

Scientific Notebook 724E

Entry: Deborah Waiting (DJW)
Date: 5/18/2006

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(1) Software Validation Plan and Report, ArcView GIS
3.3 and ArcView Spatial Analyst 2.0a.
(05/18/2006)

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Entry: Deborah Waiting (DJW)
Date: 5/18/2006

Title: **Software Validation Plan and Report, ArcView[®] GIS 3.3 and ArcView Spatial Analyst 2.0a.**

Purpose: This entry, in Scientific Notebook #724E, is to document the plan, file origins, and software codes used in the CNWRA Technical Operating Procedure – 018 Software Validation Plan and Report for ArcView GIS 3.3 and ArcView Spatial Analyst 2.0a.

Personnel: Deborah Waiting was the primary author of this software test and validation procedure. Supporting information was provided by Marius Necsoiu, Kevin Smart and Danielle Wyrick. Technical Review of the Validation Plan and Report was performed by Danielle Wyrick and Programmatic Review was performed by Gordon Wittmeyer. Administration and format support were provided by Sharon Odam. All scientific notebook entries on this project were made by Deborah Waiting, unless otherwise indicated in the text.

Project: This project followed the procedures of CNWRA Technical Operating Procedure – 018, Rev. 10, Change 0, Development & Control of Scientific & Engineering Software, Section 4 for the validation of Environmental Systems Research Institute, Inc. © (ESRI[®]) Geographic Information System (GIS) software, ArcView GIS v 3.3 and supplemental extension ArcView Spatial Analyst v 2.0a. Procedures followed, extensions used, and data presented in the Validation Plan and Report were representative of typical procedures, extensions and data used to prepare figures as part of deliverables in support of Pre-Licensing Transition to License Application Review Projects 20.06002.02.252, UZ1 ISI; 20.06002.01.262, UZ2 ISI; 20.06002.01.272, SZ1 ISI; 20.06002.01.282, DOSE1 ISI; 20.06002.01.292, General Information (Evaluation of Site Evaluation); 20.06002.01.312, DIRECT2 ISI; and 20.06002.01.352, MSOP. Work performed to date for these projects, files used, the origins of those files, and a copy of the ESRI project file (.apr) are covered in this Scientific Notebook under individual project numbers and are attached on a CD-ROM DVD (DJW. 8/26/2009).

Data: Data used in Section 6.1 are publicly available on the internet web-site of Texas Natural Resources Information System (www.tnris.state.tx.us). The files were located by searching for the Helotes quadrangle. The files downloaded in zipped format were 2998270g.zip (USGS DEM), 015_urban_dd.zip (Texas Department of Transportation (TxDot) urban data for Bexas County), and 010_urban_dd.zip (TxDot urban data for Bandera County).

Data used in Section 6.2 was created in Section 6.1, or was converted from a Data Base 4 file. The supplied data base file consists of 15 wells copied from a

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Microsoft Excel file of water well borehole stratigraphy used in the creation of a Geologic Framework Model investigating aquifers relationships in the San Antonio, Texas area.

In Section 6.3, the background raster file was created by scanning a portion of the Geologic Atlas of Texas, San Antonio Sheet and registering to UTM, zone 14, NAD27 datum. This work was previously performed in support of a non-NRC project. The Bexar County outline was copied from the ESRI Data & Maps 1998 CD #2 as dtl_cnty.shp. ESRI Data & Maps 1998 consists of four CD-ROMs containing GIS files in shapefile format for the world, Mexico, Canada, European countries and the United States. The projection for these files is Geographic, decimal degrees, NAD27 datum. Preparation of the bexar_co_u14n27.shp file was done in advance of its use in the Validation and Testing procedure. Bexar_co_u14n27.shp was created by selecting the Bexar County outline in the dtl_cnty.shp file and saving it as a shapefile. That file was reprojected to UTM, zone 14, NAD27 datum. All this work was performed using ArcView GIS 3.3. All other files used in Section 6.3 were created as part of the Validation and Testing process.

All files used in the ArcView GIS 3.3 and ArcView Spatial Analyst 2.0a TOP-18 Validation and Testing, as well as the ArcView GIS Project file can be located in the CNWRA Quality Assurance files.

Codes: The commercially available software ArcView GIS 3.3 and ArcView Spatial Analyst 2.0a were used exclusively to manage, generate, analyze, edit, and create professional quality figures to fulfill the tasks for the Software Validation and Testing Report in compliance with CNWRA Technical Operating Procedure – 18. Other codes used in this report are standard versions of commonly used commercial codes including Microsoft[®] Excel 2002 SP3 and Adobe[®] Illustrator[®] 10 v 10.0.3.

References: ESRI. ArcView GIS Version 3.3, Using ArcView GIS, Redlands California: ESRI 2002.

ESRI. ArcView Spatial Analyst Version 2.0a, Using the ArcView Spatial Analyst, Redlands California: ESRI 2000.

DJW

(2) Support Prelicensing Transition to License
Application Review -- UZ1 ISI
(06/12/2006)

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Entry: Deborah Waiting (DJW)
Date: 6/12/2006

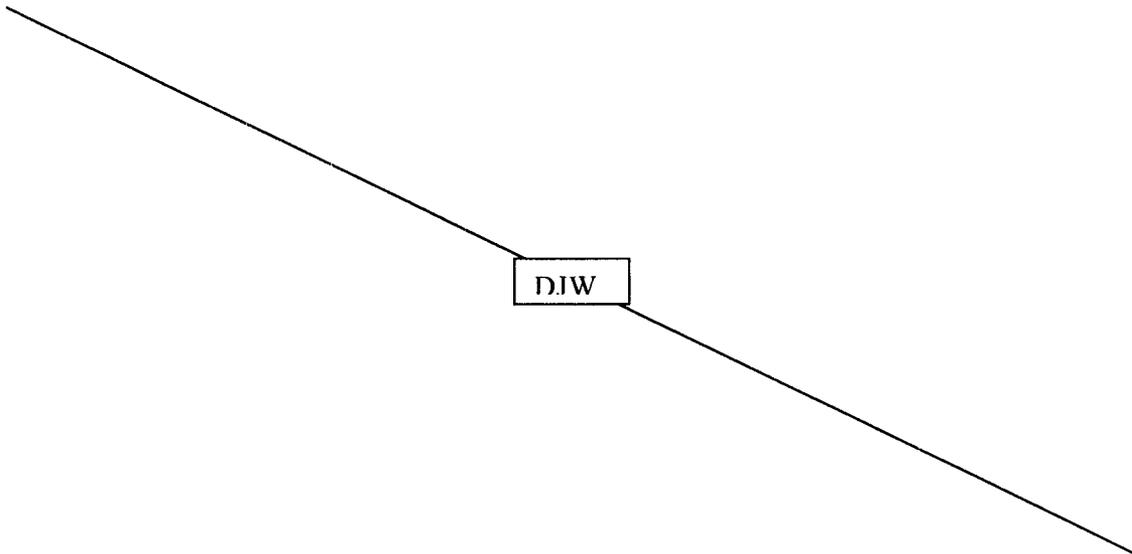
Title: Support Prelicensing Transition to License Application Review – UZ1 ISI, Project #20.06002.01.252.

Purpose: Documentation of data sources used with GIS software to create informational figure, export to Adobe Illustrator for image and labeling enhancement, and saved in a high resolution format for inclusion in Support of Prelicensing Transition to License Application Review – UZ1 ISI documents.

Personnel: Deborah Waiting is responsible for locating and/or generating GIS files that are geo-spatially correct and display, to the best of her knowledge, accurate data representation and analysis as requested and directed by Stuart Stothoff. All entries made herein, are made by Deborah Waiting, unless otherwise noted.

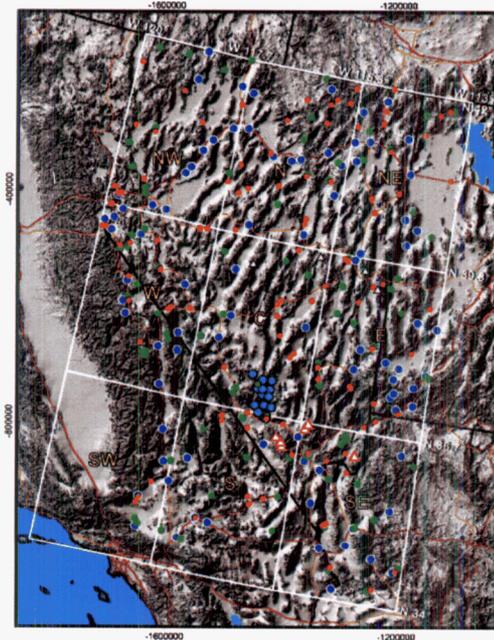
Project: Initial files for the essential information to be displayed in the figure(s) was supplied by Stuart Stothoff. This entry contains file information for two (2) figures. The first will be referred as Sta. Loc. and the second as Sub-basins. Both figures were assembled using ESRI ArcView GIS 3.3 project file, ym_recording_sta.apr

Sta. Loc: S. Stothoff requested a map figure covering Nevada, Western Utah, Western Arizona, and Southern California contained within a grid having an upper-left corner of N 40° Latitude, W 120° Longitude and lower-right corner of N 34° Latitude, W 113° Longitude. The figure would also show the location of meteorologic recording stations within the grid, state routes and intrastate highways, and state boundaries. This figure is still in draft form – it has not been finalized for document inclusion. (See Figure sta_loc_draft.jpg, below)



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Date: 6/12/2006



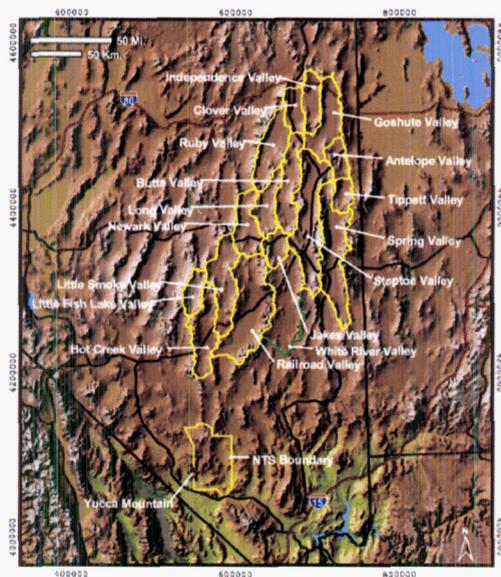
Sta_loc_draft.jpg

Sub-basins: S. Stothoff requested a map figure showing the location of 16 Nevada hydrologic sub-basins in relation to Yucca Mountain and the National Test Site (see revis1_hydrounits.jpg, below). S. Stothoff also wanted the background image to show topography and the state routes and intrastate highways in the area. This figure was included in, “Review of Infiltration under Analog Future Climatic Conditions—Letter Report” (IM 20.06002.01.252.620).

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Revis1_hydrounits.jpg

Data: *Sta. Loc.:* The figure background is clipped portion of 200m resolution Grayscale Conterminous US Shaded Relief (srgy48i2001.tif) downloaded from the National Atlas web site (www.nationalatlas.gov), as was the State Boundaries (statesp020.shp). Due to the size of the area covered in the National Atlas files, the files are projected as Lambert Azimuthal Equal Area, meters. This projection with NAD83 datum was used as the projection of the ArcView Project View1 for this figure. Route and Intrstat road files were copied from the ESRI Data and Maps CD #2, which was received as part of the ArcView GIS 3.1 software package. This data was in Geographic coordinates, decimal degree (dd) units, NAD 27 datum, and was reprojected for this view. The Station Grid was created in ArcInfo 8.0 using Generate. The coordinates of the Station Grid were supplied by S. Stothoff as Geographic, dd, NAD27 datum and then reprojected to Lambert Azimuthal Equal Area, meters, NAD83 datum. Re-projections to Lambert Azimuthal Equal Area was done using the Feature Project tool in Arc GIS 9.0 and datum shifts from NAD27 to NAD83 were done in either ArcView GIS 3.3 or Arc GIS 9.0. The clipping polygon was created as a new theme in ArcView using the Station Grid as the center. Station locations were received in Microsoft Excel format (station_summary.xls). Each sheet having coordinates for station locations was copied and saved as individual text (.txt) files. Text files were added to the ArcView Project as Event Themes and then converted to shapefiles. All files are located on the attached [CD DVD \(DJW, 8/26/2009\)](#) in directory, stothoff_252.

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Sub-basins: View2 of ArcView GIS 3.3 project, ym_recording_sta.apr displays the data assembled for the location of sub-basins relative to Yucca Mountain. The background figure is clipped from the, Color Shaded Relief of North America, shdrf020.tif, downloaded from www.nationalatlas.gov. This image has a resolution of 1 kilometer. After clipping the image, the clipped portion was re-projected from Lambert Azimuthal Equal Area, NAD83 datum to Universal Transverse Mercator, NAD27 datum. The change in projection was due to the fact that the area at this scale displays in truer proportions. S. Stothoff supplied an Microsoft Excel file, (NicholsBasins.xls) listing the identification number and names of the 16 sub-basins of interest. The Nevada Hydrologic Basins, shapefile format, 1:750,000 scale was downloaded from <http://sagemap.wr.usgs.gov/ftp/nevada/BLM/hydrobasin750p.htm>. Using a query in ArcView GIS 3.3, the 16 sub-basins were selected and converted to a shapefile. Some basins were further divided. These divisions were removed and the file was named merged_subareas_u11n27.shp. The White River Valley Basin was also converted as a separate file and is indicated by a separate color, as requested by S. Stothoff. The state boundaries, Intrastate Highways, and US Routes were copied from the ESRI Data & Maps CD ROM #2 supplied as part of the ArcView GIS 3.0 software package. The NTS outline was copied from the DOE 1999 YM GIS CD ROM. The file path is giscd/covers/base/ntsu. The sub-basins and the NTS outline did not require re-projection. All files are located on the attached DVD (DJW, 8/26/2009) in directory, stothoff_252.

Codes: The Geographic Information System (GIS) data generated, edited, and/or plotted for this project was accomplished using the commercially available ESRI software products i) ArcInfo 8.0, ii) ArcView GIS 3.3 with ArcView Spatial Analyst 2.0a, and iii) ArcGIS 9.0. These software codes are maintained in accordance with CNWRA Technical Operating Procedure – 018. All other codes used in this report are standard versions of commonly used commercial codes including Microsoft Excel 2002 SP3, and Adobe® Illustrator® v. 10.0.3.

Reference: ESRI. ArcView GIS Version 3.3, Redlands California: ESRI 2002.

ESRI. ArcView Spatial Analyst Version 2.0a, Redlands California: ESRI 2000.

ESRI ArcGIS 9.0, Redlands California: ESRI 2004.

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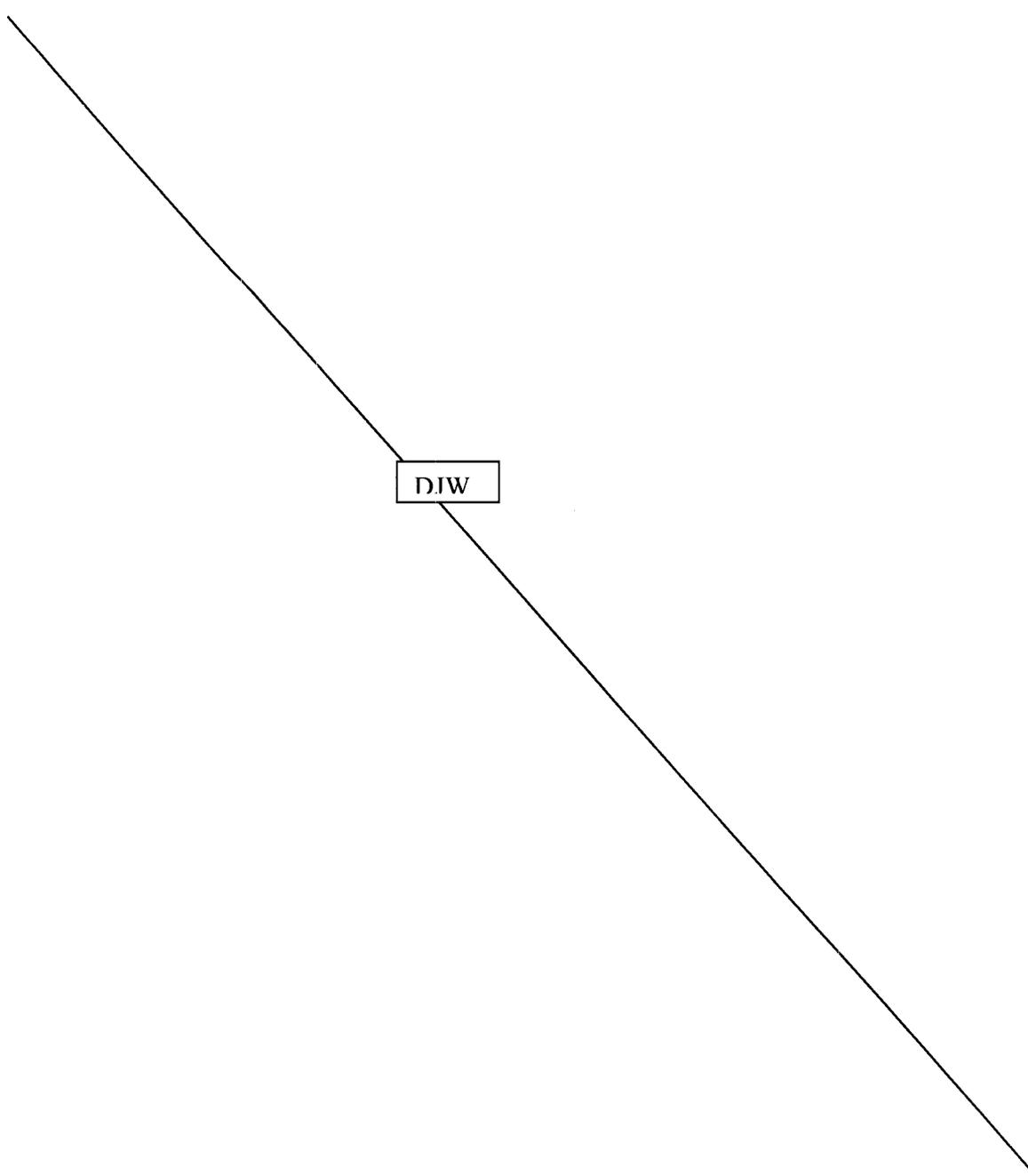
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Adobe Illustrator 10.0.3, San Jose California: Adobe 2002.

Microsoft Excel 2002 SP3, Redmond, Washington: Microsoft 2002.

DOE 1999, Yucca Mountain GIS CD ROM, Washington, DC: DOE 1999.



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(3) Support Prelicensing Transition to License
Application Review -- DIRECT2 ISI
(06/15/2006 through 06/18/2006)

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Entry: Deborah Waiting (DJW)
Date: 6/15/2006

Title: **Support Prelicensing Transition to License Application Review – DIRECT2 ISI, Project #20.06002.01.312.**

Purpose: Documentation of data sources used with GIS software to create informational figure and export as high-resolution file format for inclusion in Intermediate Milestone, Analysis to Support TPA Code Development and Technical Bases, #06002.01.312.630.

Personnel: Deborah Waiting is responsible for locating and/or generating GIS files that are geo-spatially correct and display, to the best of her knowledge, accurate data representation and analysis as requested as directed by Donald Hooper. All entries made herein, are made by Deborah Waiting, unless otherwise noted.

Project: D. Waiting was requested by D. Hooper to determine drainage basins surrounding the predefined Fortymile Wash drainage basin at Yucca Mountain, Nevada. The Fortymile Wash drainage basin GIS coverage used was created by Brittain Hill and given to D. Waiting by D. Hooper.

First attempt at determining the surrounding watershed basins was made using the Arc GIS Spatial Analyst Hydrology Tools, with a 10m resolution Digital Elevation Model (DEM). The results were very obviously incorrect as the tool was unable to create a depressionless DEM, which is an important step in the watershed/basin process. This may have been due to several factors, i) the large size of the input file, ii) the high resolution of the DEM (cell size of 10 m x 10 m), or iii) having an area of multiple drainage basins. Another attempt to use the Hydrology Tools was made using a 30m resolution DEM of the same area. The results were also unsatisfactory as again, a depressionless DEM could not be made.

The results from the Spatial Analyst Hydrology Tool were discussed with D. Hooper, and it was decided that the basins would be digitized using ArcView GIS 3.3. The DEM was converted to a shaded relief image with a vertical exaggeration of 4x using ArcInfo 7.0. The shaded relief would become the base for digitizing the watershed basins. As an aid to quickly determine individual watershed basins, a hydrographic flowline coverage was downloaded. This file was part of a Microsoft Access database file, NHDH1809.mdb, included on the attached CD-ROM DVD in folder YM_drainage (DJW, 8/26/2009). The initial image at the beginning of this phase of the project consisted of the 10 m resolution shaded relief, the flowline coverage from NHD, a state boundary line between California and Nevada, and the 40-mile drainage basin from B. Hill (see Figure 1).

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Entry: Deborah Waiting (DJW)
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Information potentially subjected
(Figure 1)
to copyright protection was redacted
from this location.
The redacted material is from
Yucca Mountain
Ikonos Satellite Image

Figure 1

Using ArcView GIS 3.3, a new theme coverage was created for each the Tonopah Wash Basin, the Lathrop Wells Sub-basin, and the Crater Flat Basin. Using the shaded relief allowed the use of shading to determine which slope was included in a basin. D. Hooper concurred with most of the basin boundaries, but requested a revision to the southern drainage flowpath of the Crater Flat Basin. This figure has been set up as a Layout to use either the 10m shaded relief or the 1m resolution Yucca Mountain Ikonos satellite image. Figure 2 shows the digitized basins (yellow, bright green, and fuchsia) with their corresponding labels. The background is a ~~1m Ikonos~~ satellite image.

THE IKONOS IMAGE WAS REPLACED WITH LANDSAT SATELLITE IMAGE AS THE IKONOS IMAGE DID NOT COVER THE DESIRED AREA. DJW 11/6/09

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Entry: Deborah Waiting (DJW)
Date: 6/15/2006

Information potentially subjected
(Figure 2)
to copyright protection was redacted
from this location.
The redacted material is from a
Ikonos Satellite Image

Figure 2

Data: All files used in this project were either in or projected to Universal Transverse Mercator (UTM), zone 11N, meter units, z-units meters, and NAD83 datum using one of the ESRI Arc GIS software products.

Data acquisition began with downloading 1/3 Arc Second, (10-meter), resolution Digital Elevation Models (DEM) from the National Elevation Dataset web site, (<http://ned.usgs.gov/>). This data covered the area of six DEMs having a mosaicked bottom left corner at 502715.9612 Easting, (36° 20' 38".00035), 4022092.2907 Northing (-116° 58' 11".04037) and top right corner at 594735.9612 Easting (37° 18' 23".47511), 4129412.2907 Northing (-115° 55' 51".50903). The 30m DEM was downloaded for use in an earlier project and was already mosaicked. It too, was acquired from the NED web site. Due to the size of the DEM grids, the mosaic and the conversion to a shaded relief were accomplished using ArcInfo 7.0.

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A search for watershed information began at the US Environmental Protection Agency web site, (<http://cfpubl.epa.gov>) where the desired watershed name and USGS Cataloging Unit number can be located by following the links on the home page (water > surf your watershed > locate watershed with interactive map). The watershed for the Yucca Mountain area is the Upper Amargosa, unit #18090202. Then select, "Science in your Watershed", then "Databases" from the left-hand column, from that page, use the link to "USGS National Hydrography Dataset" (NHD). At the NHD home page, select "Data". You can then link to the USGS ftp site for Subregions, select the "High" folder and download the NHDH1809.zip file. The unzipped file is "NHDH1809.mdb". This database can be read in ArcCatalog (part of the ArcGIS 9.0 software package). The flowline file used is included in the "Hydrography" directory as part of the database file.

The 1m resolution Ikonos satellite image was purchased by R. Fedors from Space Imaging of Thornton, Colorado as separate multispectral bands of numerous Panchromatic images of Yucca Mountain and surrounding vicinity. The bands were mosaicked into one large (52 GB) image by EarthSat Corp. using a proprietary histogram matching technique. M. Necsoiu resampled the image in Erdas Imagine creating a 10 GB image and projected the image to UTM zone 11N, meter units, NAD27 datum and then reprojected to NAD83 datum. These two files were then reformatted to Mr. SID (compression software by Lizard Tech) using a compression factor of 30. A subset from the full image was made using ENVI 4.1 to decrease the file size. Files are located in folder, YM_drainage on the attached DVD (DJW, 8/27/2009).

Codes: The Geographic Information System (GIS) data generated, edited, and/or plotted for this project was accomplished using the commercially available ESRI software products i) ArcInfo 8.0, ii, ArcView GIS 3.3 with Arcview Spatial Analyst 2.0a, and iii) ArcGIS 9.0. Also used was ENVI 4.1, a commercially available software by Research Systems, Inc. These software codes are maintained in accordance with CNWRA Technical Operating Procedure – 018. All other codes used in this report are standard versions of commonly used commercial codes including Adobe® Illustrator® v. 10.0.3.

Reference: ESRI. ArcView GIS Version 3.3, Redlands California: ESRI 2002.

ESRI. ArcView Spatial Analyst Version 2.0a, Redlands California: ESRI 2000.

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Date: 6/15/2006

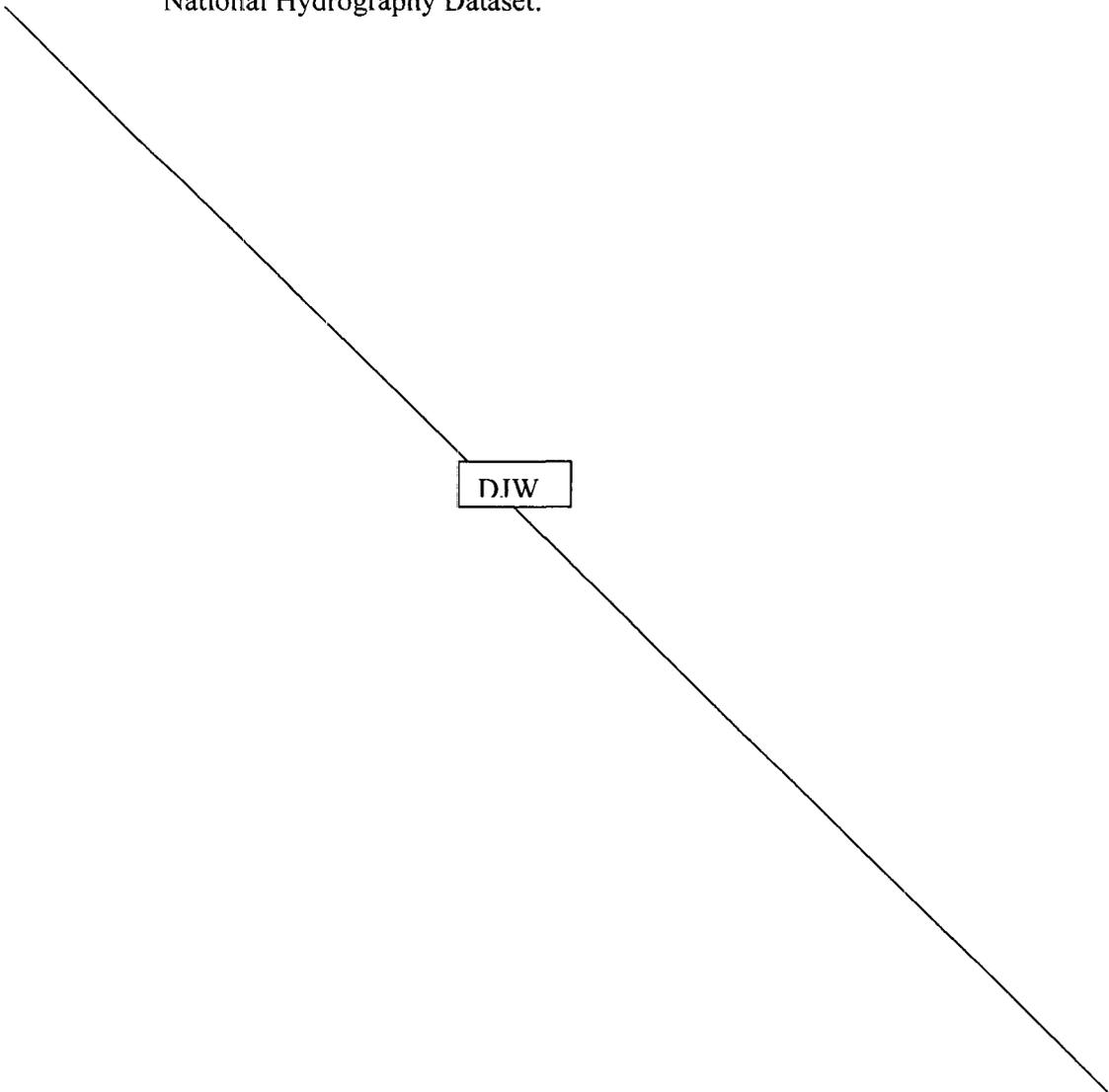
ESRI ArcGIS 9.0, Redlands California: ESRI 2004.

Research Systems, Inc. (RSI), The Environment for Visualizing Images (ENVI) Version 4.1, Boulder Colorado: Research Systems, Inc. 2004.

Adobe Illustrator 10.0.3, San Jose California: Adobe 2002.

National Elevation Dataset web site, (<http://ned.usgs.gov/>)

US Environmental Protection Agency web site, (<http://cfpub1.epa.gov>), USGS National Hydrography Dataset.



DJW

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Entry: Deborah Waiting
Date: 6/18/2006

Title: Support Prelicensing Transition to License Application Review – DIRECT2 ISI, Project #20.06002.01.312.

Purpose: Documentation of data sources used with GIS software to spatially register create a raster image created by Michael Ort and his students at Northern Arizona University, create a GIS coverage of tephra-fall deposit isopachs around Sunset Crater, Arizona from the image, and determine the area of each isopach for use in Intermediate Milestone, Analysis to Support TPA Code Development and Technical Bases, #06002.01.312.630.

Personnel: Deborah Waiting is responsible for locating and/or generating GIS files that are geo-spatially correct and display, to the best of her knowledge, accurate data representation and analysis as requested as directed by Donald Hooper and Nancy Adams. All entries made herein, are made by Deborah Waiting, unless otherwise noted.

Project: D. Waiting was requested by D. Hooper to spatially register a scanned copy of a raster image illustration of the tephra-fall deposit depths (isopachs) at Sunset Crater, Arizona measured by Michael Ort and students at Northern Arizona University. This image represents updated work based on the 1986 thesis of R.C. Amos. Previous registration work was attempted on this image, but due to distortion from copying and lack of common points, was not acceptable. Once the image was registered correctly, the area of each ash depth isopach represented on the image was to be calculated. This information was required by N. Adams in support for her hazard analysis work.

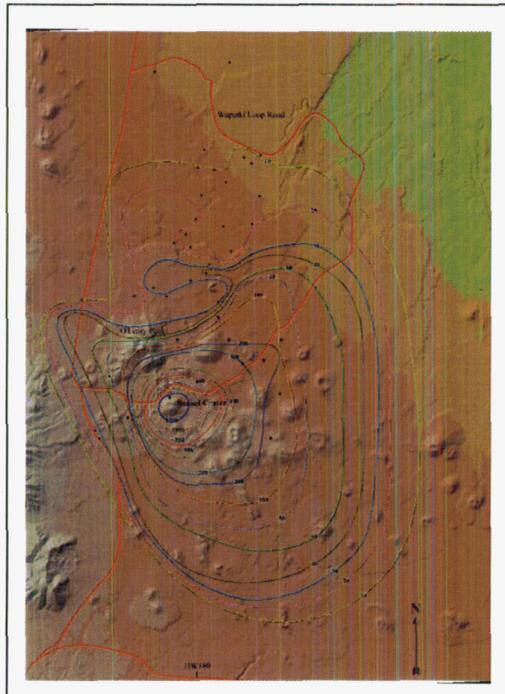
USGS 1:24,000 scale topographic maps (DRGs) were downloaded from Arizona Regional Image Archive (ARIA) web site (<http://aria.arizona.edu/>). To cover the area of the image, 12 maps were downloaded. The maps were in UTM Zone 12 projection with meter units. The datum was stated at NAD27/predicted 83, with a spheroid of GRS 1980. This information was confusing as the GRS 1980 spheroid is used with NAD83 datum. The datum of the images was verified by comparing the best match to a coverage with known datum. The images aligned correctly with the NAD27 datum, Clarke1866 spheroid.

The DRGs and The Ort isopach image were opened in Arc GIS 9.0. Adjusting the transparency of the images and using the Spatial Adjustment Editing Tool, spatial information was created for the isopach image. The registered image was named, nu_relief_isomap_u12n2tr.tif. This tiff image was opened in ArcView GIS 3.3 and a new theme of the isopachs was created by digitizing polygons from the registered Ort image. The theme attribute table was edited to

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include three new fields, one for perimeter, one for area, and one for thickness. The thickness measurement was taken from the isopach image. The perimeter and area were calculated using the calculator tool and the requests of ReturnLength and ReturnArea. A separate theme for each isopach was created by selecting the isopach polygon and saving as a shapefile. These files were named by the thickness label. All files are included on the attached [CD-ROM DVD \(DJW,8/26/2009\)](#) in directory, arizona. The project used in ArcView and ArcGIS were not saved, but a copy of the digitized isopachs on the registered image was exported as a JPEG image and is included herein.



isopachs_on_ort.jpg

Codes: The Geographic Information System (GIS) data generated, edited, and/or plotted for this project was accomplished using the commercially available ESRI software products i) ArcView GIS 3.3, with ArcView Spatial Analyst 2.0a, and ii) ArcGIS 9.0. These software codes are maintained in accordance with CNWRA Technical Operating Procedure – 018. All other codes used in this report are standard versions of commonly used commercial codes including Adobe® Illustrator®v. 10.0.3.

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Date: 6/18/2006

Reference: ESRI. ArcView GIS Version 3.3, Redlands California: ESRI 2002.

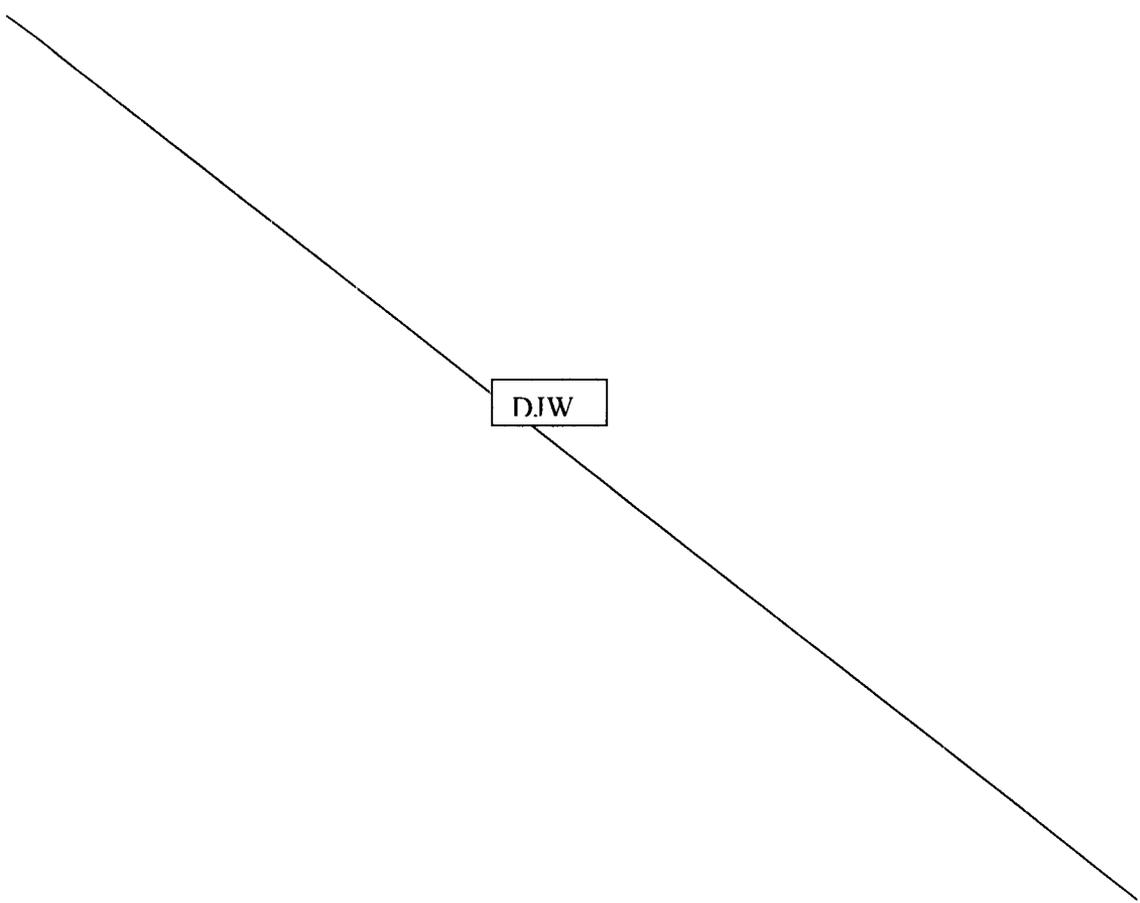
ESRI. ArcView Spatial Analyst Version 2.0a, Redlands California: ESRI 2000.

ESRI ArcGIS 9.0, Redlands California: ESRI 2004.

Adobe Illustrator 10.0.3, San Jose California: Adobe 2002.

Ort, Michael, Sunset Crater tephra-fall deposits PDF image received from D. Hooper, 2005.

Arizona Regional Image Archive (ARIA), USGS 1:24,000 scale topographic 7.5' quadrangle maps (DRGs), (<http://aria.arizona.edu/>), 2006.



DJW

(4) Support Prelicensing Transition to License
Application Review --UZ3 ISI
(2/14/2007)

Scientific Notebook 724E

Entry: Deborah Waiting
Date: 2/14/2007

Title: Support Prelicensing Transition to License Application Review – UZ3 ISI, Project #20.0600.01.232.

Purpose: Documentation of data sources used with GIS software to create informational figure, export to a high resolution format for inclusion in Support Prelicensing Transition to License Application Review – UZ3 ISI documents.

Personnel: Deborah Waiting is responsible for locating and/or generating GIS files that are geo-spatially correct and display, to the best of her knowledge, accurate data representation and analysis as requested and directed by Jude Mc Murray. All entries made herein, are made by Deborah Waiting, unless otherwise noted.

Project: Jude Mc Murray requested a figure that centered on the potential high level waste repository at Yucca Mountain with Alcoves 1 through 8 and Niches 1 through 4 identified and labeled. She also requested that the figure should identify the location of Busted Butte.

Data: The background image used in the figure is from a 1 meter resolution Ikonos satellite image purchased from Space Imaging and assembled by Earth Sat for CNWRA (as described in Support Prelicensing Transition to License Application Review – DIRECT2 ISI, Project #20.06002.01.312, above). The vector coverage of the Exploratory Studies Facility is from a digital file received from Warren Day based on “Bedrock Geologic Map of the Central Block Area, Yucca Mountain, Nye County, Nevada” (Day, et al., 1998). The alcoves and niches locations were from the 1999 YMP GIS CD-ROM received from DOE 26-June-2000.

The figure was created using ArcView GIS 3.3; project name, jude_proj1.apr, image from View 2. The image has a geographic coordinate system of UTM, zone 11, meter units and a datum of NAD27. The ArcView project was imported into ArcMap 9.0 for labeling. The map layout was exported in Tiff format for inclusion in report. See Figure 1. Files are located in folder ym_4_jude on the attached DVD (DJW, 8/27/2009).

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Entry: Deborah Waiting
Date: 2/14/2007

Information potentially subjected
(Figure 1)
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Ikonos Satellite Image

Figure 1

Codes: The Geographic Information System (GIS) data generated, edited, and/or plotted for this project was accomplished using the commercially available ESRI software products i) ArcView GIS 3.3 with ArcView Spatial Analyst 2.0a, and ii) ArcGIS 9.0. These software codes are maintained in accordance with CNWRA Technical Operating Procedure – 018.

Reference: ESRI. ArcView GIS Version 3.3, Redlands California: ESRI 2002.

ESRI ArcGIS 9.0, Redlands California: ESRI 2004.

Day, Warren C., Christopher J. Potter, and Donald Sweetkind, 1998, Bedrock Geologic Map of the Central Block Area, Yucca Mountain, Nye County, Nevada, Map I-2601, 1:6,000 scale. Denver, CO: USGS 1998.

DOE 1999, Yucca Mountain GIS CD ROM, Washington, DC: DOE 1999.

DJW