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Ground Water Conditions at the Boulder Creek Commons Property

White Paper

The Boulder Creek Commons (BCC) Project is located at 5399 Kewanee Drive and 5697 South Boulder Road and within the South Boulder Creek alluvial valley (Figure 1). As with most alluvial valleys on Colorado's Front Range, ground water is prevalent in the South Boulder Creek valley as evidenced by the large number of permitted ground water wells shown on Figure 1. During the spring and summer months, ground water levels rise throughout the alluvial valley. This ground water level rise results in the need to pump basement sumps to keep ground water from entering basements. This is especially true of the neighborhoods adjacent to the Project area. During the fall and winter months, the ground water levels drop and sump pumping generally is not required.

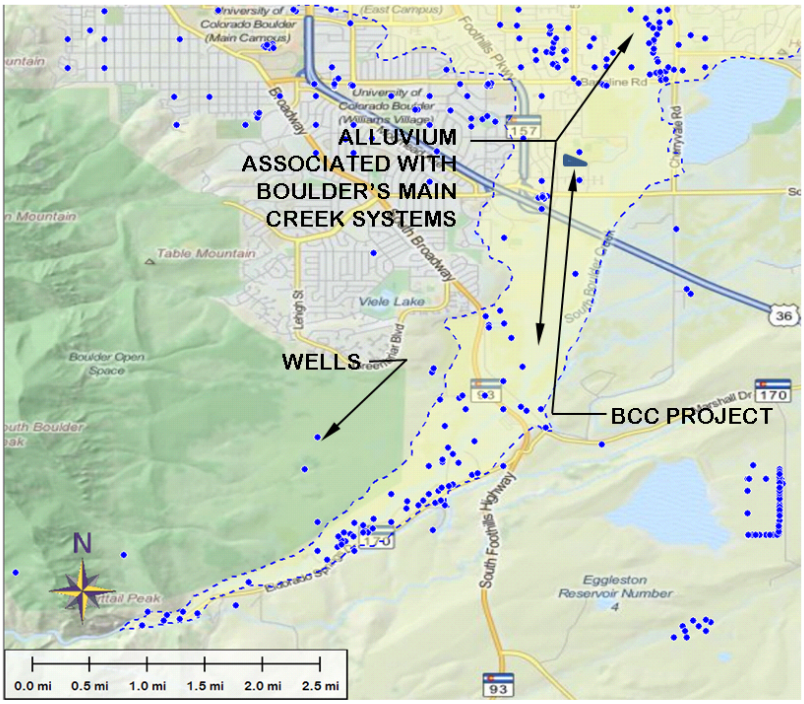
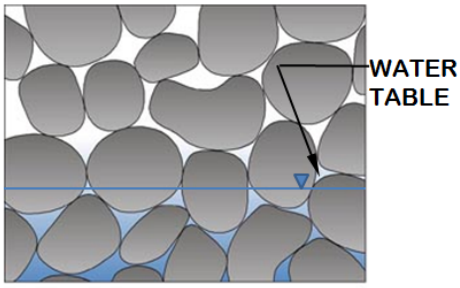


FIGURE 1. PROJECT LOCATION



Well-sorted sedimentary material
(Alluvium of the South Platte River)
Reference: Ground Water Atlas of Colorado, 2003.

FIGURE 2. DEFINITION OF GROUND WATER

So, what is ground water? Simply put, ground water is the water beneath the ground surface that is held and moves through the pore space of the geologic medium (Figure 2). The ground water – air interface is known as the water table. Ground water moves from higher to lower energy potential (e.g., from areas where the water table elevation is high to lower elevations) beneath the ground surface. If the geologic medium is comprised of sand and gravel (like the alluvium of South Boulder Creek, and the extensive terrace gravels which surround the alluvium of South Boulder

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Creek), ground water flows easily and at rates that allows it to be used as a water resource, or be a nuisance to the development of infrastructure that is built below the ground water table. If the geologic medium is of a more consolidated or structured nature (e.g., like the bedrock shale that underlies the South Boulder Creek alluvium), ground water flow is more limited.

Shallow ground water in the Boulder area that is contained by the creek alluvium and surrounding terrace gravels (as evidenced by the shallow wells shown on Figure 1) derives mainly from 4 sources: 1) precipitation (either as melting snow or direct rainfall) that soaks beneath the ground surface and is not used by vegetation, 2) rivers and creeks, 3) ditch leakage, and 4) irrigation. In the spring, rising water levels in South Boulder Creek, infiltrating snowmelt and the initiation of ditch flows contribute to the rise in ground water tables throughout the basin. At the local scale, lawn and field irrigation, sump pumping, ditch leakage, and South Boulder Creek influence ground water table elevations.

In the BCC Project area, the ground water flow direction is north to northeast, generally paralleling South Boulder Creek (Figure 3). Immediately adjacent to South Boulder Creek or irrigation ditches, ground water flow directions may be perpendicular to these features at a local

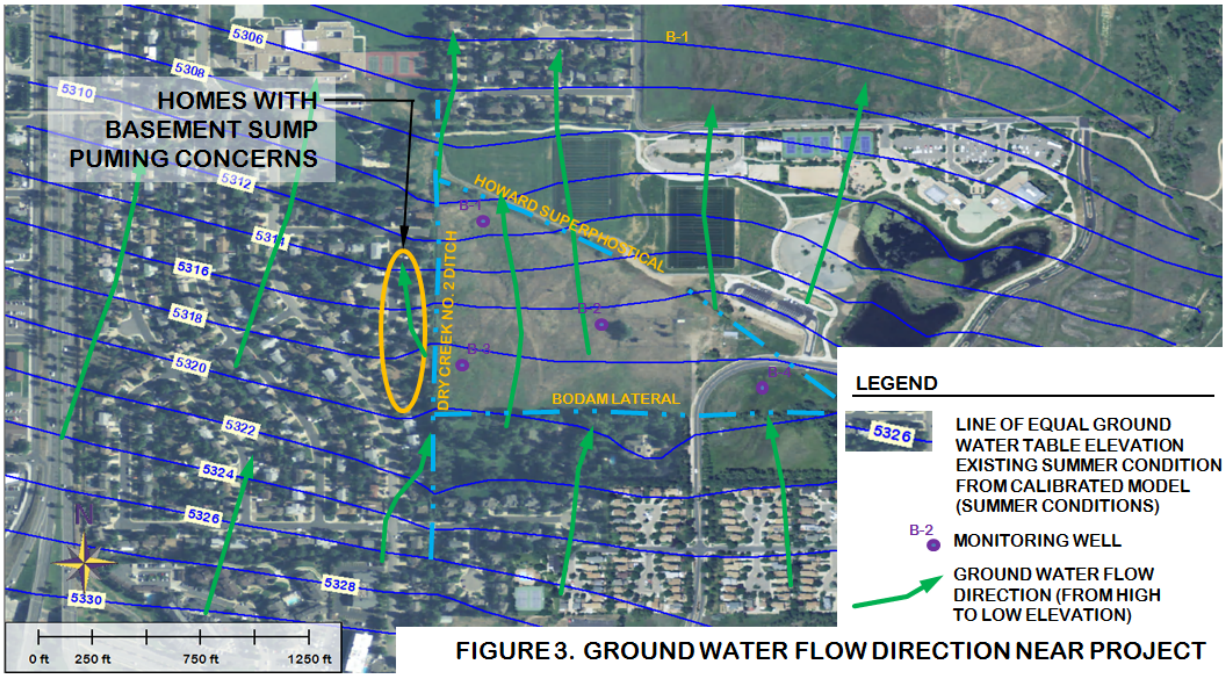

FIGURE 3. GROUND WATER FLOW DIRECTION NEAR PROJECT

scale. Also at a local scale, the ground water flow direction and ground water table elevation may be controlled by other water features such as ponds and lakes while excess infiltrating irrigation water may cause a mound.

At the BCC Project site, the ground water table fluctuates seasonally due to the general hydrologic processes that occur throughout the South Boulder Creek alluvial valley, and due to local scale processes such as ditch leakage and irrigation. Figure 4 shows the ground water table elevation fluctuations in four wells located on the property. Throughout the site, ground water is within five feet of ground surface during the winter and has been measured within just a few inches of the ground surface during the spring and after the 2013 flood event.

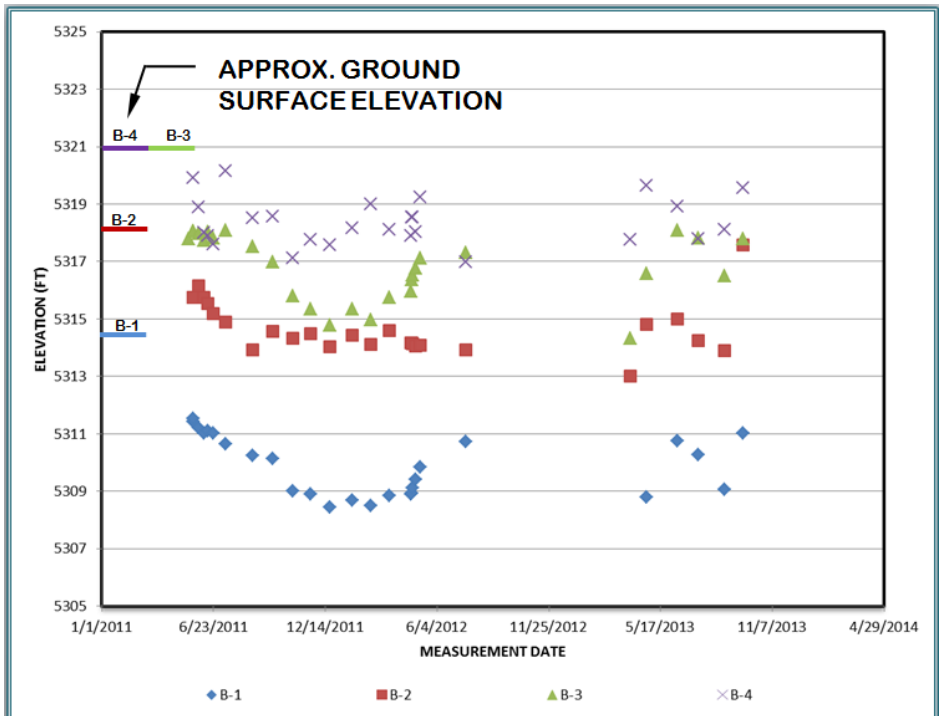

FIGURE 4. PROJECT AREA GROUND WATER TABLE ELEVATIONS

So, what does this all mean in regards to annexation of the property and future development? Because ground water is ubiquitous throughout the Boulder valley, the site is not unique in regards to ground water issues. Standard engineering practices are used successfully throughout Boulder to manage the high water table. For example, residential basement sump pumps and basement seals are plentiful throughout the area and allow families to safely enjoy additional living space, and larger and more complex dewatering and ground water control facilities provide safe ground water management for much larger areas (e.g., The Peloton Apartment complex on Arapahoe Road and Boulder Community Hospital's 17 acre East Campus). Advanced planning and regulations are other great tools available to manage the risk associated with managing ground water. For example, annexation regulations require fill to raise structures above flood levels, which in turn raises structures farther above the ground water table. Additionally, the annexation application is a good planning tool that states no basements will be built on the BCC site providing an additional assurance that ground water will not negatively affect the development potential of the property.

Neighbors in the area have expressed concerns that construction/development on the BCC site would make their ground water issues worse. They cite two primary (although technically unsupported) arguments. The first being that the weight added to the ground surface by fill and

building construction will create a "ground water dam" and divert more ground water into their variants basements. They try to use the time-correlation between the construction of the ball fields and East Boulder Community Center with the purported increase in their sump pumping for basement dewatering. There are several other reasons that they may have seen increases in sump pumping (e.g., increase in precipitation and longer/larger South Boulder Creek stream flows, failure of a forgotten neighborhood drain system) but ground water "damming" is not one of them. In order to "dam" ground water in the neighbor purported manner, the sand and gravel matrix would have to compress to remove all the pore space. Pore space accounts for approximately 25% of the volume occupied by the sand and gravel matrix. If their hypothesis were true, buildings and fill in the area would be noticeably sinking by upwards of 4 feet. This has not happened and will not happen. Engineers like to build on sand and gravel materials for their foundation properties and lack of consolidation or compressibility. Additionally, if their hypothesis were credible, the aquifers beneath their own development would be compressed such that no pore space would exist. Thus, ground water could not flow through it and into their basements, and as they have demonstrated, that is not the case. The premise/hypothesis of creating an underground "dam" by compressing the geologic matrix is simply physically impossible in this area.

The second primary reason they cite is that BCC development would increase the amount of water (recharge) reporting to the ground water in the area and negatively affect their basement sumping. Telesto has done extensive calculations to evaluate the potential range of change in the amount of water reporting to the ground water system after development, which has been reviewed by two independent experts hired by the City and deemed correct in the overall result that development would not make the ground water situation worse. Regardless, the neighbor's experts have claimed that the analysis is flawed such that the opposite conclusion must be reached. Telesto has updated the evaluations by measuring actual ditch leakage and taking into consideration the neighbor's criticisms (within the realm of physical possibilities) and review by the City experts. As shown in Figure 5, the updated estimates still conclude that recharge created by developing the property still results in less water moving to the ground water system. Thus, the conclusion reached by the neighbors is flawed.

Component	June 2012 Estimate	2013 Updated Estimate	June 2012 Estimate	2013 Updated Estimate
	Developed Condition		Pre-Developed Flood Irrigation Condition	
Summer				
Areal Recharge	17.8	21.5	51.3	51.2
Dry Creek Ditch No. 2 Leakage	0.0	0.0	64.7	35
Summer Total	17.8	21.5	116	86
Developed - Pre-Development	-	-	-98.2	-64.7
Winter				
Areal Recharge	12.5	12.7	10.2	10.3
Dry Creek Ditch No. 2 Leakage	0.0	0.0	0	0.0
Winter Total	12.5	12.7	10.2	10.3
Developed - Pre-Development	-	-	2.3	2.4
Annual Total	15.2	17.1	63	48
Developed - Pre-Development	-	-	-48	-31

NEGATIVE NUMBERS INDICATE LESS RECHARGE TO GROUND WATER

FIGURE 5. EVALUATION COMPARISON

Additionally, when considering the development potential for the property, all the factors that affect the amount of water reporting to the ground water system can be controlled by engineering and proper planning. So even if one doesn't choose to believe the numbers in the report, the processes examined provide guidance for annexation agreements and project planning. For example, rather than having grass areas in front of homes, xeriscaping can be used to limit the amount of irrigation water applied, or storm water drainage systems can be designed to limit the height of the ground water table, reducing the amount of ground water flowing off of site (i.e., as the ground water table rises, the excess water reaches the surface and runs off much more quickly than it flows through the ground water system).

At the end of the day, BCC can only control factors affecting ground water within the Project boundaries. These include reducing irrigation areas, reducing ditch leakage, and designing surface drainage to control the maximum elevation of ground water at its boundaries. All of these things can be managed through the annexation and planning process. Additionally, the ground water issues managed by the Project's neighbors will not go away after the project is constructed because the cause of their basement sump pumping is from regional processes beyond the control of the BCC development. The actions the neighbors employ now will likely continue to keep their basements dewatered in the future.

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WLN:
Enclosure
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