

DST, GIS, Mapping and Database Support

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Introduction

In Phase II of the Walker Basin Research Project, DRI continued to provide spatial data development and analysis support to the Decision Support Tool (DST) modelers at UNR as part of an evaluation of the effectiveness of potential water right acquisitions in the Walker River Basin. DRI used geographic information systems (GIS) as a framework for acquiring and developing spatial and tabular data required as inputs for the DST. DRI, at the request of the National Fish and Wildlife Foundation (NFWF), also provided spatial data analysis, mapping, and database support directly to the Foundation for their water right acquisitions and transactions activities. This report summarizes the results of these Phase II efforts from 2010 to 2012.

Phase II Tasks

DST Support

DRI continued work conducted in Phase I to support the DST modeling team with spatial and temporal data. In Phase II, the GIS support task for DST model development required even closer collaboration between DRI and UNR as the DST Principal Investigator moved to UNR in the summer of 2010. GIS data support provided by DRI consisted of updates to diversion, hydrologic, infrastructure, imagery and water rights data originally developed in Phase I: Diversion data, Hydrologic Response Units (HRUs); delivery systems (Points of Diversion (PODs), ditches, canals, drains); wells and boreholes; parcels; administrative boundaries (Walker River Irrigation District (WRID), Walker Paiute Tribe Reservation); high resolution aerial photography; and surface and groundwater rights information.

DRI initiated a second sub-contract with History Mapping Services (HMS) of Virginia City to continue development of the surface water rights database used in the DST, with additional subtasks to provide water right transfer information for the proposed water rights acquisitions in the Wabuska area of northern Mason Valley, NV. HMS also developed water right inventory units for the West Hyland and Campbell ditch HRUs.

Based on information collected from NFWF, NFWF's other sub-contractors, the Federal Water Master, WRID, Nevada Division of Wildlife (NDOW), ditch companies, and field work, the HRU data set that represents agricultural fields serviced by common delivery systems (ditches, river pumps, and primary groundwater pumps) was updated throughout Phase II, with the data set revised in August of 2012 eventually used by the DST modelers for their latest version of the model. This latest data set included the HRUs in the East Walker River corridor provided by HMS. It also included Waterfowl Hunt Units and ponds within the NDOW Mason Valley Wildlife Management Area (MVWMA) that are serviced by various diversion ditches off of the main stem of the Walker River. Also added were irrigated pastures (West Hyland and Campbell HRUs) previously not included in the data set. New crop type designations were added to the latest HRU data set based on field data collected in 2007 and 2010.

The Place of Use/Point of Diversion (POU/POD) groundwater rights geodatabase for Mason and Smith valleys originally developed in Phase I as a collaborative effort between the Nevada Division of Water Resources (NDWR) and DRI was updated to reflect change applications to existing POU/PODs as well as revisions and corrections to the existing geodatabase. Information provided by the Basin Engineer and GIS staff at NDWR, as well as that received from potential willing sellers working with NFWF, were used for these updates and revisions.

NDWR staff also provided DRI with updates to water levels and flows for wells in Mason and Smith valleys from 1948 to 2012. DRI GIS staff modified the format of these data for use by the groundwater model development staff at DRI and the UNR DST model team to improve the groundwater component of the DST. DRI also received updated pumping data for the years 1994 to 2004 for Mason Valley in hardcopy format from NDWR; they data were converted to digital format and provided to the DST modeling team for incorporation into the model.

Using information gathered from NFWF, the Federal Water Master, WRID, NDOW, ditch companies, and field work, ditch, river pump, and drain networks were updated throughout Phase II of the project. Particular attention was focused on the ditch and drain systems in the West Hyland ditch area of Wabuska. HMS provided updates to ditches in the East Walker River corridor. Additional information provided by NFWF staff and the Federal Water Master was used to update the POD locations in Mason and Smith valleys as well as the East Walker River corridor.

DRI received monthly decree, storage and permit diversion data for ditches and river pumps on the East and West Walker rivers from WRID for the years 1996 to 2011. The data were provided in hardcopy format. DRI staff converted all the hardcopy data into a digital format (Excel spreadsheets) specified by the DST team. The data were QA/QC'd by DRI before integration into the DST by UNR staff. DRI staff spent time reconciling the ditch and pump names to those previously used by the DST team; often, when attempting to compare PODs over the time series, names changed and/or were deleted when a ditch was no longer used. DRI built a diagram showing the communality and differences between WRID diversion names and the MODSIM model diversion names used in the first phase of the modeling effort (the original MODSIM diversion names were based on diversion data received from the Federal Water Master). DRI received hardcopy versions of the NDOW MVWMA diversions from 1996 to 2011 from NFWF and NDOW; these data were subsequently converted to digital (Excel) format and provided to the UNR modelers.

DRI provided the UNR modeling team with water rights information related to NFWF Change Application 80700 for the L&M properties in the West Hyland HRU. This included the Change Application maps produced by HMS, the WRID water cards associated with all the proposed transfers, and a spreadsheet detailing the amounts of the proposed water transfer relative to priority dates, claims, and parcel numbers (APNs).

HMS and DRI updated the decree/storage water rights table originally developed in Phase I for the DST model. Updates and revisions included the reduction of maximum days of diversion

from 245 to 135, adjustments to the calculated diversion rate, and a check of the proper priority dates for storage rights. Tabs were removed to make the table cleaner, and the Campbell ditch diversion rates were added. HMS provided DRI with an updated explanation of each of the tabs in the table as well as the columns in the HRU values worksheet. This latest version was developed in June of 2012 and provided to the DST modelers.

DRI provided the DST modelers with METRIC evapotranspiration (ET) results for the 2007 irrigation season. Monthly and seasonal ET raster data sets (30 meter cell size) were provided for agricultural areas in Mason and Smith valleys from March through October. ET summaries were calculated by HRU and by crop type to facilitate comparison to the ET Nevada report net irrigation requirement data used in the DST. ET summaries were derived using a 30 meter buffer on the HRU field polygons to remove the edge effects of the field boundaries and ensure that the overall ET rate of the field was properly calculated.

DRI staff participated in numerous planning and presentation meetings related to the DST development effort. This included participation and presentation of results at the Walker Basin Water Group meetings throughout Phase II. DRI presented an overview of the spatial data and water right information inputs to the DST to the Water Group in a number of meetings at the USGS office in Carson City in April, 2012. Other meetings attended including working meetings with NFWF, NFWF sub-contractors, NFWF legal representation, WRID, NDWR, the Federal Water Master, and presentations to the Walker River Paiute Tribe.

GIS, Mapping, and Database Support

DRI performed a number of spatial analysis, mapping and database support tasks for the Walker Basin Restoration Program. These tasks support NFWF's potential water right acquisitions in the Walker River Basin.

Water Transaction Mapping

DRI produced triplicate map sets for potential willing sellers' properties in Mason and Smith valleys. The three map sets consisted of a reference map, surface water map, and groundwater map. Reference maps contained the Public Land Survey System (PLSS) to the quarter/quarter level, infrastructure, parcel boundaries and parcel numbers, and high resolution aerial photography flown in 2007. Surface water maps contained PLSS data, infrastructure, parcels and parcel numbers, HRUs, ditches and drains, and the C-125 decree layer. The groundwater map contained the PLSS data, infrastructure, parcels, PODs, POUs, and NFWF permit numbers. The maps were created in ArcGIS, converted to PDF format, and disseminated to both NFWF and NFWF's contractor Ecosystem Economics, Inc.

Exhibit Map Development

DRI provided NFWF and NFWF's legal representation with exhibit maps showing areas of proposed surface and groundwater transfers in Mason and Smith valleys as well as the East

Walker River corridor. Information displayed on these maps included PLSS data, parcel boundaries and parcel numbers, and surface and groundwater rights. Irrigated acreages were calculated for existing and proposed water rights. DRI provided NFWF's legal representation with an Exhibit map of the proposed change application for primary groundwater transfer to the L&M properties in the Wabuska area of northern Mason Valley, NV. This map displayed existing surface and groundwater rights as well as the proposed POU and POD.

DRI developed an inventory farm lease reference map of NFWF and NDOW properties in lower Mason Valley. The map indicated land purchased by NFWF, lands purchased by NFWF but transferred to NDOW, parcels where NFWF had purchased water only, and NFWF property deals in the queue.

Ditch/Diversion Reconciliation

DRI conducted an analysis of several diversion systems and irrigated agricultural land in Mason Valley and the East Walker River corridor to assess the total acreage of individual parcels serviced by a particular diversion, the total acreage of irrigated fields within each of those parcels, and the associated C-125 decree claim number for each of the irrigated fields. The analysis was performed in ArcGIS and the resultant tables were converted to Excel and forwarded to NFWF and NFWF's sub-contractor Ecosystem Economics. The analysis was conducted for the West Hyland ditch, the Campbell ditch, the Spragg-Woodcock ditch, and all the ditches along the East Walker River corridor from the California-Nevada state line to the Santa Margarita Ranch fields just above the southern entrance to Mason Valley.

DRI and NFWF staff met with the Federal Water Master to reconcile diversion ditch and ranch names along the East Walker River corridor. Inconsistencies in ditch and ranch names were addressed and corrected to the most current designations. DRI then provided NFWF and their sub-contractors with updated maps showing the HRUs, ditches, and parcels for the entire East Walker River corridor.

GeoDatabase/Database Development

DRI began work on NFWF's relational database system for relating water right and property information from NFWF's existing SharePoint site. DRI related information from MicroSoft SharePoint files to spatial entities such as diversions, parcels, and fields for Mason and Smith valleys. DRI used its existing ESRI site license software, specifically ArcServer, and Flex4 to develop a web-based graphical user interface that will allow NFWF to combine water right data with spatial data for Mason and Smith valleys in an ArcGIS geodatabase. This work will continue in the upcoming Walker Basin Restoration Program – Phase III as additional water rights information and individual property information for the NFWF Change Application 80700 are loaded on to the SharePoint site.

DRI began work on the reorganization of NFWF's file and data structure on their DropBox. DRI personnel met with NFWF, NFWF's legal team, and Ecosystem Economics staff to

reorganize the naming conventions and categories of documents on the project DropBox. DRI investigated software alternatives for applying permissions and restrictions to the resultant reorganized file structure on the NFWF DropBox. This task will continue in the upcoming Walker Basin Restoration Program – Phase III as NFWF prioritizes which components of the DropBox they want to assign permissions and restrictions to as the DropBox file system expands and a greater number of users gain access to the system.

General Water Acquisition Display Maps

DRI updated and provided D and E size maps of both the Mason Valley and Smith Valley areas to NFWF showing the relationship of HRUs to ditches, drains, administrative boundaries (WRID, Walker River Paiute Tribe, Yerington Paiute Tribe, MVWMA), USGS gaging stations, and both water rights and property acquired by NFWF and water rights acquired by NFWF. DRI provided NFWF and their sub-contractors with additional maps of Mason and Smith valleys and the East Walker River corridor showing the relationship of C-125 decree claims to ditches, HRUs, and parcels in areas where NFWF had potential willing sellers.

Miscellaneous Mapping and Spatial Analysis Tasks

DRI provided NFWF with large format maps of the Walker River Basin on photographic paper for use in a Western Water Transaction Workshop Walker River Basin Point of Interest Tour that was conducted in the spring of 2012. DRI also created a map book containing maps and images of the points of interest on the Tour.

DRI provided centroid coordinate pairs (latitude/longitude) to NFWF for the following properties and/or areas of interest in Mason and Smith valleys: L&M Change Application area, Aguiar, Sciarani, Sunrise, and Sovereign.

DRI provided NFWF with a data layer showing the locations of domestic wells in Mason and Smith valleys.

Thermal Image Data Acquisition of the Walker River System

At the request of NFWF, DRI prepared a Request for Proposal (RFP) for flying thermal infrared imagery over the Walker River corridor in both the winter and summer seasons. These data would be used for modeling fish habitat and evaluating potential groundwater seeps into the river channels. Watershed Sciences, Inc. (WSI) of Corvallis, Oregon was selected as the vendor to fly the thermal imagery.

Two collects were flown over the Walker River. A winter collect was flown in November of 2011 along 143 river miles of the East, West, and Main Walker River from Coleville, CA on the West Walker River and Pitchfork Ranch on the East Walker River down to Walker Lake along the main stem. See Appendix 1 for report. Imagery was collected in the early morning hours to maximize thermal contrasts between the cooler river temperatures and warmer groundwater discharges and seeps into the main river channels. DRI assisted in the coordination of

temperature logger deployment by Watershed Sciences along the west, east and main stems (a total of 10 new logger locations). DRI coordinated these deployments with UNR, NDOW, the U.S. Fish and Wildlife Service (USFWS), and the Walker River Paiute Tribe. These in-stream measurements were used to help calibrate the thermal imagery. DRI used the resultant thermal imagery to determine the locations of thermal anomalies possibly related to groundwater seeps in or near NFWF's properties on the south end of the NDOW MVWMA to target locations for additional thermal analysis research.

The summer collect, originally planned for August of 2011, was postponed to the summer of 2012 due to an abnormally high water year in 2011. The summer thermal survey was conducted in July of 2012 along 237 miles of the East, West and Main Walker River from the Sierra headwaters on the West Walker, Bridgeport Reservoir on the East Walker down to Weber Reservoir on the main stem of the Walker River. See Appendix 2 for report. Imagery was collected at the peak of the diurnal cycle, i.e. the mid-afternoon, to maximize thermal contrasts between the warmer surrounding temperatures and the cooler river temperatures. DRI assisted in the coordination of temperature logger deployment by Watershed Sciences along the river system, where existing UNR iButton loggers were utilized in addition to the deployed WSI Hobo sensors. The thermal imagery was delivered to DRI in December of 2012 and has not been analyzed yet. The summer data will be used primarily by the UNR/USU aquatic team to model fish habitat in the Walker River system.

Relevance to the Walker Lake Restoration Program

The DST GIS support described in this report directly supports water rights acquisitions and the movement of additional water to Walker Lake. The spatial and tabular data acquired and developed by DRI are used as inputs for the DST, and the DST is and will be used by NFWF to evaluate the effect of water purchases and subsequent withdrawals on other users in the system. In the near term data generated by DRI and integrated in the DST will be used in the upcoming NDWR hearings for NFWF's Change Application 80700.

The mapping and database support DRI has provided NFWF directly supports NFWF's ongoing public outreach and water rights purchases in the Walker Basin. Transaction maps are produced for potential willing sellers' properties, helping NFWF track potential willing sellers and the water rights they own. The database work DRI has provided helps NFWF track water transactions, the "colors" of water for potential willing sellers, and the amounts of water potentially available for delivery downstream to Walker Lake. The ditch/diversion reconciliation work performed by DRI directly aids NFWF and their subcontractors as they attempt to reconcile water rights, irrigated acres and actual water use for all properties serviced by ditches, river pumps, and wells.

Finally, the summer and winter thermal image surveys collected over the Walker River system were conducted at NFWF's request, as they saw value in assessing the thermal properties

of the river surface on a seasonal basis for such applications as fish habitat modeling and groundwater seepage analysis.

Appendix 1: Airborne Thermal Infrared Remote Sensing; Walker River Basin (Winter), Nevada/California

Appendix 2: Airborne Thermal Infrared Remote Sensing; Walker River Basin (Summer), Nevada/California