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September 27, 2011

Jeff Arthur
Engineering Review Manager
Planning & Development Services
1739 Broadway, 3rd fl., Boulder, CO 80302
303-441-1880

Subject: Ground Water Hydrology and the Hogan-Pancost Property

Dear Mr. Arthur:

In a meeting on January 6th, 2011 Leslie Ewy of the Sanitas Group, LLC gave a presentation to the planning board summarizing a number of studies completed for the Hogan-Pancost Property including:

- Conceptual Storm Water Management and Floodplain Mitigation
- Preliminary Subsurface Investigation
- Ground Water Evaluation
- Vegetation and Wildlife Habitat Existing Conditions / Species of Concern
- Wetland Mitigation / Enhancement and Prairie and Riparian Habitat Creation
- Groundwater Hydrology Monitoring and Wetland Delineation
- Transportation Impact Feasibility Study.

All studies were previously submitted to the planning department and reviewed by an independent consultant who concluded:

> "In general, the reports reviewed in relation to the Boulder Creek Commons, LLC proposed development of the Hogan/Pancost Property meets the requirements outlined in the ***City of Boulder Design and Construction Standards, November 16, 2000*** and in ***The City of Boulder Revised Code (BRC) Title 9, Land Use Regulations, 198.*** In addition, a review of On-site natural resources, drainage, groundwater and soil issues against currently acceptable engineering standards of practice was completed and found that the modeling and procedures used to evaluate the On-site natural resources, drainage, groundwater and soil issues does meet current and acceptable engineering standards of practice and no additional information is requested at this time."

Given the public comment, and the questions from the board regarding the Ground Water Evaluation, it was apparent that it would be beneficial for the board to gain further understanding

of the basics of ground water hydrology. In response, planning department staff retained Mr. Gary D. Witt of Wright Water Engineers to give an introductory presentation on ground water hydrology to the City of Boulder Planning Board on May 5th, 2011. The presentation provided a general overview of basic ground water hydrology.

Although Mr. Witt's presentation was informative, the presentation was not intended to provide information on the ground water hydrology of a particular site (i.e., the Hogan-Pancost property). The purpose of this letter is to address some of the site specific questions raised during the public comment session, address questions raised by the planning board at the January 6th, 2011 meeting, and provide relevant ground water hydrology information pertinent to the Hogan-Pancost property. For clarity, the information presented herein is in a question and response format.

The Hogan-Pancost property is located in the South Boulder Creek watershed. Precipitation, snow melt, storm water runoff, agricultural irrigation and residential irrigation are factors that can affect ground water levels.

Question: What is the lateral extent of the ground water?

Response: The location of the Hogan-Pancost property in relation to the approximate lateral extent of the alluvial ground water system is shown in Figure 1. The lateral extent of the alluvial ground water system was estimated based on stream locations, ground elevations and the well location data obtained from the Colorado Department of Water Resources, Department of Natural Resources. As can be seen from the figure, the ground water below the Hogan-Pancost property represents a small fraction of the overall ground water system.

Question: How does the Hogan-Pancost property area compare to the South Boulder Creek watershed area that recharges ground water?

Response: The 22-acre Hogan-Pancost property covers only 0.04 square miles which is 0.03% of the 132 square mile (84,480 acres) South Boulder Creek watershed. (Figure 2)

Question: What can cause ground water levels to rise and fall?

Response: Ground water levels rise and fall in response to the amount of recharge that becomes ground water.

Question: But, what is recharge?

Response: It is simply the water that flows to ground water. Recharge occurs when water from precipitation, snowmelt, agricultural irrigation, lawn irrigation and seepage from ponds, streams and unlined irrigation ditches flows into the ground water system. Storm water runoff, evapo-

transpiration by vegetation, and surface evaporation reduce the amount of water that can become ground water.

Question: How do these factors affect seasonal ground water levels?

Response:

- **Fall and Winter = Seasonal Low Ground Water** (Figure 3) In the late fall and winter, the ground water levels have dropped because: 1) South Boulder Creek has drained the area due to its low flow condition, and 2) recharge to ground water is limited because snow melt is not prevalent, surface ponds are not full and residential lawn watering does not exist.
- **Early Spring = Ground Water Levels Begin to Rise** (Figure 4) In early spring, flow in South Boulder Creek starts to increase due to mountain snow melt from high in the watershed, surface ponds fill, local snowmelt starts, and precipitation increases. If precipitation is lower than normal, lawn irrigation will begin in developed areas in the watershed. These increases start to raise the ground water level.
- **Late Spring and Early Summer = Seasonal High Ground Water** (Figure 5) By late spring and early summer, ground water has been replenished by inflows from South Boulder Creek, leaking ponds and irrigation ditches, natural precipitation recharge, and recharge from residential lawn watering. Seasonal flood irrigation by the neighbor located to the immediate south (5692 S Boulder Rd) contributes to the local rise in the ground water levels as evidenced by the thick vegetation along south Hogan-Pancost property line. Ground water levels during this period are high enough that it intersects basement sumps which then must be pumped.

  Ground water levels in the spring can increase quickly and dramatically. This past spring the ground water levels came up 42 inches within 16 days (Figure 6). Ground water levels are typically at maximum elevations during this time.
- **Late Summer = Ground Water Level Begin to Drop** (Figure 7) As summer progresses, South Boulder Creek no longer carries snowmelt from high in the watershed and the flow is now sustained by the stored ground water. South Boulder Creek begins to drain ground water. Locally, the water level remains elevated in comparison to winter conditions due to recharge from residential lawn watering, leakage of surface ponds and reservoirs, ditch leakage and local flood irrigation. As these mechanisms cease in early fall, the ground water levels decline rapidly back to winter conditions.

Question: What effect will the development of the Hogan-Pancost property have on the local ground water level?

Response: It is not possible for the development on Hogan-Pancost property to significantly influence the local ground water level because the lateral extent of the underlying ground water is so extensive and the property represents only a small fraction (0.03%) of the total watershed area. The property owners can only control on-site recharge.

Recharge to ground water from the development area will attempt to mimic the current recharge condition. As a result, development will not increase recharge to ground water or increase the elevation of the local ground water level. Piping Dry Creek Ditch No. 2 will reduce the local recharge to ground water.

Summary

The ground water underneath the Hogan-Pancost property is part of a much larger ground water system. Recharge to ground water occurs throughout the South Boulder Creek watershed. However, the Hogan-Pancost property represents only 0.03% of the 132 square mile South Boulder Creek watershed. Therefore, in the absence of flood irrigation, it is not possible for development irrigation to significantly influence local ground water levels. However, flood irrigation by the neighbor located to the immediate south will continue to contribute to a seasonal local rise in ground water levels. The Hogan-Pancost property owners can only control recharge occurring on their property and will do so by attempting to mimic current hydrological conditions by controlling recharge sources and rates.

Sincerely,

Telesto Solutions, Inc.

Terence M Fairbanks

Terry Fairbanks
Senior Hydrologist

Enclosure:

Figure 1 Approximate Ground Water Extent
Figure 2 South Boulder Creek Watershed
Figure 3 Hydrologic Conceptual Model Fall/Winter Conditions
Figure 4 Hydrologic Conceptual Model Fall/Winter Conditions
Figure 5 Hydrologic Conceptual Model Late Spring/Early Summer
Figure 6 2011 Depth to Ground Water Measurements
Figure 7 Hydrologic Conceptual Model Late Summer Conditions

cc:

Leslie R. Ewy, PE, The Sanitas Group, LLC

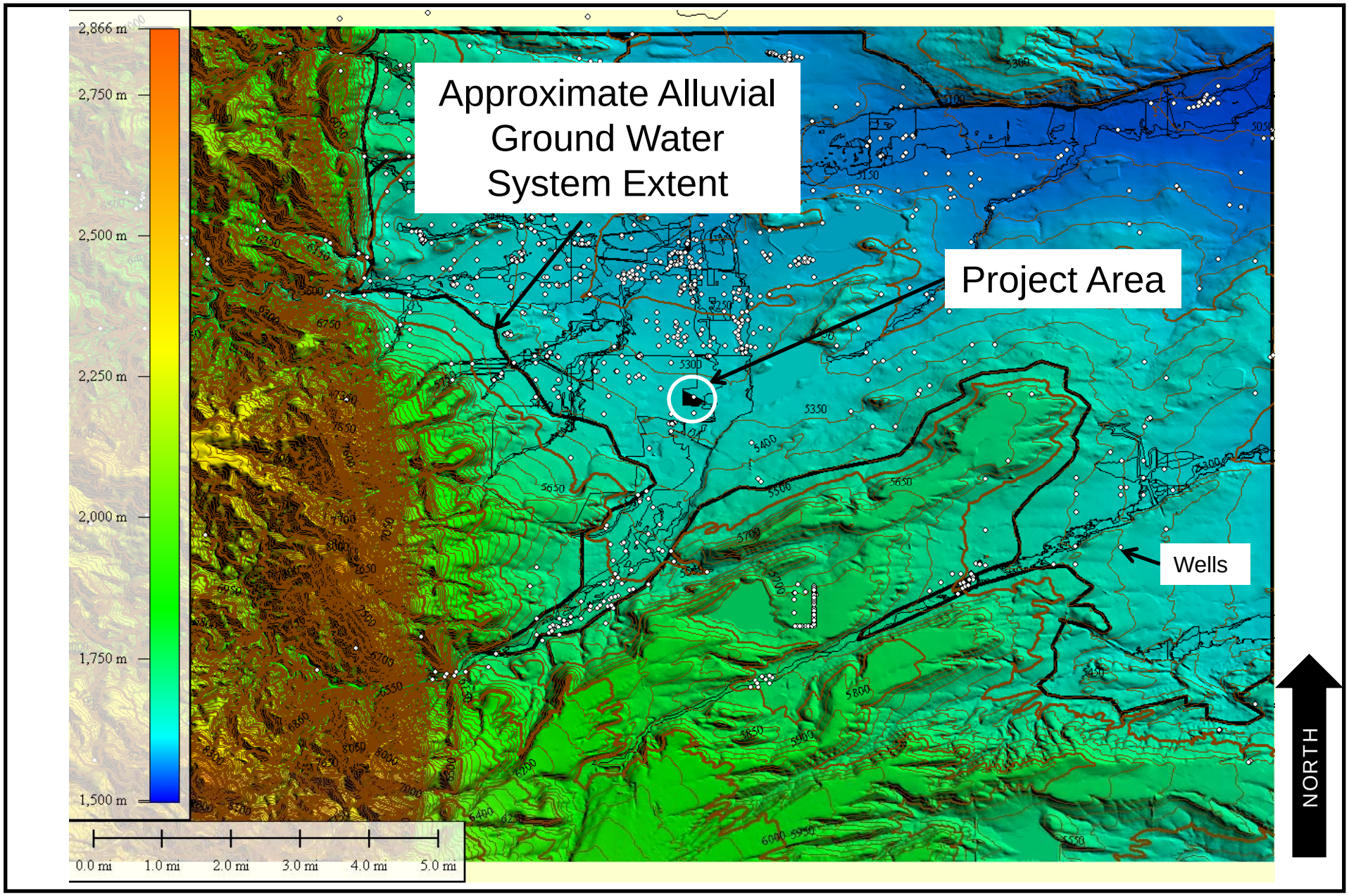

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FIGURE 1
APPROXIMATE ALLUVIAL GROUND WATER SYSTEM EXTENT

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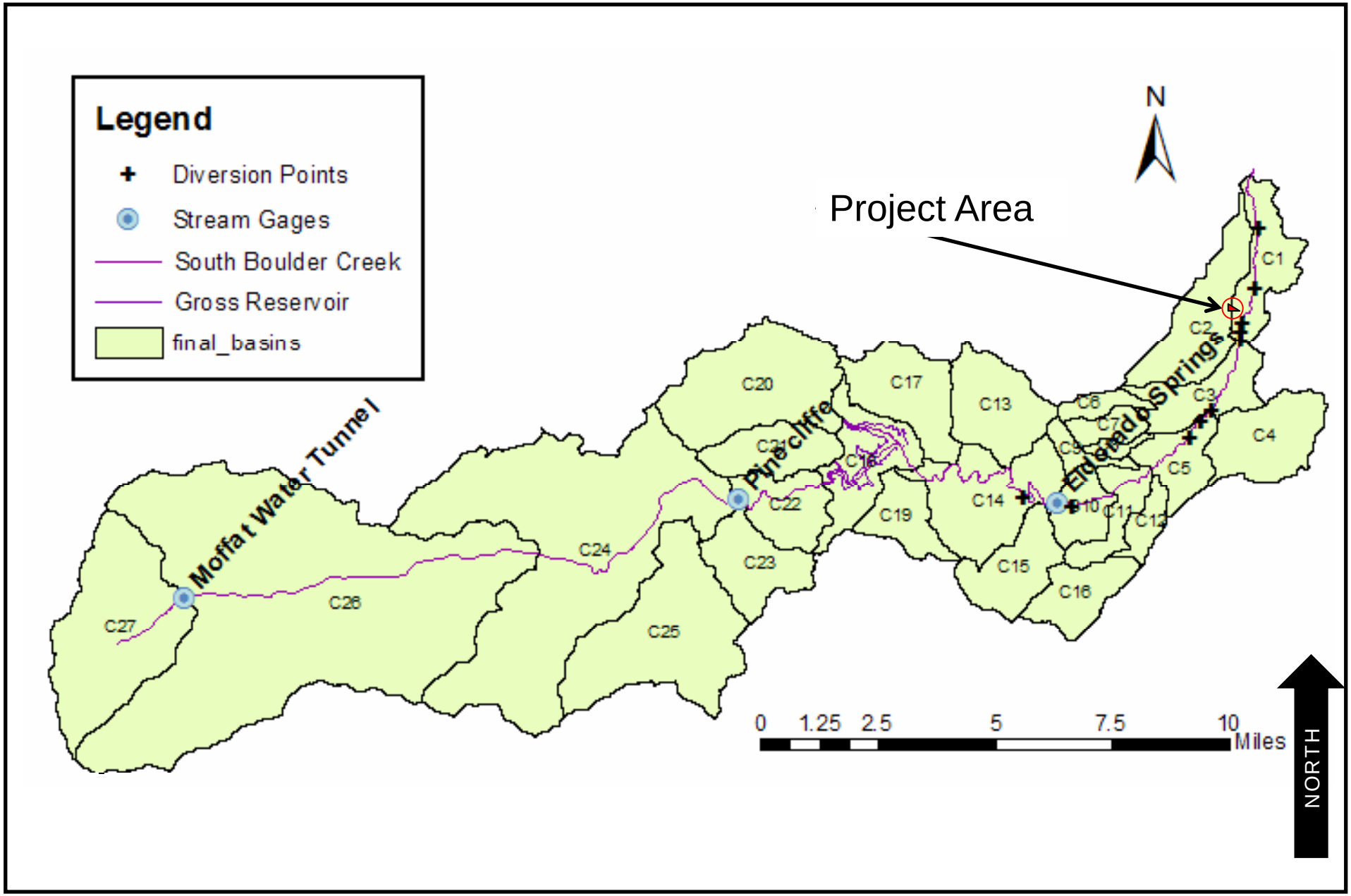

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FIGURE 2
SOUTH BOULDER CREEK WATERSHED

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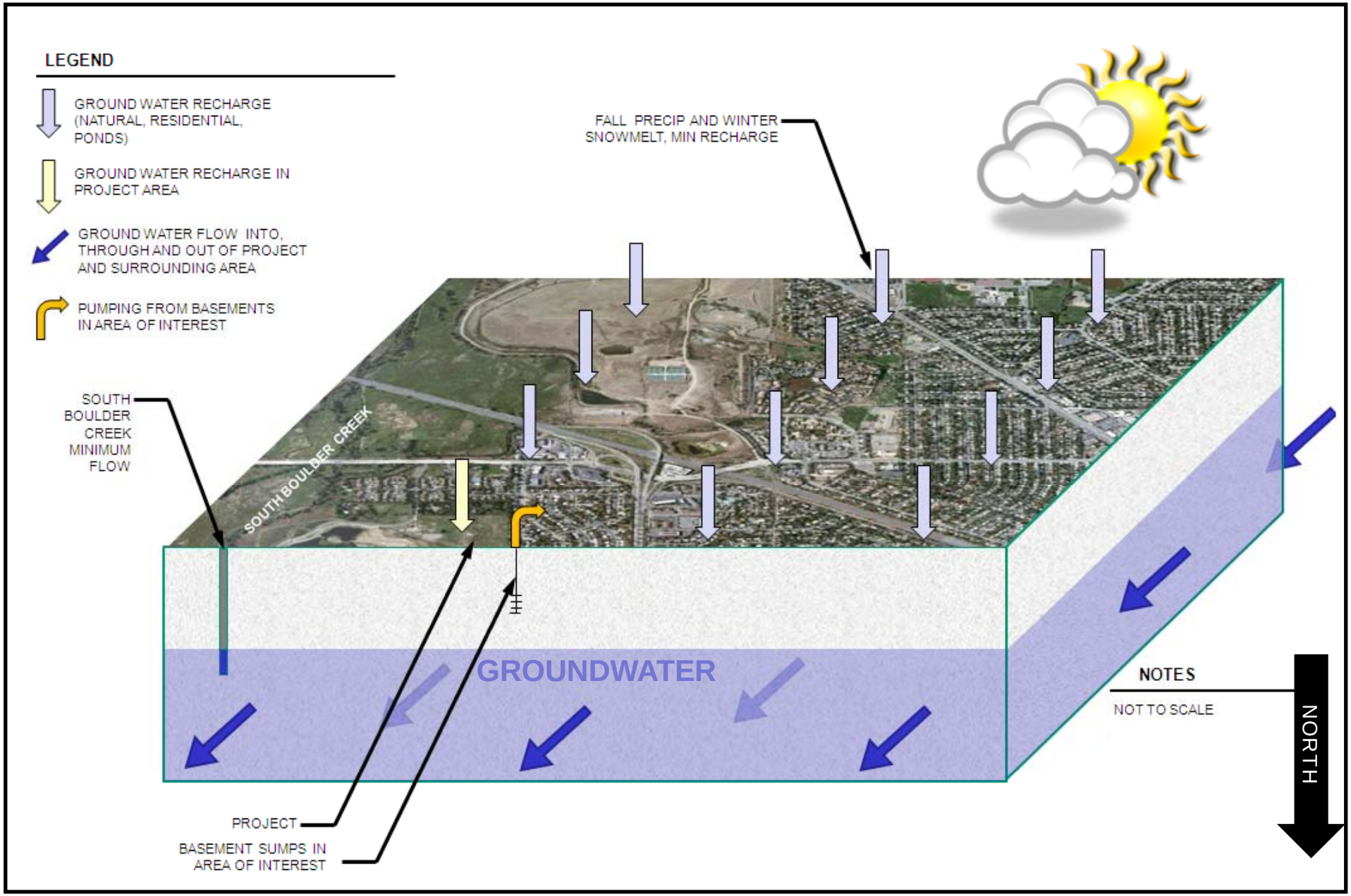

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FIGURE 3
HYDROLOGIC CONCEPTUAL MODEL FALL/WINTER CONDITIONS

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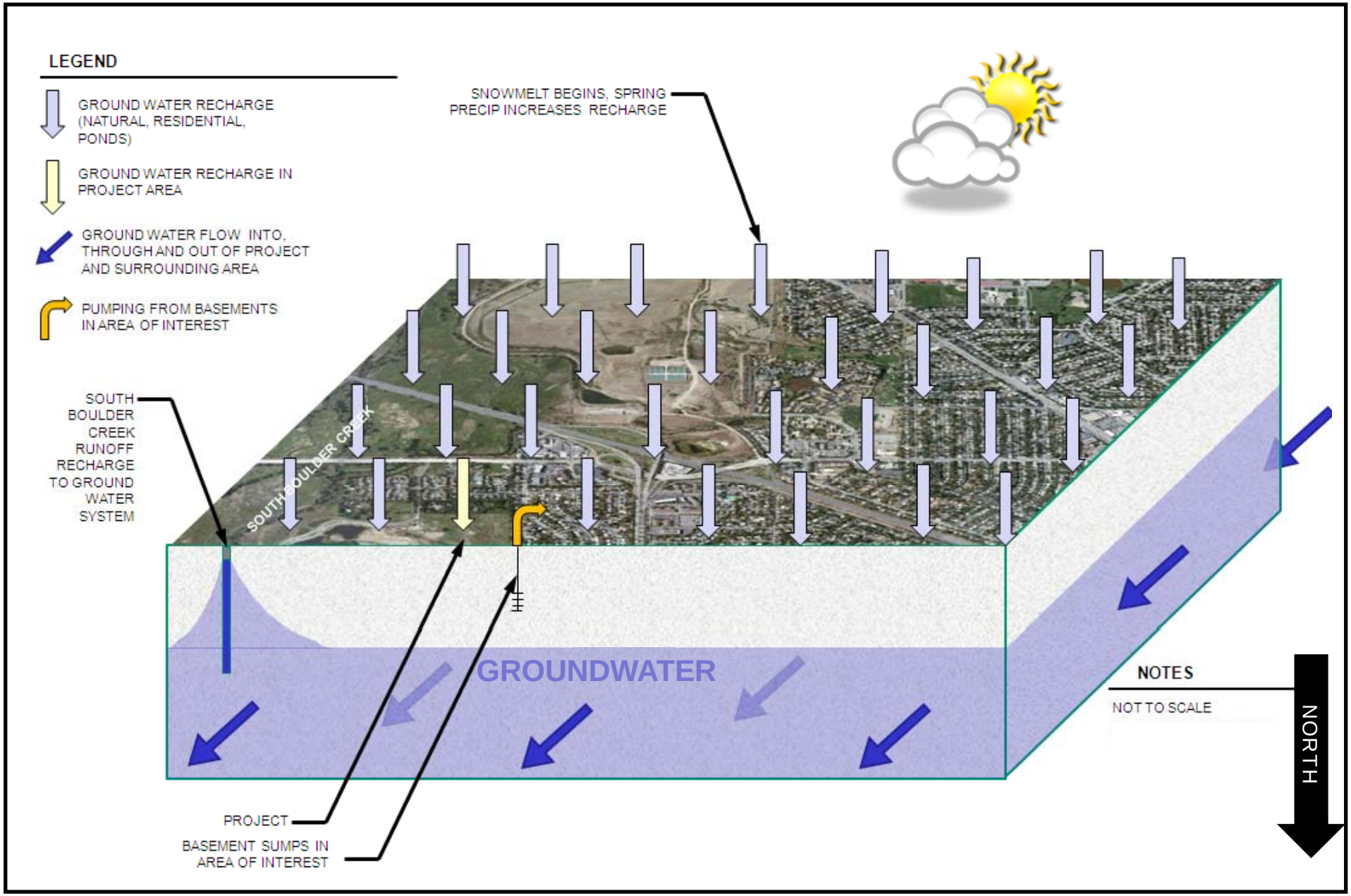

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FIGURE 4
HYDROLOGIC CONCEPTUAL MODEL FALL/WINTER CONDITIONS

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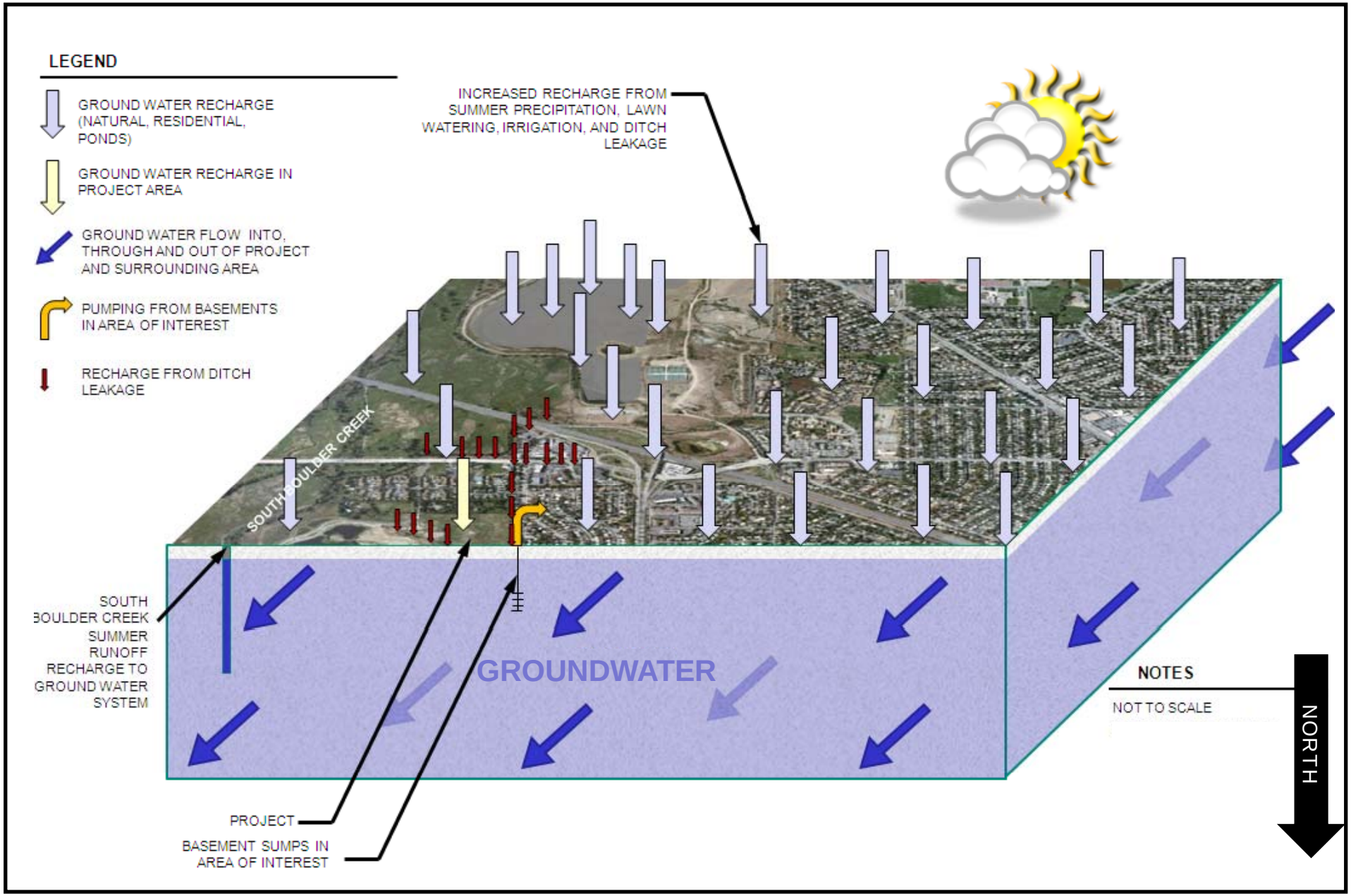

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FIGURE 5
HYDROLOGIC CONCEPTUAL MODEL LATE SPRING/EARLY SUMMER

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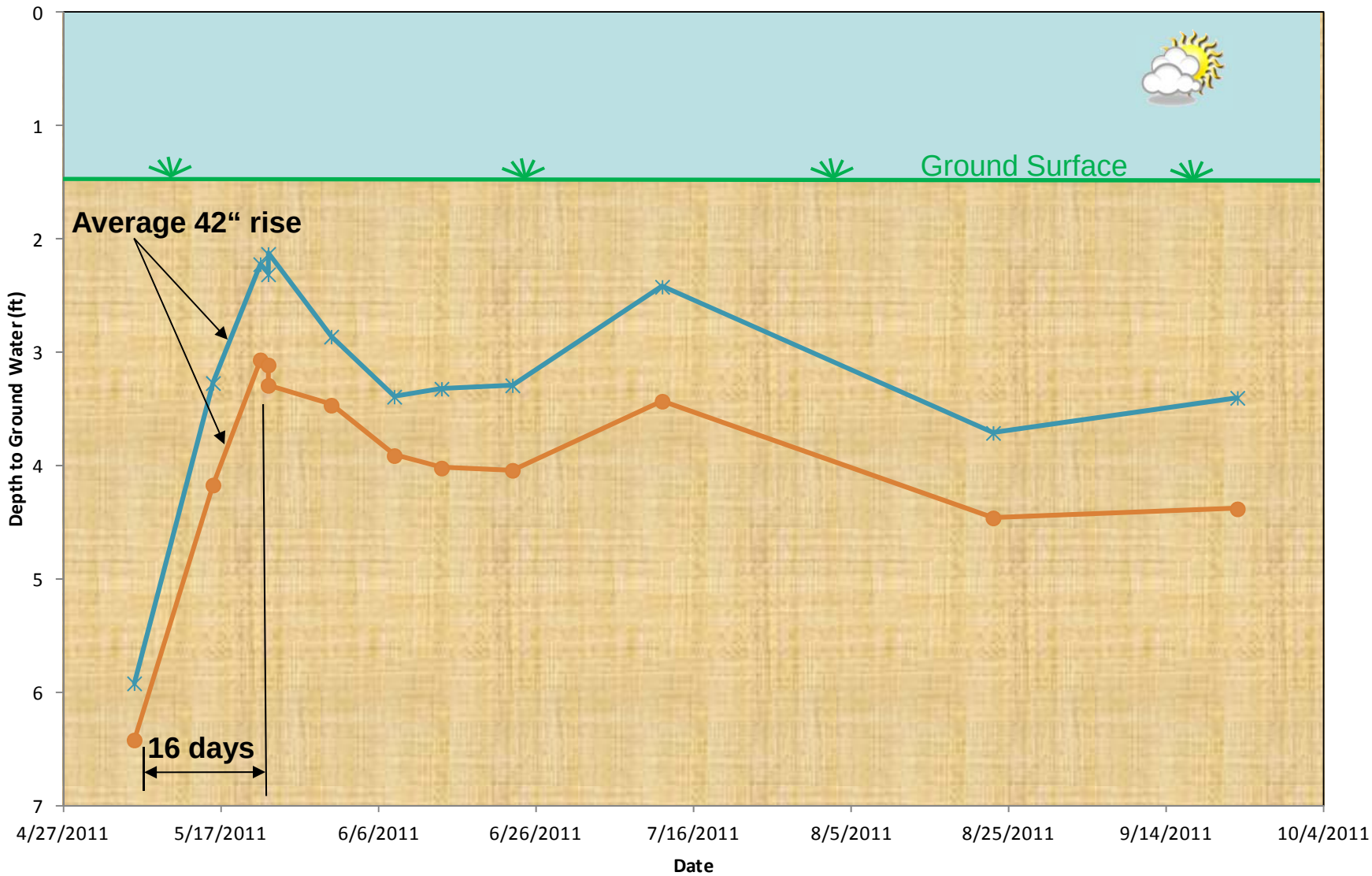

The average ground water level rise between 5/6/11 & 5/22/11 was 42.3” (PVC-SE = 44.4”, PVC-SW = 40.3”)

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FIGURE 6
2011 MEASURED DEPTH TO GROUND WATER

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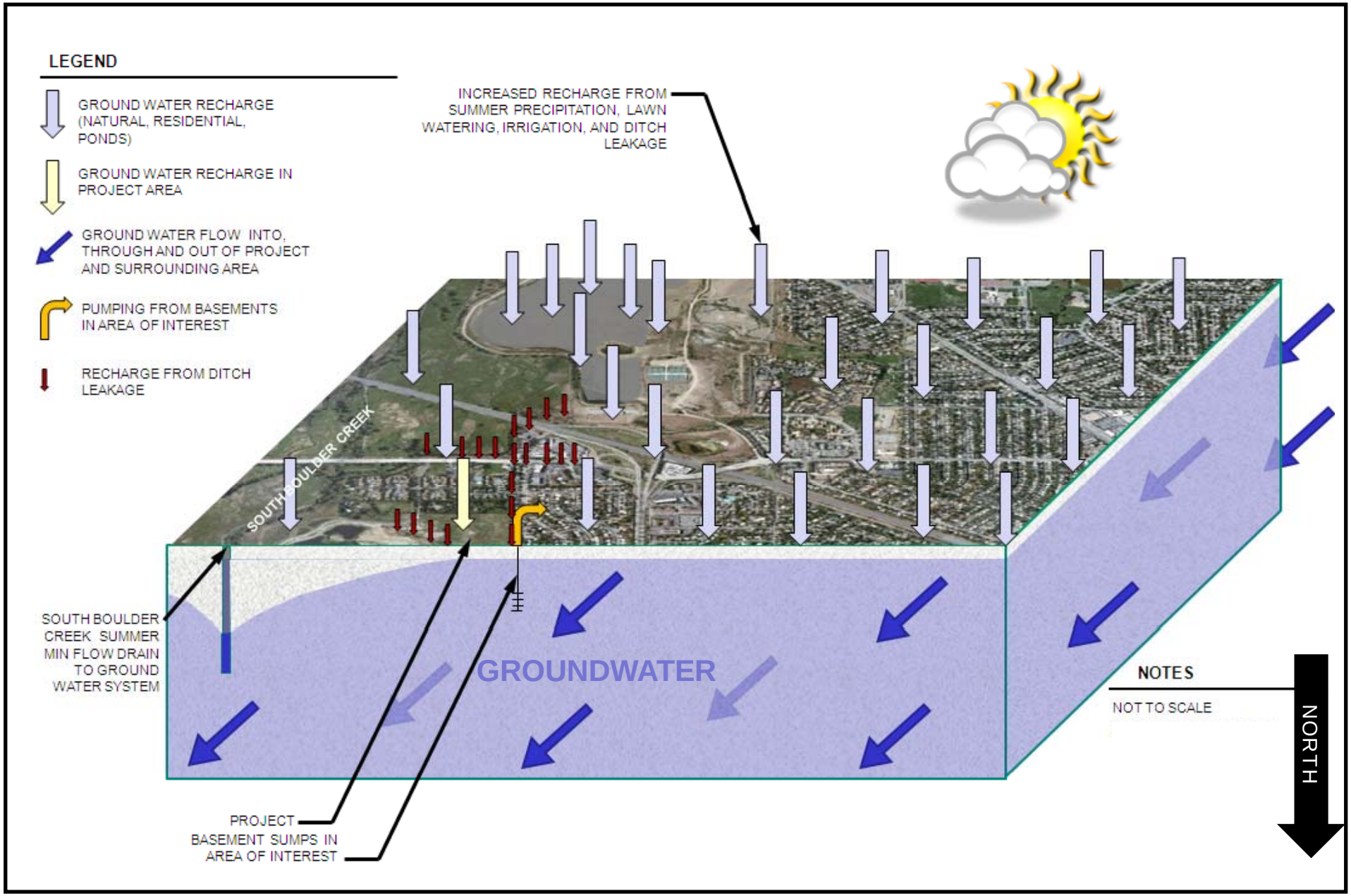

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FIGURE 7
HYDROLOGIC CONCEPTUAL MODEL LATE SUMMER CONDITIONS

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