CLARK, LINCOLN, AND WHITE PINE COUNTIES GROUNDWATER DEVELOPMENT PROJECT EIS

WATER RESOURCES TECHNICAL REVIEW
MEETING 1 – BASELINE DATA
June 23-24, 2005

METEOROLOGY AND CLIMATE DATA

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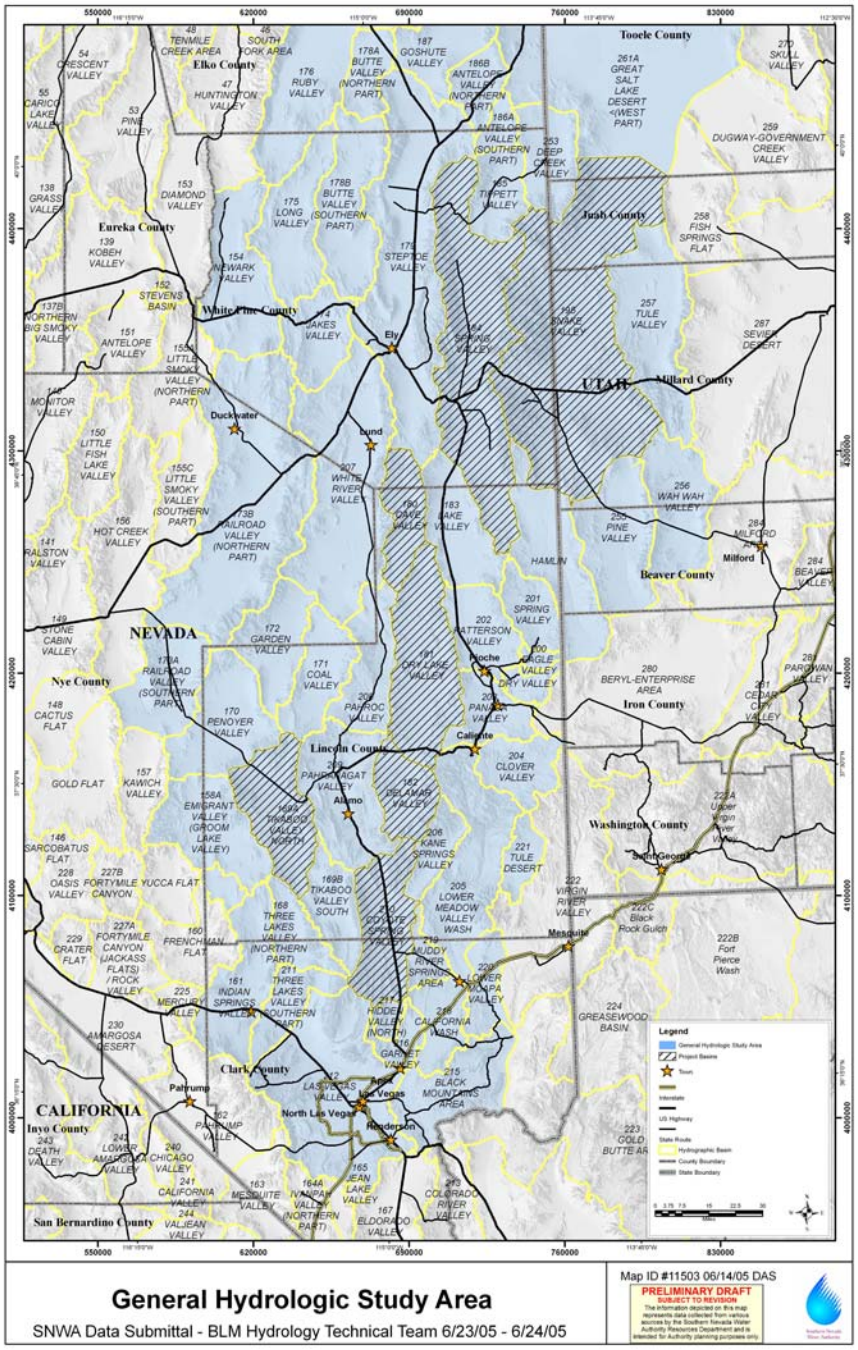
Presentation Organization

- Presentation Objective
  - Description of meteorological and climate data to be transmitted
- Data Overview
- Precipitation data presented
- ET and PET data presented
- Data arrangement on CD / DVD

General Hydrologic Study Area



Levels of Investigation:

Reconnaissance

vs.

Detailed

Meteorology and Climate Data Types

- **Precipitation Data**
  - **Daily, Monthly, Seasonal, Annual, "Long term"**
- **Evapotranspiration (ET) (direct and indirect ET estimates)**
  - **Daily, Monthly, Seasonal, Annual, "Long term"**
- **Potential ET Data (direct and indirect ET estimates)**
  - **Daily, Monthly, Seasonal, Annual, "Long term"**

PET data

- Potential Evapotranspiration = amount of water removed from the surface to the atmosphere with unlimited water supply
  - Accounts for the influence of meteorological parameters that are not dependant on availability of water
  - Allows for transfer of ET data from one area to another

Use of Data (Precipitation, ET, & PET)

- **Long term (averaged) data**
  - **Useful for basin water budgets**
- **Daily, Monthly, Seasonal, Annual data**
  - **Specific sites and times useful for ET studies**

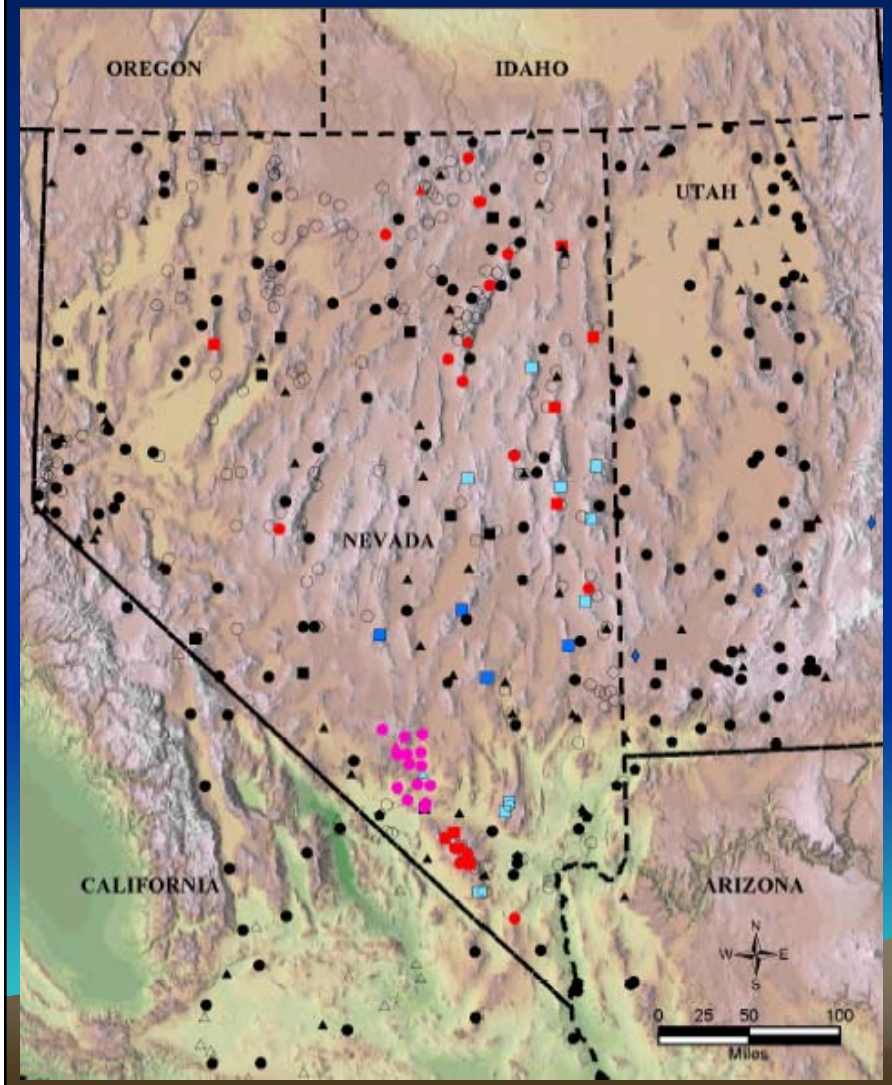
Climate (Precipitation) Data Sources

- **WRCC / NCDC (Western Regional Climate Center/ National Climate Data Center)**
  - **Daily, Monthly, Low Altitude, Main Source of Data**
- **SORD (Special Operations and Research Division)**
  - **Daily, Monthly, Low to High Altitude, Local Area**
- **NDWR (Nevada Division of Water Resources)**
  - **Annual, Moderate to High Altitude, Long Records**
- **USGS (U.S. Geological Survey)**
  - **Seasonal, High Altitude, Moderate Length Records**

Precipitation Data Collection - Devices

- Daily gages (WRCC and SORD)
  - Most common variety is a “tipping bucket”
    - Precision mechanical devices require maintenance / are subject to failure in adverse conditions
    - Size of “bucket” is determined by primary use / researcher
- Storage gages (USGS and NDWR)
  - Water is stored on site until the gage is measured / serviced
    - Precipitation volume may exceed gage capacity, resulting in lost data
    - Precipitation (volume) can be lost through vandalism, mechanical failure of gage or evaporation
- Data Recorders / Telemetering

Precipitation Station Locations
(348 total in Nevada / Great Basin and adjoining California and Arizona)



- Black (278) – WRCC / NCDC Sites
- Light Red (17) – SORD Network
- Dark Red (36) - NDWR Network
- Light Blue (13) - USGS gages installed between 1984 - 1986
- Dark Blue (5) – USGS gages installed between 2001 – 2003
  - One additional USGS gage installed in 2004

Climate (Precipitation) Data Availability

- **WRCC (Western Regional Climate Center)**
  - **http://www.wrcc.dri.edu/**
- **SORD (Special Operations and Research Division)**
  - **http://www.sord.nv.doe.gov/SORD_Rain.html**
- **NDWR (Nevada Division of Water Resources)**
  - **Available through NDWR**
- **USGS (U.S. Geological Survey)**
  - **Available in Annual Data Book**

WRCC / NCDC DATA

Western Regional Climate Center/National Climate Data Center

- **WRCC (one of six regional centers) is physically located in Reno and associated with Desert Research Institute (DRI) and University of Nevada, Reno (UNR) but maintains data for the entire western region (Wyoming to Hawaii) of U. S.**
- **Subset of NCDC records described by WRCC (278)**
  - **Original data was usually collected on a daily basis. A very good quality control system is used to indicate number of missed daily records**
  - **Monthly and period of record data is maintained (checked and modified) and posted on website**
  - **Main source of data but sites are generally low altitude**
    - **Better data coverage in states adjacent to Nevada**

SORD Data

Special Operations and Research Division

- **Local high quality data from Nevada Test Site**
  - **Data appears high quality because no missing data reported**
  - **Daily data also available to check monthly data**
  - **Currently available on Website**

NDWR Data

Nevada Division of Water Resources

- **Collected specifically to manage water resources**
  - **Large Spatial Extent**
  - **Long Duration Records**
  - **Moderate to High Altitude**
  - **Low Spatial Density**
  - **Collected Annually (mid summer)**
  - **Data may be lost because of vandalism**
  - **Available through Nevada State Engineer's office**

USGS Data

U.S. Geological Survey

- **Collected specifically to improve network in eastern Nevada and Spring Mountains**
  - **High Altitude**
  - **Coop USGS / (DOE) / NDWR / LVVWD / (SNWA)**
  - **Records began in mid 1980's**
  - **Restricted to eastern Nevada**
  - **New installations improve coverage**
  - **Seasonal data may be lost due to the difficulty in access and vandalism**
  - **Collected Seasonally (Spring and Fall)**
  - **Available in USGS Data Reports**

“Long Term” Precipitation Data

- “Long term” is often defined by the researcher
- Climatic data are data collected from weather (meteorological) (precipitation) stations over a long time period
- A measure of “long term” is NCDC Climate Normals calculated after 30 years of continuous data collection
  - Very few precipitation stations in Nevada (most low altitude) are eligible by this standard
- Precipitation data is inherently variable
  - Records of less than 10 years may be unreliable

Use of “Short Term” Precipitation Data

- Site and time specific data can be used in ET estimates
- May also be used for spring flow and water level data studies
  - Examples
    - Comparison of stream and spring flow volumes to precipitation variations
    - Comparison of water level measurements to precipitation variations

Precipitation Data Considerations

- Spatial density of precipitation data is usually related to population density
  - Nevada, with it's low population density, has less available precipitation data than adjacent states
- Precipitation data is collected for numerous purposes by a wide variety of methods / devices and is unusually inexpensive
- Most important features for "long term" estimate is length (duration) and completeness of record
  - Precipitation data is cumulative - Long duration and complete records are necessary because of the large variations inherent in any precipitation data
  - Period of time (years) when data was collected may influence the "period of record average" due to variations in climate and weather

Precipitation Data Transmitted

- Data organized by sources
  - Western Regional Climate Center/ National Climate Data Center precipitation data
    - Further organized by state
  - Special Operations Research Division of the Air Resources Lab at the Nevada Test Site precipitation data
  - Nevada Division of Water Resources precipitation data
  - U.S. Geological Survey precipitation data

General Relationship Between Precipitation and ET / PET

- On valley floors, PET rates usually exceeds precipitation rates
  - Spring Valley
    - Precipitation rate about 6 to 10 in/yr
    - PET rate rate about 24 to 36 in/yr
  - Las Vegas
    - Precipitation rate about 4 in/yr
    - PET rate rate about 60 to 84 in/yr
- PET usually exceeds actual ET (consumption)
- PET may or may not exceed precipitation at high altitude

ET = evapotranspiration

- The process by which water is returned to the atmosphere through evaporation from soil, open water bodies and transpiration from plants
- Important component of discharge when conducting basin-wide water budgeting
- Phreatophytic species, such as greasewood and rabbitbrush act as natural hydraulic pumps increasing the potential to use groundwater through ET

Objectives

- Provide brief overview of methodologies for estimating ET
- Summarize past estimates and studies of ET within the general study area
- Present current ET data gathering efforts
- Provide an overview of PET (potential evapotranspiration) data

Significant ET Experiments

- **Lee (1912)**- tank experiment looking at salt grass in Owens Valley
- **White (1932)**- tank and water table elevation experiment looking at salt grass and greasewood in Escalante Valley
- **Young & Blaney (1942)**- tank experiment using salt grass, cattails, sedge, and willow in New Mexico

More Recent ET Methodologies

Picture taken by Dr. Devitt, UNR, ET study team

- Bowen ratio towers - measures humidity, temperature, net radiation, and soil heat flux; ratio between sensible heat flux to latent heat flux; works best when soil moisture is not limiting

- Eddy correlation (flux) towers - measures photosynthetic fluxes, water fluxes, and heat fluxes between the ground and atmosphere; all components of the energy balance; better in dry environments

Historical ET Estimates

- **USGS and NV State Eng Office**
  - Earliest estimates of ET, 1940s – 70s
  - Compiled as Reconnaissance Series Reports and Water Resources Bulletins
  - Technical Publications (Utah)

Considerations: estimates were derived from older methodologies

More Recent ET Estimates

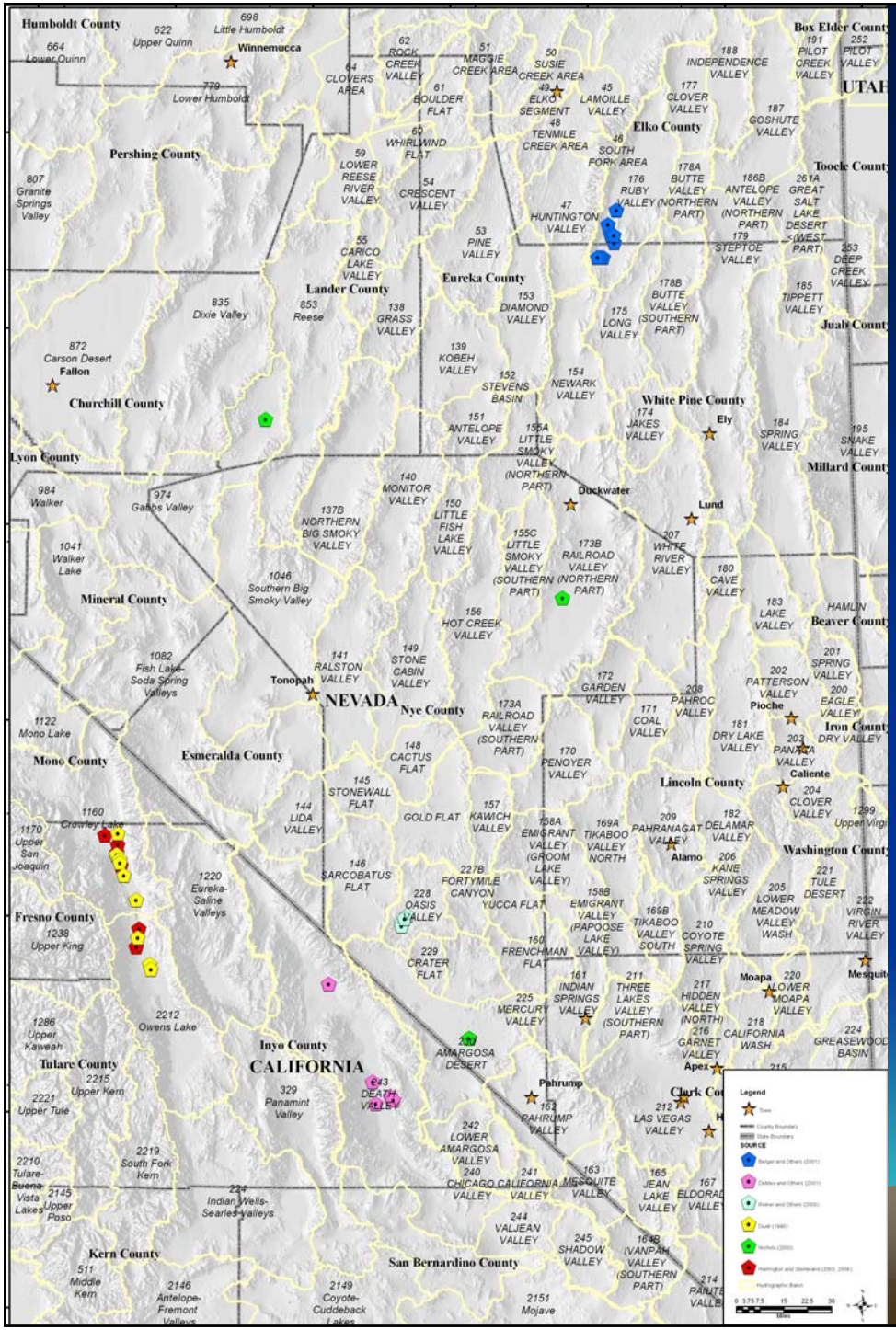
- **Nichols (2000) -** USGS in coop w/ LVVWD and NDWR
  - Compilation of data sets from Duell (1990), Nichols (1994) and Nichols (1997). Estimated ET for several basins including Butte, Clover, Jakes, Long, Spring and Steptoe Valleys.
  - Utilized satellite imagery and remote sensing to extrapolate ET estimates from station/point data to basin level.
  - Estimation of ET from vegetation cover and from water level information

ET Studies analyzed in Nichols (2000)

- **Duell (1990)** – measured ET using both Bowen and eddy towers and other methods at 7 sites in Owens Valley in 1984 and 1985
- **Nichols (1994)** – measured ET using the Bowen ratio method during the late 80s through the early 90s at 7 sites throughout Nevada, including Smoke Creek Desert, Smith Creek Valley and Railroad Valley.
- **Nichols, et.al. (1997)** – measured ET using Bowen ratio method in 1994 at 2 sites in Ash Meadows

More Recent ET Estimates

- **LVVWD (2001)**
  - Prepared in support of State Engineer's hearing on LVVWD's Coyote Spring groundwater applications (Exhibit 54)
  - Covered 18 basins in Nevada



Additional ET Studies

Published after 2000

- Harrington and Steinwand (2003, 2004) – Owens Valley
- DeMeo and others (2003) – Death Valley
- Laczniak and others (2001) – Death Valley
- Reiner and others (2001) – Oasis Valley
- Berger and others (2001) – Ruby Valley

Map ID# 11499

Previous ET Investigations

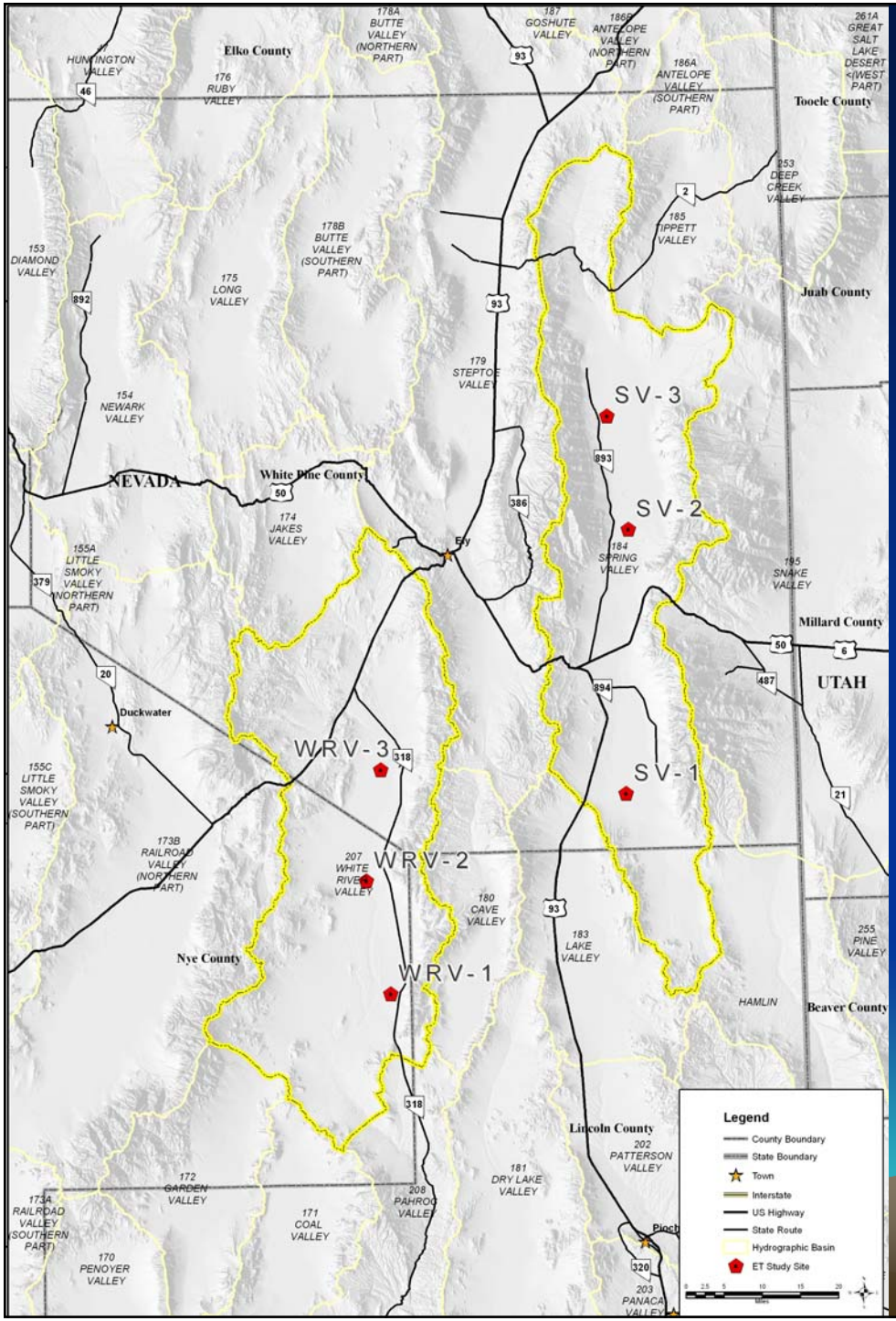
Data considerations:

- Limited number of measured sites within central-eastern region of Nevada
- Extrapolating growing season ET to long-term average annual ET can be a significant source of error
- Climatic conditions can cause variability in estimations
  - In the northern basins of interest non-growing season ET may be close to negligible
  - In the southern basins of interest non-growing season ET may be a significant portion of total ET

Additional/Future ET Data

Estimating ET in White River Valley and Spring Valley, UNR and DRI

- **Plant level**= stomatal conductance, leaf area index, etc.
- **Canopy level**= eddy flux towers at 6 sites and 2 fully automated weather stations
- **Basin level**= monitoring plant water use through satellite imagery and employing appropriate equations/models in order to utilize spectral data to estimate ET



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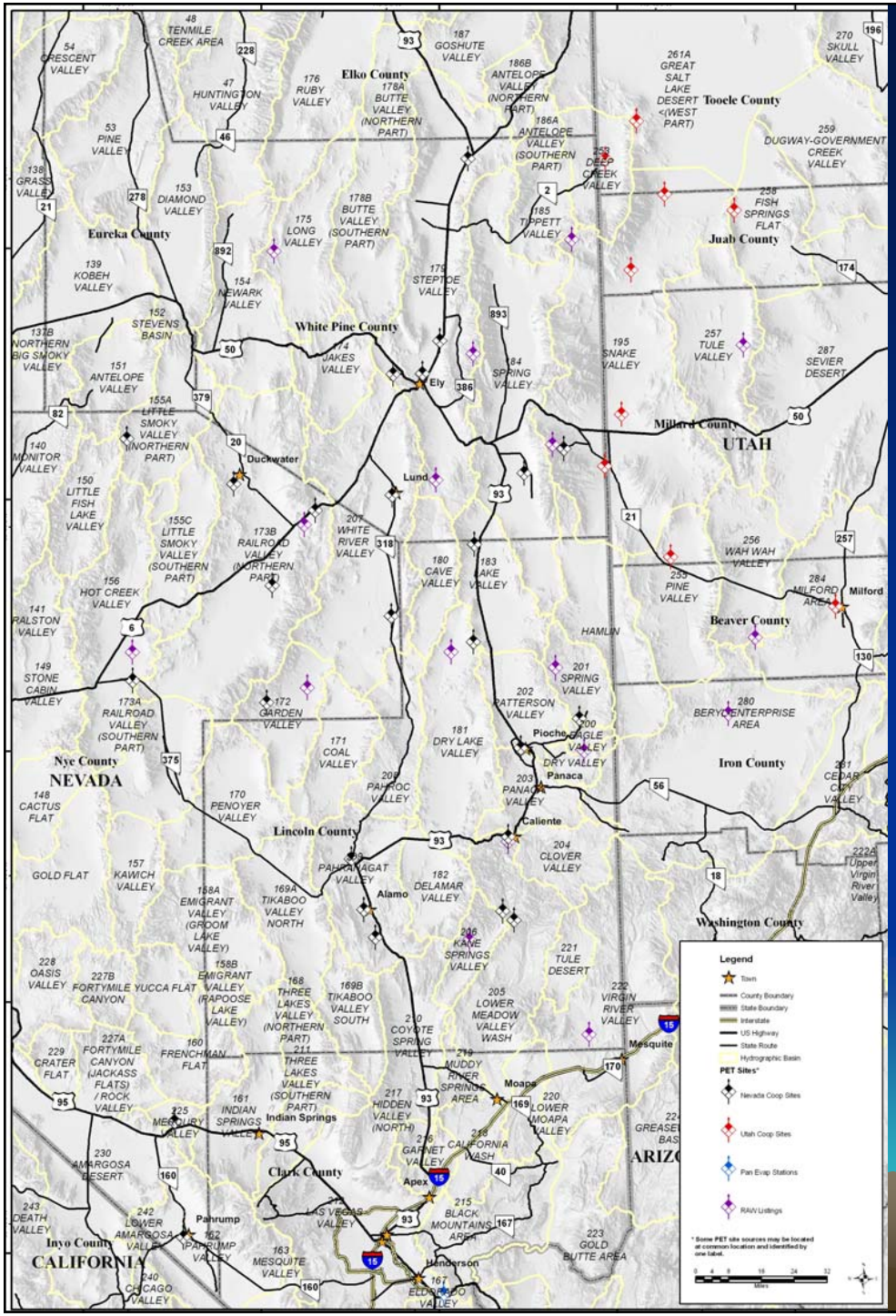


PET data

Desert Research Institute (2004)

Coop w/ SNWA

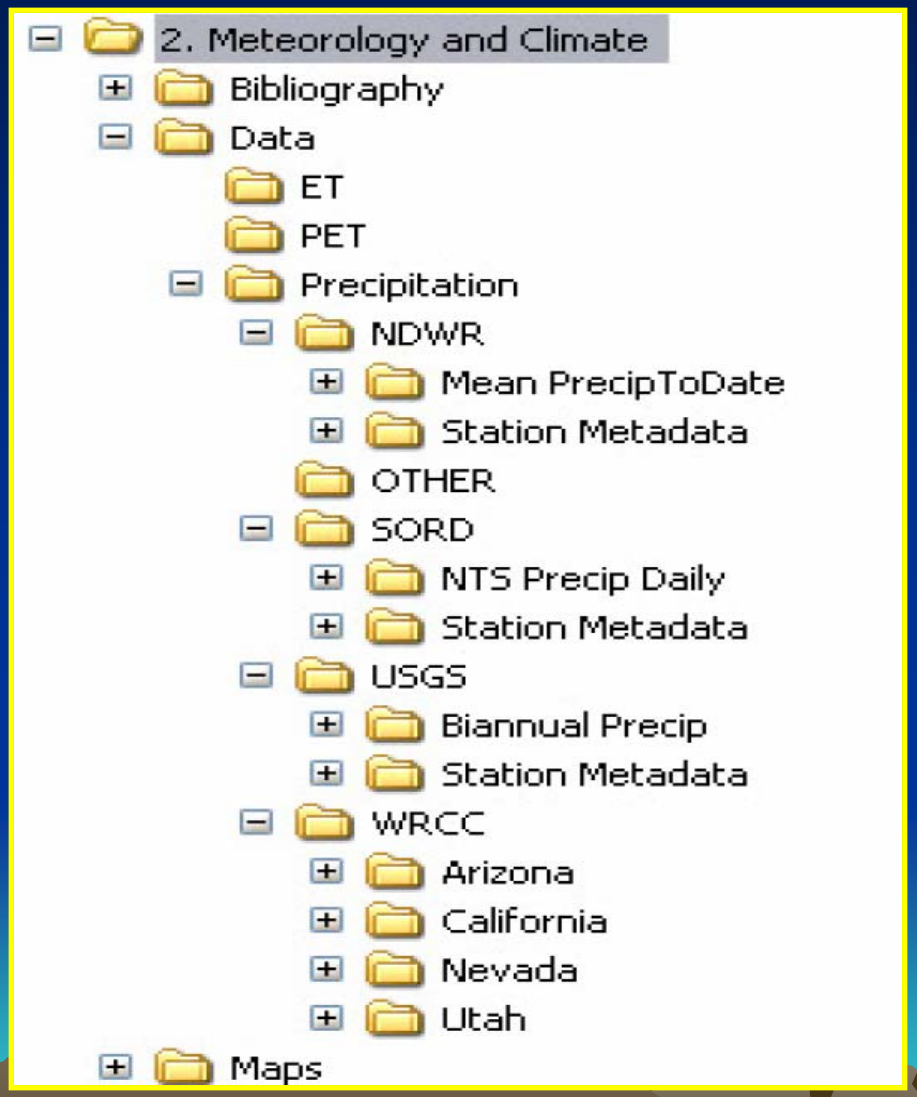
- **RAWS** (Remote Automatic Weather Stations) – USDA for fire weather; solar radiation, temp, humidity, wind speed
- **Coop sites** (cooperative observer) – NWS; daily min and max temp
- **Pan evaporation sites** – provides a direct measure of evaporation through use of standard evaporation pan

Map ID #11492

Conclusions

- ET is a significant portion of discharge when balancing water budgets
- ET data is generally lacking in the central-eastern portion of the Great Basin
- Research is currently being done to fill this data gap
- Future research using methodologies which incorporate remote sensing will assist in estimating ET across basins

Meteorology and Climate Data Structure



- Data organized by type
  - Evapotranspiration (ET)
  - Potential ET (PET)
  - Precipitation
- Precipitation data further organized by source
  - NDWR
  - SORD
  - USGS
  - WRCC