screened above and below the silt layer at MW6 indicate two different water tables – one in the underlying sand (6D) and one perched on the silt (6S).

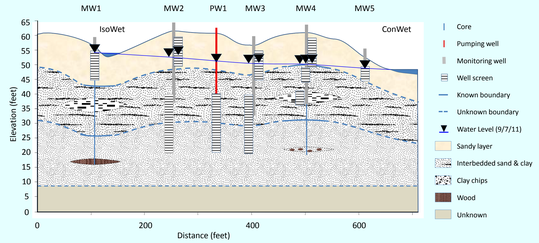
Aquifer Pumping Test



The perched water at MW6S was not affected by pumping from the deep well (PW1). The site-wide water table was independent of (not affected by) the silt body.

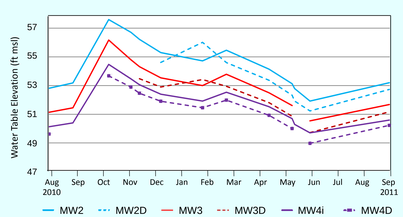
Semi-confined or layered system
Site GS1

Cross-section



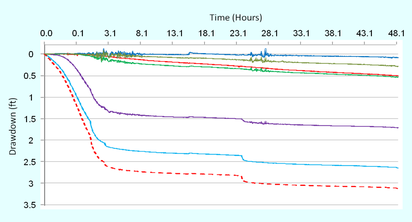
Site GS1 is a layered system in the shallow aquifer, where sand units sandwich an inter-bedded sand and clay. We call this site the "Sinkholes" site, because the land surface here is covered in hollows. Something beneath the surface collapsed and the entire section sank several feet - the thickness of each layer remains consistent while the surface elevation changes. Sinkhole topography is not controlling the water table. Coring data here was critical to understanding the hydrology. Maximum core depth was 65 feet. It is unknown how thick the lower sand is in this location.

Water Levels



The sediment layers do affect hydrology. The water level in the shallow wells in the upper sand unit is approximately 0.8' higher than that of the deep wells in the lower sand unit. The inter-bedded sand and clay unit exerts some control.

Aquifer Pumping Test



Water was pumped from a deep well in the center of the site during an aquifer pumping test. The different responses of shallow and deep wells tells us that the two sand units are hydraulically connected and the inter-bedded sand and clay layer is semi-confining.

Management Ramifications

Examples of the practical questions this work should help us understand better:

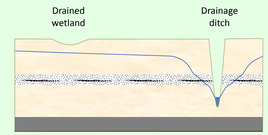
- What is the impact of changing the dynamics of a system which includes isolated wetlands, either by:
  - lowering the groundwater by pumping water from the aquifer or by dredging a nearby stream?
  - or plugging a drainage ditch?
- If reclaimed water is used to augment/enhance a wetland, what would be the effect on the aquifer and/or adjacent streams?
- What level of hydrogeologic assessment is required to address these questions?

Examples of how stratigraphy may affect the water table when a system is drained by pumping water from the aquifer or by dredging a nearby stream, and what may result when a drainage ditch is plugged.

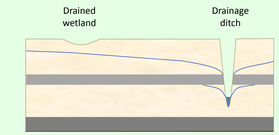
Natural system - simple sand aquifer. There is no impediment to flow between the wetland and the downgradient stream.

Scenario 1 – simple sand aquifer. There is no impediment to flow. Plugging the ditch should result in raising the water table and restoring wetland hydrology.

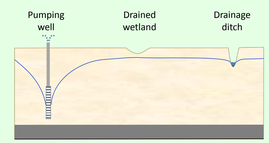
Scenario 2 - Perched wetland with a discontinuous clay body. It's unlikely this stratigraphy will lead to a different result than scenario 1 if the ditch is plugged.



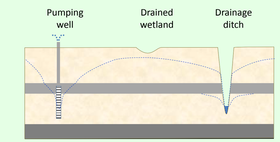
Scenario 3 – layered system – two sand units sandwich a unit with lower hydraulic conductivity (similar to GS1). The ditch drains all three units. Plugging the ditch should result in restored water levels in all three units though it will take longer than in Scenario 1.



Scenario 4 – layered system – a surficial aquifer, a confining unit and a confined aquifer. The ditch drains both aquifers. It is uncertain how long it will take for the confined aquifer to fill sufficiently for the surficial aquifer to recover to the point of rehydrating the wetland.



Scenario 5 – Multiple drainage activities. Which one is controlling the system?



Scenario 6 – Multiple drainage activities and a confining unit. Which one is controlling the system?

- The information on IWs gained from this study can be used to improve management decisions and provide better protection for these ecosystems.
- To truly understand a system which includes IWs, it is important to conduct this level of hydrogeologic characterization.
- In this study, none of the silt or clay lenses encountered appear to be extensive enough to present a significant barrier to groundwater flow.

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