Lake Powell Pipeline

Draft Groundwater Resources Work Plan

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Section 1
Introduction

The purpose of this work plan is to define the procedures for analyzing impacts on Groundwater Resources associated with construction and operation of the Lake Powell Pipeline (LPP). This work plan presents the issues and concerns, defines the impact area and significance criteria, describes the analysis methodology, reviews existing data and identifies data needs, references an outline for the Groundwater Resource Technical Report, and identifies dependency items and relationships to other resources.

Section 2
Issues

Groundwater-related issues and concerns identified during the formal scoping process will be addressed in the analysis for the LPP alternatives. Related questions raised during the informal scoping process have been consolidated into the following issue(s).

- What impacts would occur on groundwater resources from construction and operation of the LPP?
- How would seepage from reservoirs, forebays and afterbays associated with the LPP affect groundwater recharge?
- How would groundwater recharge associated with the LPP affect the availability of groundwater resources in the vicinity of St. George?
- How would construction of the pipeline affect groundwater along streams crossing the LPP alignment?

Additional issues that arise during the formal scoping process, or during the preparation of the analysis, will be added and addressed.

Section 3
Impact Topics

The groundwater impact topics include the following:

- Groundwater levels
- Groundwater recharge
- Groundwater production
- Groundwater along streams and rivers

Section 4
Impact Area and Significance Criteria

4.1 Impact Area

The impact area would include the following:

- St. George and vicinity affected by development of groundwater resources
- The area immediately around Sand Hollow Reservoir
- Reservoirs, wetlands, and stream crossings along the LPP alignment.

4.2 Significance Criteria for Each Impact Topic

Impacts on groundwater resources would be considered significant if construction, operation or maintenance activities would result in any of the following conditions:

- Substantial changes in the availability of groundwater supplies for municipal, industrial, agricultural, or domestic uses
- Changes in groundwater levels that would substantially affect the size and/or growing seasons of documented wetlands
- Changes in the rate of groundwater seepage that would substantially affect the rate and/or periods of baseflow recharge to streams and rivers.

Section 5
Methodology

5.1 Introduction and Overall Approach

Groundwater resources will be analyzed by a review of groundwater reports, databases, and maps; field reconnaissance to identify seeps, springs, wetlands and other areas that would likely be affected by LPP activities; observation well installations at selected locations to measure groundwater occurrence and levels; groundwater level measurements at observation wells and selected production wells to improve characterization of groundwater levels; shallow subsurface infiltration tests at selected locations associated with reservoirs and points of LPP discharge to evaluate recharge capacities; aquifer tests at selected locations to approximate aquifer hydraulic conditions; groundwater flow modeling at primary points of recharge; evaluation of data and findings; and report preparation.

5.1.1 Definition of Baseline Conditions

Groundwater resource baseline conditions will be based on average groundwater conditions for the period 1995 through 2005. Dry conditions will be modeled using groundwater level conditions available for a year characteristic of dry years, defined for these purposes as the year closest to two standard deviations below the average annual precipitation for the baseline condition period. Likewise, wet conditions will be

modeled using groundwater levels from a year closest to two standard deviations above average annual precipitation for the baseline period.

5.1.2 Analysis of Alternatives

Impacts on groundwater resources will be analyzed for each of the alternatives. These impacts will be measured by determining whether changes in groundwater levels would occur as a result of the LPP alternatives and whether these changes in groundwater levels would affect the availability of groundwater for municipal, industrial, agricultural, or domestic production, or would affect groundwater losses to rivers and streams, or would affect groundwater levels along streams and in the vicinity of wetlands.

5.1.2.1 Review of Existing Hydrogeologic Literature

Existing hydrogeologic and soils data and information relevant to the LPP project that are available in current published reports, maps, well logs, and literature will be identified from agency sources such as the U.S. Geological Survey, the Utah Geological Survey, the Natural Resource Conservation Service, the U.S. Bureau of Reclamation, the affected counties, and similar sources. Previous preliminary investigation work also will be obtained and reviewed. General locations and depths of municipal, industrial, and agricultural wells in the immediate vicinity of Sand Hollow Reservoir, Quail Creek Reservoir, and the Cedar City recharge basin will be extracted from the well log databases.

5.1.2.2 Field Reconnaissance

Field reconnaissance will include a physical inspection of each alternative alignment. Particular attention will be given to locations and features identified in the hydrogeologic literature review that may be affected by LPP construction or operation. Any additional features identified in the field that were not included in the literature will also be documented and a preliminary description will be prepared. An effort will be made to locate seeps, springs, and wetlands near the pipeline alignments and at Sand Hollow Reservoir. Existing wells that were identified in the literature review that may be useful in characterizing groundwater conditions will be located and inspected, provided that access to the wells is granted by the owners.

5.1.2.3 Technical Memorandum

Correlation of information obtained from the literature review and the field reconnaissance will be performed. This will include determining whether field observations are generally consistent with hydrogeologic and soil descriptions obtained from the literature. Where differences are noted that are relevant to groundwater resources, these differences will be described.

A technical memorandum (TM) will be prepared summarizing the findings. The TM will be used by the LPP team and the Utah Division of Water Resources to assist in selecting a preferred alignment.

5.1.2.4 Subsurface Hydrogeologic Investigations

Following selection of the preferred alignment, subsurface hydrogeologic investigations will be performed to verify literature review and surface reconnaissance conclusions and to define groundwater conditions. This will consist of installation of test and observation wells, two rounds of static groundwater level measurements at existing and new wells, and aquifer pumping tests in selected wells.

Additional shallow piezometers may be required at other selected locations, such as near wetlands and

streams crossed by the selected alignment of the LPP. It is assumed that six 15-foot piezometers may be installed near these features.

All new wells and piezometers will be permitted and constructed in accordance with state regulatory requirements, using a licensed well driller. Well driller reports/logs will be prepared and submitted to the regulatory agencies as required, and well logs will be used to supplement available hydrogeologic information.

Static water level measurements will be collected from selected existing wells and from the new test wells and piezometers. It is assumed that up to 6 existing wells will be screened in the shallow groundwater affected by recharge and will be accessible for measurements. It is further assumed that 4 new wells and piezometers will be available for static water level measurements. Static water level measurements will be collected from all of the selected wells within a 48-hour period on two occasions, approximately six months apart, representing a period of higher groundwater elevations and lower groundwater elevations.

Aquifer pumping tests will be performed in selected new and/or existing wells to characterize the aquifer hydraulic parameters (hydraulic conductivity, transmissivity, storativity). It is assumed that up to four wells will be used for aquifer pumping tests, and additional observation wells will be used for pump test monitoring as available and appropriate. Each set of aquifer tests will include a preliminary observation of static water levels, a step-rate test consisting of four 1-hour steps at progressively higher flowrates, a 24-hour constant-rate pumping test, and a recovery test observation period of up to 24 hours. Water levels will be measured using automated dataloggers and pressure transducers, as well as periodic manual measurements. Static water level measurements and aquifer pumping test results will be analyzed using standard techniques to determine aquifer hydraulic parameters.

5.1.2.5 Analysis and Recommendations

The findings of the subsurface hydrogeologic investigations and flow modeling will be analyzed to characterize the existing hydrogeologic conditions in the study area as they would affect groundwater resources. The results of modeling will be summarized with piezometric surface contour maps and piezometric difference maps to illustrate drawdown or rise. Flow budgets will be provided to illustrate estimated changes in fluxes between alternatives. If essential data gaps are identified that would require additional characterization, recommendations will be made for accomplishing this.

5.1.2.6 Prepare Technical Report

A Technical Report will be prepared summarizing the results of the hydrogeologic characterization. An outline of the report is referenced in Section 8.

5.1.3. Analysis of Cumulative Impacts

The groundwater resource cumulative impacts analysis will address the combined impacts of the alternatives and any past or future proposed or planned actions that have or are likely to affect the groundwater resources in the impact area. Specific inter-related projects will be identified as applicable. The cumulative impacts will be documented in the Technical Report.

Section 6
Data Needs and Analysis

6.1 Data Needed

The data needed to perform the analysis include:

- Regular, seasonal groundwater level records near receiving reservoirs, infiltration basins, streams and wetlands for the baseline period
- Infiltration test data for the locations of reservoirs
- Aquifer hydraulic data (hydraulic conductivity, transmissivity, aquifer thicknesses, storativity)
- Well locations, well construction logs, and geologic logs
- Groundwater contribution quantification for gaining streams and rivers.

6.2 Data Available and Adequacy

Much of the data required to complete the groundwater resources analysis can be acquired from the following identified and existing sources:

- Limited USGS groundwater well data available at: http://waterdata.usgs.gov/ut/nwis
- USGS groundwater publications at http://ut.water.usgs.gov/newUTAH/waterdata/index.html
- Well logs and geologic logs available from the Utah Department of Water Resources, Division of Water Rights at http://www.waterrights.utah.gov/wellinfo/default.asp
- General groundwater modeling showing some characteristics of groundwater in regional bedrock in Thomas, B.E., 1985, Simulation analysis of water-level changes in the Navajo Sandstone due to changes in the altitude of Lake Powell near Wahweap Bay, Utah and Arizona. U.S. Geological Survey Water-Resources Investigations Report 85-4207
- Generalized groundwater and aquifer information in Virgin River Watershed Management Committee, 2006, Virgin River Watershed Management Plan, February 2006
- General information on seeps, springs, wells, and some groundwater information in the Arizona Strip, in Bureau of Land Management, 2006, Final Environmental Impact Statement, Management Plan for the Arizona Strip
- Soils and limited groundwater information in Natural Resource Conservation Service reports for Iron, Kane, and Washington Counties
- Weiss, E., 1991. Regional ground-water flow in upper and middle Paleozoic rocks in southeastern Utah and adjacent parts of Arizona, Colorado, and New Mexico**.** U.S. Geological Survey Water-Resources Investigations Report 90-4079

- V.M. Heilweil and G.W. Freethey, 1992. Simulation of ground-water flow and water-level declines caused by proposed withdrawals, Navajo Sandstone, southwestern Utah and northwestern Arizona. U.S. Geological Survey Water-Resources Investigations Report 90-4105

- V.M. Heilweil, D.D. Susong, P.M. Gardner, and D.E. Watt, 2005. Pre- and Post-Reservoir Ground-Water Conditions and Assessment of Artificial Recharge at Sand Hollow, Washington County, Utah, 1995-2005. U.S. Geological Survey Scientific Investigations Report 2005-5185.

6.3 Additional Data Needs

6.3.1 Primary

The following data will be required in addition to the data described in Section 6.2: (description of new data from field study, acquired from new demographic surveys, or from other resource field study, modeling, etc.)

- Field aquifer tests

- Field infiltration tests

6.3.2 Secondary

The following data will be required in addition to the data described in Section 6.2: (description of data need from governmental agencies, historical records, or derived from other resource analysis results, etc.)

- None.

Section 7
Procedures For Developing Mitigation

The analysis of impacts on groundwater resources will be based on the standard operating procedures and measures to avoid or reduce impacts, both of which will be included in the project description chapter of the Draft Groundwater Resources Technical Report. The significance criteria for groundwater resources will then be applied to determine if any impact would be significant. Mitigation measures would then be developed to offset significant impacts. The mitigation measures will be based on applicable state and Federal statutes and regulations, past experience and best professional judgment to either satisfy a legal requirement or to satisfy the public interest requirement. In some cases significant impacts may not be able to be mitigated. All reasonably foreseeable mitigation options will be evaluated by the Federal Energy Regulatory Commission, Bureau of Land Management, and other responsible federal agencies and factored into the respective decision documents.

Section 8
Technical Report

A technical report will be necessary to document in detail baseline conditions of and potential impacts on groundwater resources. The technical report will follow the resource technical report outline common to all resource work plans (see Resource Technical Report Outline).

Section 9
Dependency Items From Other Resources

The following items are required from other MWH Team resource specialists:

- **Mapping** - Names and/or counts of stream/wash crossings by alternative pipeline alignment, as well as locations of wetlands, reservoirs and recharge basins

- **Geology** – Types of rocks and soil along the alternative pipeline alignments where groundwater may be encountered during pipeline construction and/or operation, as well as at reservoir locations

- **Water Quality -** Groundwater and surface water quality interactions that may affect long-term aquifer permeability in the vicinity of reservoirs and recharge locations.

- **Wetlands and Riparian Areas** – Wetland locations and sensitivity to changes in groundwater levels.