FINAL PROJECT REPORT

AGENCY/ORGANIZATION: National Park Service, Lake Mead National Recreation Area

PROJECT NAME: Lake Mead Geographic Information System (GIS) and Data Management Support

PROJECT NUMBER: 2005-NPS-525-P

REPORTING PERIOD: 2/2/2008 through 02/14/2012

PROJECT CONTACT: Mark Sappington, GIS Specialist, National Park Service, Lake Mead National Recreation Area

EXECUTIVE SUMMARY

Two objectives were accomplished by this project:

(1) Geographic information system and data management support was provided to ten MSHCP-funded National Park Service projects, contributing to their successful completion.

Support to other projects included development of field data collection methodologies, field data collection sheets, and electronic field data collection systems; development of spatial and tabular databases, including queries and reports; development of metadata records; quality control review of collected data; development of mapping products and assistance with map development; technical assistance with geographic information systems and global positioning systems; and delivery of data to Clark County.

(2) Spatial and tabular databases were created from mined historic agency resource data and maps in sixteen topic areas, providing information important to MSHCP implementation on National Park Service lands.

Historic National Park Service data were mined for the following topic areas: abandoned mine lands, water quality, geology, fire history, groundwater, springs, vegetation transects, geographic names, wildlife observations (various species), climate, and species data, including razorback sucker, bonytail chub, bighorn sheep, bats (various species), gila monster, and southwestern willow flycatcher.

INTRODUCTION

Description of the Project

This project provided geographic information system (GIS) and data management support for Clark County Multiple Species Habitat Conservation Plan (MSHCP) funded projects taking place on National Park Service (NPS) lands. Support included assistance with project design; development of spatial and tabular databases; development of field data collection methodologies using global positioning system (GPS) receivers, mapping software, and data dictionaries; assistance with data analysis; development of database queries and reports; development of maps; and other GIS and GPS technical assistance as needed. In addition, this project developed spatial and tabular databases from mined historic agency resource data and maps to provide information important to MSHCP implementation on NPS lands.

Background and Need for the Project

Successful accomplishment of many MSHCP objectives requires development and maintenance of species and habitat databases and GIS data. These data are needed to gauge effectiveness of

conservation measures outlined in the MSHCP and to provide information to guide planning and development in Clark County. Data are derived from data sets and reports from previous scientific studies and historic records; current geospatial data from federal, state, and local agencies; and new data, reports, and geospatial information being generated by MSHCP-funded projects. However, because historic data frequently does not exist in digital formats, current geospatial data is generally out of date, and MSHCP generated project data and information are often not documented or in standard formats, available data are not immediately useful for accomplishment of MSHCP objectives, including implementation of the County's Adaptive Management Plan (AMP). Therefore, historic data needs to be converted to digital formats, geospatial data must be updated and improved, and MSHCP project data must be standardized and documented.

Clark County's Science Advisor recognized the need for additional GIS and data management infrastructure within participating agencies to help accomplish MSHCP goals. High priority needs outlined in the 2004 Biennial Adaptive Management Report included assessing needs and building GIS and data management capacity within the cooperating agencies (UNR/BRRC, 2004). This recommendation is consistent with the MSHCP Objective to provide "[a]ssistance to federal and state land and wildlife managers" (Clark County, 2000).

This project increased GIS and data-management capacity within Lake Mead NRA to help accomplish MSHCP objectives on National Park Service lands. Similar projects were funded in the 2001–2003 biennium and the 2003–2005 biennium, and this project continued to build upon the successes of those projects. During the first biennium, the process of inventory and documentation of existing databases and GIS base data was initiated. Databases, for weather, water quality, and wildlife observations (among others) were updated. Updating of GIS base data was also begun. The following biennium's work (2003–2005) focused on improving GIS base data through the mining of historic data and reports, converting mined information to electronic formats, updating spatial data with this information, and linking improved spatial data to this information. Data from other MSHCP funded projects at Lake Mead was also processed, analyzed, and mapped. As it was completed, all data was documented with Federal Geographic Data Committee (FGDC) compliant metadata and submitted to the Clark County MSHCP central repository. This project continued work started in the 2003–2005 biennium.

Management Actions Addressed

The following Management Actions from the Clark County MSHCP were addressed either directly by this project through mining of historic agency data or indirectly by support to other MSHCP-funded NPS projects:

NPS(1): Develop brochures, pamphlets, interpretive signs, and exhibits for Covered Species and the habitats on which they depend as determined to be appropriate by NPS in coordination with the MSHCP I & M Committee.

NPS(3): Cooperate in the identification, development, and implementation of research projects located on Federal lands. Emphasis shall be placed on research that addresses management concerns and the conservation of Covered and Evaluation Species.

NPS(5): Inventory populations of relic leopard frog and other amphibians, as time allows).

NPS(6): Coordinate inventory of three−cornered milkvetch and sticky buckwheat with other survey efforts on Federal lands.

NPS(7): Inventory bat populations in selected areas, with priority given to proposed project sites).

NPS(8): Develop information on the population distribution of summer tanager, Arizona Bell's vireo, yellow−billed cuckoo, and blue grosbeak in the study area. Surveys are needed in the spring to document breeding and nesting activity in southern Nevada. Protect existing riparian habitat.

NPS(9): Inventory and monitor mesquite and acacia habitat that may be important as resting and/or nesting habitat for resident and neo−tropical migrants.

NPS(10): Develop information on the population distribution in the study area and the subspecific relationship of the southwestern willow flycatcher in southern Nevada. Survey in the spring to document breeding and nesting activity in southern Nevada.

NPS(11): Continue monitoring tortoise populations on LMNRA, and assist with ongoing survivorship studies, as appropriate.
NPS(12): Monitor peregrine falcon nest occupancy and production.
NPS(13): Monitor wintering bald eagle population trends.
NPS(14): Monitor populations of relict leopard frog and other amphibians, as time allows.
NPS(15): Monitor Las Vegas bearpoppy populations.
NPS(18): Monitor priority bat roosting and foraging sites and success of management actions targeted at bat protection.
NPS(31): Conduct NEPA review and analysis for development of new areas for intense recreational use.
NPS(37): Include MSHCP Covered Species as sensitive species in evaluations of road construction or maintenance activities on Federal lands.
NPS(39): Monitor and protect water sources, including springs, seeps, and streams.

Goals and Objectives of the Project

Two MSHCP-related goals were identified in the original proposal for this project:

1. Park databases and geospatial base and project data related to MSHCP covered species and habitats of interest within the park are updated, documented, and in formats which meet park needs and compatibility needs of the Clark County MSHCP.
2. Data is available and accessible to the AMP contractor, IMC, USFWS, and other MSHCP cooperators to answer MSHCP management questions and to provide species and habitat information.

To accomplish the above goals, this project had two objectives: (1) provide GIS and data management support to other MSHCP-funded NPS projects, and (2) develop spatial and tabular databases from mined historic agency resource data and maps to provide information important to MSHCP implementation on NPS lands. GIS and data management support was provided to the following MSHCP-funded NPS projects:

2005-NPS-475 – Peregrine Falcon Monitoring at Lake Mead
2005-NPS-476 – Relict Leopard Frog Monitoring and Management
2005-NPS-526 – Monitoring of Illegal Ground Disturbance
2005-NPS-529 – Monitoring of Road Conditions and Signs
2005-NPS-532 – Threats Research and Monitoring of Sahara Mustard
2005-NPS-535 – Inventory, Research, Monitoring for Covered Plant Species
2005-NPS-536 – Inventory, Research, Monitoring of Watch Plant Species
2005-NPS-537 – Interagency Weed Sentry
2005-NPS-540 – Bald Eagle Monitoring
2005-NPS-542 – Assessment of Nine Bird Species

METHODS AND MATERIALS

Personnel

Two full-time positions, a GIS technician and a data manager, were hired through a NPS agreement with the University of Nevada, Las Vegas (UNLV) and stationed at Lake Mead NRA. The positions worked with the NPS Lake Mead NRA GIS Specialist, other NPS staff, and personnel from other agencies involved in the efforts described herein to accomplish the project goals.

Data Handling and Storage

Data standards originally developed by the Clark County MSHCP GIS Working Group and approved by the Implementation and Monitoring Committee (IMC) were adhered to for data handling and storage. Individual data management plans for each MSHCP-funded NPS project were developed in accordance with the Clark County MSHCP Data Management Plan Development Guidelines (Clark County, 2007) the existing Lake Mead NRA Data and Information Management Procedures (Lake

Mead National Recreation Area, 2001) and Quality System Management Plan (Lake Mead National Recreation Area, 2002) guidelines. These plans provide protocols for project planning, Quality Assurance/Quality Control (QA/QC) of collected data, and data management and storage procedures. Project data management plans were co-developed through this effort as first quarter deliverables for each supported project.

Certain data management activities were common to all plans; in addition, each project involved project-specific requirements that were detailed in each data management plan. This section describes overarching data-management procedures (see individual data management plans for project-specific procedures). All data were stored in industry standard or open standard formats. Geospatial data was stored in Environmental Systems Research Institute (ESRI) shapefile or personal geodatabase format with a Universal Transverse Mercator (UTM) Zone 11 projection and NAD1983 datum. Non-spatial data sets were stored in the latest versions of Microsoft Access database format or Microsoft Excel spreadsheet format. Documents were stored in the latest version of Microsoft Word document format or Adobe Portable Document Format (PDF) with full text search capability whenever possible. All data, spatial and non-spatial, were documented with Federal Geographic Data Committee (FGDC) compliant metadata in extensible markup language (XML) format. Data and metadata were supplied to Clark County on an annual basis in accordance with the Data Management Plan Development Guidelines or upon completion of the dataset, whichever occurred first. Sensitive species and cultural resource data were labeled as 'confidential' and supplied to the County on the agreed-upon condition that it would not be released to the public (letter from the Program Administrator dated May 10, 2007).

GPS and GIS Support

Field data collection support for most supported projects included development of data sheets, electronic data collection on GPS devices, or a combination of the two. GPS devices used were either high-end consumer grade (e.g. Garmin GPSMap 76 model) or resource grade (e.g. Trimble GeoExplorer or Magellan MobileMapper). Minimum mapping accuracy for all projects was 5 meters. Accuracy was maintained on consumer grade units through frequent checks on the accuracy reported by the units; accuracy on resource grade units was maintained through software filtering of positional accuracy. Data collection on resource grade units was performed using ESRI ArcPad software (version 7.x and 8.x). Details of field data collection methodologies and use of GPS are contained within each supported project's quarterly, biennial, and final reports.

GIS support for projects was performed using ESRI ArcGIS software (version 9.x and 10.0). Geodatabase development, data creation, data editing, data analyses, map development, and metadata creation were all performed within the ArcGIS software. Various extensions, such as Hawth's Tools (http://www.spatialecology.com/htools/tooldesc.php) and ET Geo (http://www.ian-ko.com/), were used as needed. Non-spatial database development was performed in Microsoft Access (2007 and 2010 versions) along with development non-spatial queries and database reporting. Reporting for geodatabases was performed by linking Access queries and reports to the appropriate geodatabases. GIS operations were documented within each supported project's quarterly, biennial, and final reports.

Data Mining

Data mining was conducted on source documents and data sets located within in-house historic archives and libraries, cooperating organizations, and other agencies. Maps were scanned, georeferenced where possible, and saved in a standard digital format (tiff or jpg). Relevant geospatial data were digitized from applicable maps and saved in standard geospatial data formats (ESRI shapefile or geodatabase). Reports were scanned and converted into Adobe PDF format electronic documents with full-text search capability when possible. Data from reports and data sets were entered into databases and linked with geospatial data. FGDC compliant metadata was created for each map, document, database, and geospatial data set. Current GIS base data sets and databases were updated using historic information, other available agency data, and field checks as necessary. Data from historic reports and data sets were reconciled to the extent the data’s integrity permitted and used to update databases. Current geospatial data were evaluated against geospatial data from

historic reports and locations collected in the field with GPS, and geospatial base data was updated as necessary. FGDC compliant metadata were updated for geospatial data and databases as needed.

RESULTS AND EVIDENCE OF THE RESULTS

Objectives Completed

The first objective of this project, *GIS and data management support to other MSHCP-funded NPS projects*, was completed for each of the ten supported projects. Support provided to each project is detailed below:

2005-NPS-475 – Peregrine Falcon Monitoring at Lake Mead

- provided guidance on and review of data management plan
- assisted with development of field data sheets
- developed geodatabase to house legacy data and new field data, including eyrie locations, territories, and monitoring results
- developed QA/QC procedures for field data collection and data entry
- assisted with field testing of data sheets
- assisted with spatial and tabular data updates in geodatabase
- assisted with QA/QC of geodatabase data
- scanned field data sheets to digital format
- created and updated metadata for geodatabase
- provided annual data transfers to County
- provided final data transfer to County

2005-NPS-476 – Relict Leopard Frog Monitoring and Management

- provided guidance on and review of data management plan
- assessed data collection and database needs
- developed geodatabase and electronic field data collection forms
- developed QA/QC procedures for field data collection and data entry
- migrated legacy data to geodatabase; performed QA/QC of geodatabase
- trained field staff in operation of GPS, electronic field forms, and geodatabase
- assisted with field testing of geodatabase and field software
- developed documentation and standard operating procedures for geodatabase and field forms
- developed and updated metadata for geodatabase
- provided ongoing GIS, GPS, database, and mapping assistance as needed
- revised geodatabase to meet new querying and reporting needs
- provided assistance with QA/QC of geodatabase
- scanned field data sheets to digital format
- provided annual data transfers to County
- provided final data transfer to County

2005-NPS-526 – Monitoring of Illegal Ground Disturbance

- provided guidance on and review of data management plan
- evaluated compatibility of existing database and new traffic counter software; developed strategy for integrating historic data from old traffic counters with data from new traffic counters
- integrated historic and new traffic counter data in database
- provided recommendations for development of field data sheets for road and traffic counter monitoring
- reviewed specifications for new traffic counter hardware and provided recommendations for data download and management
- trained staff in the operation of the traffic counter database
- assisted with updating database and spatial data
- created database queries

- provided ongoing GIS, GPS, database, and mapping assistance as needed
- modified database to keep track of supplemental disturbance/redisturbance data
- provided support for PDF field data collection forms developed by UNLV
- developed and updated metadata for geodatabase
- provided ongoing GIS, GPS, database, and mapping assistance as needed
- provided assistance with QA/QC of geodatabase
- scanned field data sheets to digital format
- provided annual data transfers to County
- provided final data transfer to County

2005-NPS-529 – Monitoring of Road Conditions and Signs

- provided guidance on and review of data management plan
- developed geodatabase and electronic GPS field forms for sign monitoring
- developed QA/QC procedures for field data collection
- assisted with field testing of database and field software
- trained personnel in the operation of the geodatabase and electronic field data collection equipment
- performed QC on legacy data and documented discrepancies
- corrected discrepancies in legacy data
- developed migration strategy to move legacy data to new geodatabase
- migrated legacy data to new geodatabase
- developed documentation and standard operating procedures for new geodatabase and electronic field software
- provided ongoing GIS, GPS, database, and mapping assistance as needed
- updated geodatabase with new field data
- performed QA/QC review on geodatabase
- developed queries and reports in Microsoft Access linked to geodatabase
- created and updated metadata for geodatabase
- created tables for biennial and final reports
- scanned field data sheets to digital format
- provided annual data transfers to County
- provided final data transfer to County

2005-NPS-532 – Threats Research and Monitoring of Sahara Mustard

- provided guidance on and review of data management plan
- provided guidance on development of QA/QC procedures for data
- assisted with development of metadata for spreadsheets and geospatial data
- assisted with scanning data sheets to digital format
- provided annual data transfers to County
- provided final data transfer to County

2005-NPS-535 – Inventory, Research, Monitoring for Covered Plant Species

- provided guidance on and review of data management plan
- developed recommendations for field data collection methodologies
- developed geodatabase for spatial and tabular project data
- developed documentation and metadata for geodatabase
- developed shapefiles and Excel files for spatial and tabular data storage to replace geodatabase
- trained field personnel on use of geodatabase, shapefiles, and Excel files
- provided ongoing GIS, GPS, database, and mapping assistance as needed
- developed spatial data for plot locations from field GPS data; created spatial data for grid layouts within plots
- developed and updated documentation for spatial and tabular data (metadata)
- performed QA/QC on spatial data and provided assistance with QA/QC for tabular data; documented results in metadata for spatial and tabular data

- assisted with scanning data sheets to digital format
- provided annual data transfers to County
- provided final data transfer to County

2005-NPS-536 – Inventory, Research, Monitoring of Watch Plant Species

- provided guidance on and review of data management plan
- developed recommendations for field data collection methodologies
- developed shapefiles and Excel files for spatial and tabular data storage
- developed spatial data for plot locations from field GPS data; created spatial data for grid layouts within plots
- developed and updated documentation for spatial and tabular data (metadata)
- provided ongoing GIS, GPS, database, and mapping assistance as needed
- performed QA/QC on spatial data and provided assistance with QA/QC for tabular data; documented results in metadata for spatial and tabular data
- assisted with scanning data sheets to digital format
- provided annual data transfers to County
- provided final data transfer to County

2005-NPS-537 – Interagency Weed Sentry

- provided guidance on and review of data management plan
- developed geodatabase and electronic field forms
- standardized domains for field data collection
- developed QA/QC procedures for field data collection
- assisted with field testing of geodatabase and field software
- performed QC on legacy data and discrepancies were documented and corrected
- developed migration strategy to move legacy data to geodatabase
- migrated legacy data into geodatabase
- trained personnel on field data collection procedures, QA/QC of field data, and uploading field data into the database
- provided ongoing GIS, GPS, database, and mapping assistance as needed
- developed documentation and standard operating procedures for database and field forms
- developed database reports and linked to geodatabase
- created summary database reports for biennium reports
- performed spatial queries to develop data for biennial and final reports
- ran quarterly, biennial, and final reports from the database
- developed, reviewed, and updated documentation and metadata for database and spatial data
- assisted with scanning data sheets to digital format
- provided annual data transfers to County
- provided final data transfer to County

2005-NPS-540 – Bald Eagle Monitoring

- provided guidance on and review of data management plan
- created and updated field survey maps for annual surveys
- created and updated field data sheets for annual surveys
- configured GPS units for annual surveys
- provided field assistance with annual surveys
- performed QA/QC on annual survey data
- provided assistance with data entry into database
- developed maps of annual survey results
- developed information for a presentation on monitoring activity on Lake Mead
- developed, reviewed, and updated metadata for database and spatial data
- assisted with scanning data sheets to digital format
- provided annual data transfers to County
- provided final data transfer to County

2005-NPS-542 – Assessment of Nine Bird Species

- provided guidance on and review of data management plan
- researched methods for georeferencing historical location data and provided guidance to project PI
- developed protocol for compilation and georeferencing of historic data
- developed geodatabase design and documentation for historical data
- provided technical assistance for management and analysis of historic data
- provided guidance and outline for tracking search effort and results of historic data mining
- developed initial survey locations for targeted surveys from historic data
- developed geodatabase for targeted surveys
- migrated data from Excel files into geodatabase
- provided training for field personnel on use of database and data entry
- provided field support for surveys
- created navigational maps for field surveys
- developed and updated metadata for databases and geodatabases
- scanned datasheets and field maps for intensive area searches and point count surveys
- provided datasets and metadata to USGS personnel working on project with UNLV
- provided assistance with QA/QC of intensive area survey data
- provided assistance with QA/QC of historical records
- developed database queries for preliminary data analyses
- assisted with scanning data sheets to digital format
- provided annual data transfers to County
- provided final data transfer to County

The second objective of this project, *development of spatial and tabular databases from mined historic agency resource data and maps*, was completed for each of sixteen topic areas. Datasets from the following sixteen topic areas were developed from mined agency resource data, both historic and contemporary:

Topic Area	**Description of Mined Data**
Historic vegetation transects	maps and report of vegetation transects from 1979 in the Newberry Mountains
Razorback sucker	locations of spawning habitat, collection sites, and release sites along with agency and contractor reports
Bonytail chub	locations of collection and release sites along with agency and contractor reports
Bighorn sheep	historic location data along with contemporary data from satellite collars
Bats	locations of monitoring sites and tabular results of surveys
Gila monster	locations from agency records and visitor reports
Southwestern willow flycatcher	survey locations and survey data from NPS
Wildlife observations	historic wildlife observation data from park visitor reports
Geology	maps and polygon layers from various sources, including USGS and Nevada Bureau of Mines and Geology
Fire history	locations of historic fires including polygon boundaries (when available) and attributes such as year, acreage, etc.
Groundwater	maps and polygon layers from various sources, including USGS and Nevada Division of Water Resources

Springs	locations of springs along with physical, chemical, and biological survey data from NPS and other sources
Water quality	water quality data for springs and wells from USGS and EPA databases linked to spatial data
Climatic data	climatic variables from Prism and BioClim datasets along with National Weather Service (NWS) precipitation data (2005 – present) and storm total precipitation data from the NWS radar archive (2010)
Abandoned mine lands	locations of mine features (e.g. shafts and addits) and hazards along with monitoring data including wildlife inventories (e.g. bats)
Geographic names	official place names from the USGS for features within the park were compared with names of historic mined data (e.g. springs), and over 150 place names were identified to be added to or updated in the USGS database; 30 names were updated by USGS during the course of the project

Evidence Objectives/Needs were Met/Fulfilled

The first objective of this project, *GIS and data management support to other MSHCP-funded NPS projects*, was met through the successful completion of all ten of the supported projects. Deliverables for each of these projects, including data management plans, annual data deliveries, and final data deliveries, were completed, inspected, and accepted by the County.

The second objective of this project, *development of spatial and tabular databases from mined historic agency resource data and maps*, was met through the successful completion of this project. Products for each of the sixteen data mining topics were delivered, inspected, and accepted by the County.

Tables and Figures of Data, Maps, and Graphs

Numerous maps, graphs, tables, database reports, and figures were developed for MSHCP-funded NPS projects that this project supported. These products have been included in quarterly, biennium, and final reports along with presentations for the respective projects and have not been reproduced here.

EVALUATION/DISCUSSION OF RESULTS

This project was unique in that it was primarily funded to provide GIS and data management support for ten other MSHCP-funded NPS projects. As a result, close coordination with individual project leaders along with field personnel for each project was essential to identify, develop, and manage data flows to achieve the research and monitoring goals for each project. Personnel working on this project provided needed technical and analytical expertise in the fields of data management, database development, geographical information systems, global positioning system technology, and development of graphic and cartographic products. Working with biologists and resource specialists on each of the supported projects, project personnel were able to integrate their expertise on interdisciplinary teams. Consequently, these projects are among the most successful carried out on NPS lands in Clark County in terms of the quality of their data collection, management, storage, and documentation.

A second objective of this project was to mine historic agency resource data and maps to provide important information relevant to the Clark County MSHCP. Data from sixteen different topic areas were selected, and data, information, and maps related to each topic area were consolidated, digitized, and documented. These data were delivered to Clark County and are now available for MSHCP purposes, including comparisons with contemporary data sets, integration with other data sets, and long-term archiving. These data sets constitute the majority of historic biologic and physical resource data held by the NPS in Clark County, and their consolidation with other data sets at the County is an important achievement.

CONCLUSION

Data and information are the primary products of natural resource inventories and ecological monitoring studies. As a result, this data and information must be carefully managed. As described throughout this report, data management systems and procedures for this project were designed and documented to ensure their long-term value.

RECOMMENDATIONS

A number of challenges were overcome to accomplish project objectives, some of which were related to technology. Although technology, such as global positioning systems and electronic field data collection devices, can save time in the field, provide instantaneous feedback on collected data, perform QC checks upon data entry, and provide novel experiences for field personnel, these devices still have many shortcomings. Equipment malfunctions and failures are still common, and alternative methods of collecting data should always be provided to field personnel. In addition, skills in collecting data manually (e.g., skill in the use of map and compass) should be available to field personnel as a backup in case of equipment malfunction or failure.

Another challenge with electronic field data collection is ensuring proper QA/QC is performed on field data. Reliance on and faith in technology can develop complacency in field personnel, and QC checks on field data must be maintained throughout the life of the data collection project. Building strong data stewardship ethics in data collection personnel and project managers is essential to project success.

Electronic storage and management of data also presents challenges. The lifespan of a data set should extend across the duration of a given data-collection activity, and numerous changes in technology are to be expected. File formats and data storage media continually change and evolve, and refreshing data into new formats and on to newer media can provide financial and logistic challenges that should be planned for programmatically.

Continued coordination between the County and local federal land management agencies should be fostered as new projects are carried out. Data and information sharing prevent duplication or interference among projects, provide financial savings, provide for better land management across entities, and help ensure public trust in government at every level.

LITERATURE CITED

Clark County. 2000. Final Environmental Impact Statement for the Clark County Multiple Species Habitat Conservation Plan.

Clark County. 2007. Desert Conservation Program Project Handbook.

University of Nevada, Reno/Biological Resources Research Center (UNR/BRRC). 2004. Clark County Desert Conservation Program biennial adaptive management report, 2004.

Lake Mead National Recreation Area. 2002. Quality System Management Plan for Environmental Data Collection Projects.

Lake Mead National Recreation Area. 2001. Data and Information Management Procedures