Water Grand Challenges: Water Governance

Groundwater - Surface Water Interactions

Background – In Texas, groundwater and surface water are treated differently with regard to regulatory policy. Surface water is owned by the state and is appropriated through a permit system based on prior appropriation; on the other hand, groundwater is owned by the private landowner and is based on rule of capture. Treating these two water entities as separate based on geographic location has been the traditional approach in Texas despite an increasingly sophisticated understanding of the interactions between surface and groundwater. These two water sources are directly related to one another, pumping and utilizing groundwater affects the levels and flow of surface water, likewise, removal of surface water reduces the overall groundwater levels. This hydrological link is affected at different rates depending upon the geological conditions of the area. The following will discuss this cyclical pattern as it pertains to the specific environmental circumstances in Texas.

Defining Surface and Groundwater –Groundwater is stored in nine major aquifers and 21 minor aquifers throughout the state and supplies 59% of the 15.6 million acre-feet of water used. Surface water, on the other hand, is owned by the state and includes all ordinary flow, underflow, and tides of every river, natural stream, lake, bay, canyon, ravine, and watershed. This does not include certain types of runoff and does allow for individual appropriations, such as rainwater collection, to be carried out without any regulatory interventions. While the state differentiates these two water sources, it is important to note that the water itself is the same in both instances; it is just based on a delineation of where the water physically is at that moment in time.[1]

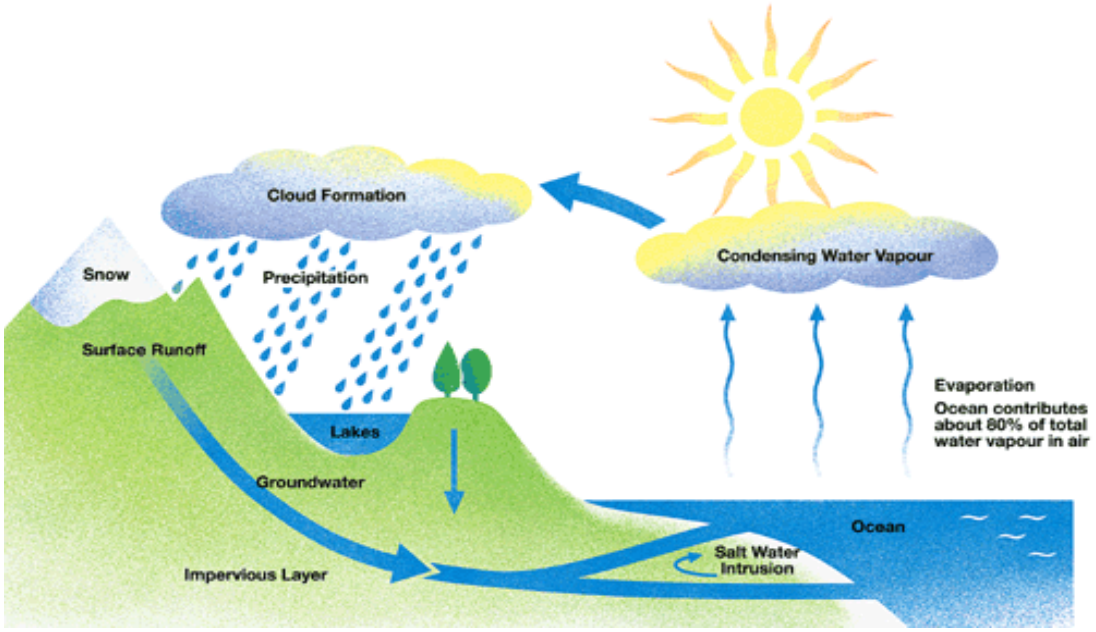
Surface and Groundwater Interaction – Treating surface water and groundwater as separate entities is a policy seemingly not based on the realities of the interactions between these two water conditions.[1,2] While water may be in the ground at one moment, it can quickly move to the surface during its hydrological cycle. Groundwater and surface water are physically interrelated and are part of the same sequence. Underground flow from aquifers moves water, via springs, to sustain surface water, likewise, surface water, through recharge zones, fills underground sources. This interplay depends upon the geological conditions of the area.[3]

Groundwater is recharged through surface conditions and is greatly influenced by geological, anthropogenic, and weather patterns. Areas that have highly porous surfaces, such sand and honey-comb limestone, more readily take water into aquifers and these areas are commonly

[1] 1904 Texas Supreme Court ruling that GW was a mystery: "so secret, occult, and concealed" that it was too difficult to legally control it.

known as recharge zones. Groundwater moves along flow paths of varying lengths from areas of recharge to areas of discharge. Surface water is mainly supplied by precipitation, while this source falls nearly everywhere in the state, the amount and the location of precipitation can vary greatly from year to year, and underscores the importance of recharge zones.[4] This cycle of evaporation, precipitation, recharge, and runoff can be seen in Diagram 1.

Diagram 1: Cycle of Evaporation, Precipitation, Recharge, and Runoff[5]



Fortunately, with increasingly refined approaches and understandings of this vital interplay between ground and surface water, more accurate and appropriate conclusions can be drawn. Humans have a direct effect on this interaction, for instance, heavy pumping from an aquifer may cause spring flows to decline or cease, which can affect surface waters. If extreme pumping is continued it can reverse this natural process. For instance, before pumping, the water flowed from the aquifer into the stream and after extensive pumping the stream flow went into the declining aquifer altering vital ecological conditions. These declining conditions have been shown to have already occurred in many Texas locations and linked directly to human influences on pumping water from aquifers. Studies show that the Comanche Springs, Lake Amistad, and the Rio Grande at El Paso have been reduced from anthropogenic interferences on the interaction between ground and surface water. These cases serve to highlight the importance of acknowledging the relationship between groundwater and surface water in Texas. [6]

Important Regions – The interaction of ground and surface water has been shown to be a complex process involving physical, chemical, and biological systems, and varies based on physiographic regions. Texas has several regions where the interaction between surface and

groundwater differ dramatically. For example, the Edwards Aquifer in Central Texas is comprised of a karst formation that easily moves water from the surface to the ground through its honeycomb limestone formations. In contrast, the Ogallala aquifer, which supplies water to the Panhandle as well as several other states, has very limited recharge ability. This is due partly to the clay soils, which do not allow for water flow to easily move from the surface to the groundwater tables. [7]

Closing Remarks – While Texas has traditionally treated surface and groundwater as two separate entities this approach is not grounded on our current scientific understandings of the interaction between them. Approaching surface water as belonging to the state and allocating it through permits is inconsistent with treating the same water that is in the ground as privately owned.

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[1] George, Peter. Mace, Robert. Petrossian, Rima. Texas Water Development Board. The Aquifers of Texas. 2011.
[2] Mace, Robert E, Cynthia Ridgeway, and John M Sharp Jr. *Groundwater is no longer secret and occult-a historical and hydrological analysis.* Austin: Texas Water Development Board, 2006.
[3] Hill Country Alliance Water Resource. Issue: Surface and Groundwater Policy Integration. 2007
[4] Winter, Thomas. Harvey, Judson. Franke, Lehn. Alley, William. Groundwater and Surface Water A Single Resource. US Geological Survey Circular 1139. 1998.
[5] The Water Cycle. SA Water. Community and Education Department. Australian Government. <http://www.sawater.com.au/sawater/education/ourwatersystems/the+water+cycle.htm> 2013
[6] Mace, Robert. Austin, Barney. Angle, Edwards. Batchelder, Rebecca. Surface Water and Groundwater – Together Again? Texas Water Development Board. 2007.
[7] Texas A&M University. Texas Water Facts. <http://texaswater.tamu.edu/faqs> 2013.