USGS/UNIVERSITY OF UTAH SUGGESTIONS FOR GROUNDWATER MONITORING
MOAB-SPANISH VALLEY
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Prepared by:

Vic Heilweil (USGS), Melissa Masbruch (USGS), Phil Gardner (USGS), Nora Nelson (USGS), David O'Leary (USGS), Kip Solomon (University of Utah), Chris Wilkowske (USGS).

The State of Utah's Department of Natural Resources Division of Water Rights (DWRi) has been proactive in supporting studies and data collection to guide future sustainable development of groundwater in Spanish Valley, Utah. DWRi is currently developing a Groundwater Management Plan, including an evaluation of possible improvements to the existing monitoring network. As a complement to their decades-long support of long-term monitoring of water levels at wells and streamflow along upper Mill Creek by USGS and the Moab Area Watershed Partnership (MAWP), DWRi has recently provided matching funds for a new USGS gage on lower Mill Creek and additional streamflow monitoring by MAWP. DWRi is requesting suggestions for additional groundwater monitoring to aid them in making future decisions on well withdrawals in the valley. Such monitoring data, collected by the USGS, MAWP, or other local agencies, could also be used for future groundwater flow modeling (numerical simulation) efforts. The following is a prioritized list of additional monitoring suggestions for consideration by DWRi:

1. <u>Continuous spring discharge measurements</u>: Continuous monitoring of spring discharge from the Glen Canyon Group Aquifer (GCGA) will provide fundamental data for future numerical modelling efforts and predictions used for resource management. Springs that provide culinary water to the City of Moab are one of the largest components of discharge from the GCGA. As such, USGS recommends that the City of Moab undertake an effort (including re-plumbing if necessary) to permit the continuous measurement of total discharge from all springs used as culinary water sources, rather than just the fractions of spring water diverted for use. The USGS and MAWP could work with Moab City to determine how to best make continuous

measurement of discharge. Criteria includes access for measurement of the full discharge before any diversions into their water-supply system. A continuous monitoring system would ideally comprise in-line flow meters (which must be kept in calibration) but could instead include pressure transducers installed in Parshall flumes. In addition to monitoring Moab City springs, continuous monitoring of one or more GCGA springs such as Old City Park Spring (not currently used for public supply) and/or Water Park North Spring (Jennifer Speers, owner) is also recommended.

2. <u>Continuous groundwater-level monitoring of in wells using dedicated submersible pressure transducers:</u> Emphasis should be placed on monitoring of groundwater levels in the GCGA, the aquifer containing the best-quality groundwater (and primary source of drinking water) for Spanish Valley. However, monitoring of a pair of wells or a multi-depth piezometer screened in both the GCGA and the Valley-Fill Aquifer (VFA) would provide useful information on interactions between these two aquifers and could be used as an early warning indicator of the possibility of inducing poorer-quality VFA groundwater into the GCGA with increased pumping from the GCGA. Two options (from more to less expensive) include:

    a. Drilling a new multi-level monitoring well completed in both the shallower VFA and deeper GCGA. This could be drilled near one of the larger springs that Moab currently uses for culinary supply. To balance observing the influences of seasonal pumping with long-term trends in water levels, the nested piezometer well should be located a reasonable distance from production wells. With proper planning, water-level monitoring may be able to differentiate the effects of pumping withdrawals from climate-driven trends.

    b. Identifying an existing unused (abandoned) well that is screened in the GCGA. Well-integrity testing would be needed to confirm hydraulic connection between the well bore and surrounding aquifer. While this is less expensive than a new monitoring well, the unknown quality of casing and cement seals in existing/abandoned wells may not yield as accurate water-level data. If a separate abandoned nearby well screened in the

VFA could be located, continuous monitoring of these two existing wells could be used for aquifer testing to evaluate the hydraulic connection between the two aquifers. Unused or idled long-screened wells also present an opportunity to evaluate the vertical distribution of flow into the well under both pumped and unpumped conditions and to evaluate the groundwater chemistry of the pumped aquifer(s). Knowledge of how water enters the well under pumped conditions and how water redistributes through the aquifer under unpumped conditions can be used to provide both qualitative and quantitative information regarding aquifer hydrology and geochemistry and can be used to establish baseline aquifer conditions.

3. Stream gage on upper Pack Creek (perhaps at Pack Creek Road Bridge): Streamflow losses from Pack Creek are likely the main source of recharge to the VFA. Continuous year-round measured streamflow in upper Pack Creek will help to constrain recharge to the VFA.

4. Water quality sampling: sampling could include (a) targeted stable oxygen/deuterium isotope sampling of newly developed wells or springs that can be used for evaluating the source aquifer (e.g. GCGA versus VFA) and; (b) quarterly or annual sampling of major ions and selected trace elements (e.g., bromide) at existing GCGA wells or springs; (c) annual vertical profiling of specific conductance in existing monitoring wells in Matheson Wetlands Preserve. Samples for oxygen and deuterium isotopes are easy to collect, inexpensive to analyze, and have been shown to distinguish deep GCGA water from poorer-quality VFA water and(or) underlying brine (associated with the Paradox Formation). Major-ion chemistry and ratios of selected dissolved constituents (e.g. Cl/Br) are also useful for identifying groundwater sources and mixtures. These data can be used to evaluate changes in water quality caused by inducing flow from poorer-quality aquifers, such as the VFA or underlying brine. Vertical profiling of specific conductance (a proxy for salinity) in the wetland will show changes in the thickness of freshwater lens and indicate migration the underlying brine. This monitoring can serve as an early warning against pumping induced salinization of fresh groundwater resources to the southeast. This information

also will be needed for defining this important boundary in any future numerical groundwater flow model (see #6 below).

5. Continuous water-quality monitoring: Specific conductance and temperature monitoring of wells or springs in the GCGA can be used to evaluate changes in water quality caused by natural processes (e.g. droughts) or development (e.g. increased well withdrawals). Such monitoring could serve as an early-warning system for protection of the quality and quantity of GCGA resources. Also, such monitoring can detect the presence of very young water during storm events that can signal potential problems with the spring box and its seal.

6. Data to support future numerical groundwater flow modeling: We recommend that a numerical flow model be developed to: (1) test recently updated hypotheses regarding aquifer connections, recharge zones, and flow directions; (2) assess the recently revised (decreased) groundwater budget estimates; (3) optimize locations of additional groundwater monitoring sites; and (4) simulate changes to the groundwater system based on potential future changes in climate and/or groundwater development. Currently, a numerical model integrating both surface water and groundwater flow is being constructed by the USGS for the Upper Colorado River Basin, with a proposed publication date of fall 2022. This model can be used as a base for developing a more refined model for the Spanish Valley area through local grid refinement, or it could serve as a starting point for a detailed stand-alone model of the Moab-Spanish Valley groundwater system. The proposed additional monitoring (Items 1-5 above) would greatly increase the amount of model calibration targets (observations) in the area, thereby reducing uncertainty in predictive simulations of the effects of potential future changes in climate and/or groundwater development on the groundwater and surface-water system. For this type of model, continuous groundwater discharge data (e.g. flow to streams or springs) is a very useful tool that can help reduce uncertainty in simulated aquifer properties, such as hydraulic conductivity. This modeling effort will need to compile and evaluate the quality of well testing results (e.g. existing aquifer properties data) and identify the need for additional aquifer tests to be used in numerical groundwater modeling.

7. Utilize the USGS "Furnished Data" program to publish water level data collected by other agencies. Furnished water level data is data that is collected by other agencies (for instance UDWR, MAWP, Moab City, GWSSA) and subsequently reviewed for quality assurance by USGS personnel. If approved, the data is then made publicly available through the USGS National Water Information System (NWIS) database (https://waterdata.usgs.gov/nwis). Data collection methods and equipment need to meet USGS protocols to be approved. While there is a nominal cost associated with review of the data, this may be a useful mechanism to consolidate and archive groundwater monitoring data collected by various agencies in Spanish Valley. USGS can also provide basic training and quality-assurance of equipment, such as calibration of water-level measurement tapes at the USGS Hydrologic Instrumentation Facility (HIF). Other equipment, such as certified pressure transducers, can also be purchased through HIF by partner agencies.