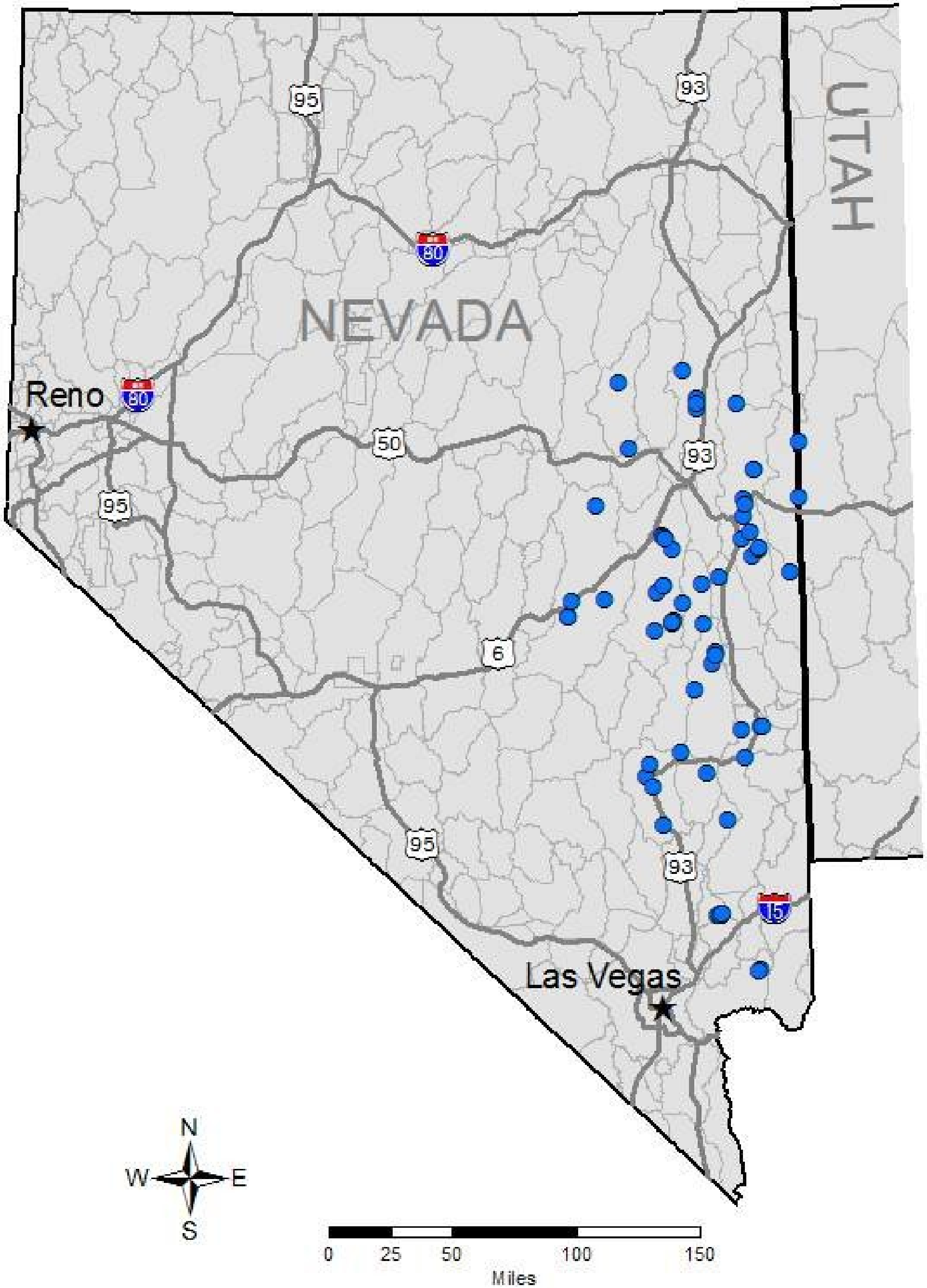
CHARACTERIZATION OF SPRINGS IN EASTERN NEVADA

D. J. Donovan, G. M. Kistinger, and S. Y. Acheampong
Southern Nevada Water Authority,
Groundwater Resources Department

NWRA Annual Conference
February 20 - 22, 2007

Purpose and Scope

- Characterization of springs (spring complexes) in eastern Nevada to determine sources and local setting (conditions)
- The springs are:
  - Significant for biologic resources
  - Usually historical and current points of diversions



Springs Evaluated In Eastern Nevada

Selection Criteria

- Springs on valley floor emphasized
- At least one spring (where possible) per valley

Fundamentals and Nomenclature

- Outline of Ground-Water Hydrology, with Definitions (O. E. Meinzer, 1923)
  - Provided 11 classification groups for springs based on:
  - character of openings, geologic structure, rock type, geologic horizon, "sphere" of water, quantity, flow variability, permanence, quality, temperature, and related features
- Most are descriptive (qualitative) terms

Classification by Average Discharge Meinzer (1923)

- Springs classified in 8 magnitude groups (literally orders of magnitude in metric units but rounded for Imperial units)
- First - largest => 100 cfs and Eighth – smallest < 1 pint per minute (~0.0001 cfs)

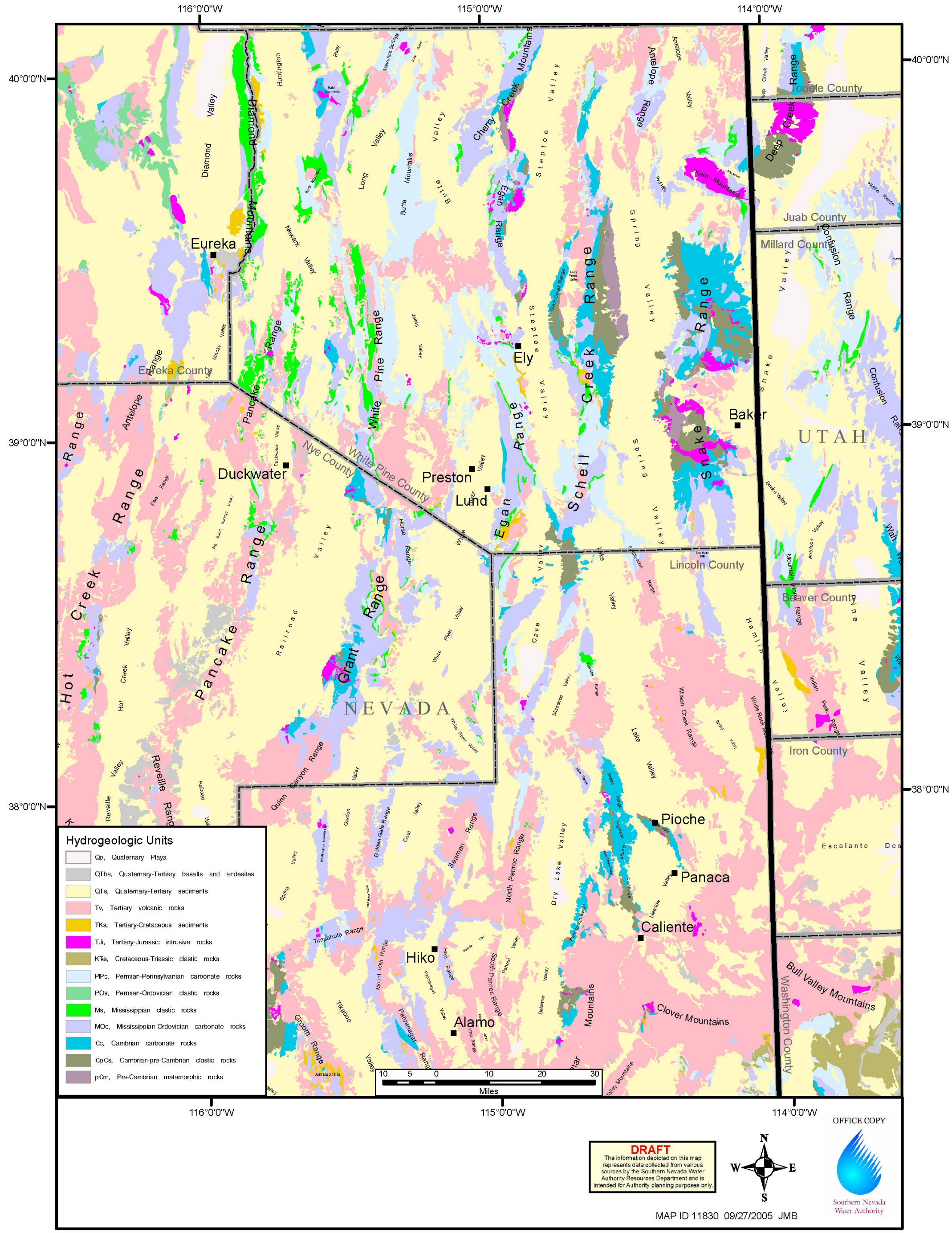
Classification by Variability Meinzer (1923)

- Variability = 100 X (Max Q – Min Q / Ave Q)
- Specified considerations
  - Existing records will underestimate absolute or actual variability
  - Long gage records best
  - Variability must be expressed as a specified period of record
  - All springs that go dry are "variable"

Classification by Temperature Garside (1979)

- Hot
  - > 32.2 degrees Celsius
  - Deep circulation or locally enhanced gradient
- Warm
  - 21.1 to 32.2 degrees Celsius
  - Springs in central part of valleys
- Cold
  - < 21.1 degrees Celsius
  - Springs near recharge areas in mountain block

Generalized Hydrogeologic Map



Classification by Geochemistry

- Mifflin (1968)
  - Terminology extensively used
  - Integral to delineation of flow systems in Nevada
  - Regional – local division defined as an epm of 1 (Cl + SO4 and Na + K)
  - Carbonate geochemical signature common due to hydrogeologic setting
  - Regional – local division may not be consistent with other chemical parameters

Classification by Flow Volume

- Any valley where discharge exceeds recharge must receive interbasin flow
- Any spring where discharge is larger than the recharge must receive interbasin flow
- Uncertainties in recharge and discharge estimate may be significant

Methodology (background)

- Acquisition of as many historical records as possible (including water rights information)
  - Historical information also aids logistics of field visit
- Review of general geologic setting

Methodology (site visit)

- Site visit to determine
  - Local geologic features
  - Orifice characteristics
  - Degree and type of modification
  - Current flow conditions
  - Collection of water samples
  - Temperature of water

Methodology (initial analysis)

- Reanalysis of historical data to determine data quality
- Development of local geologic maps
- Analysis of field collected geochemical data
- Comparison of estimated and measured flow rates to basin recharge and discharge estimates
- Process is ongoing

Order of Springs

- Second to fifth
- Mostly third (1 to 10 cfs)
- Mean uncertain due to sparseness of record and anthropogenic modification

Variability of Springs

- Though easy to estimate, highly uncertain based on available data
- Diversions and modification of the spring pool / mound are common and of unknown date
- Instantaneous measurements collected decades apart may or may not be collected in the same locations

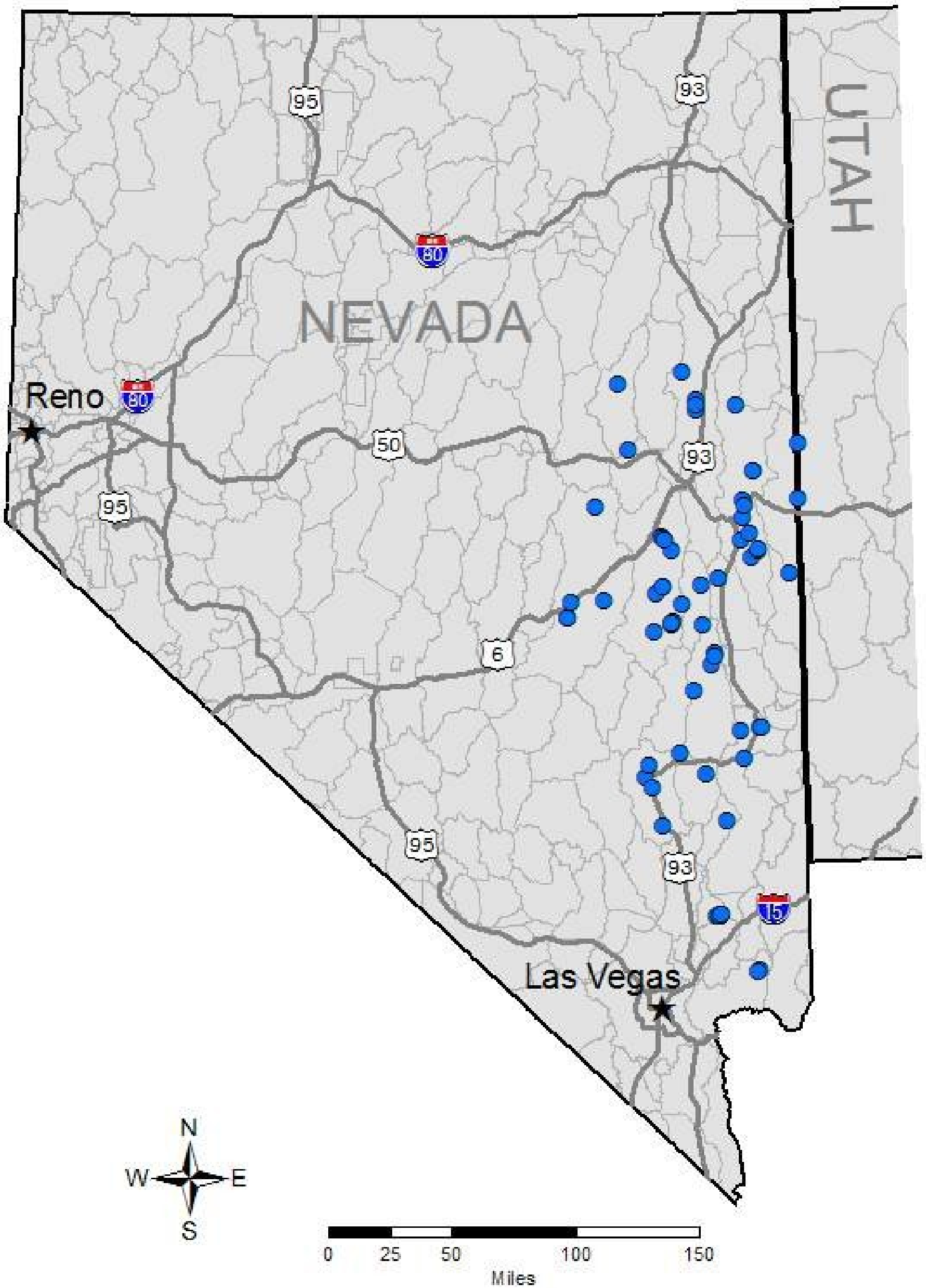
Temperature of Springs

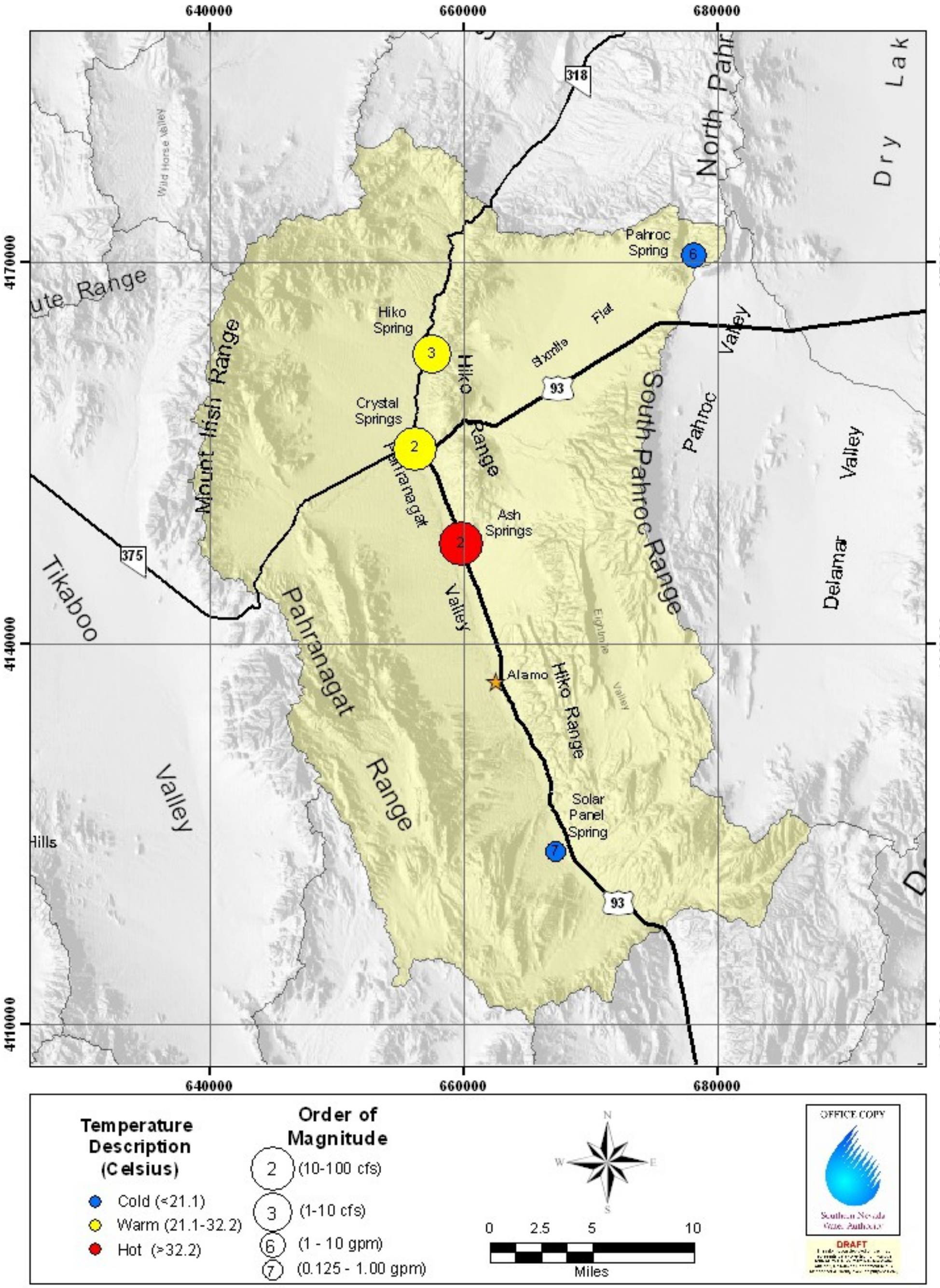
- “Regional” springs determined by other parameters are usually warm (> 21.1 degrees Celsius)
- Cold springs unlikely to be regional

Regional Springs by Flow Volume

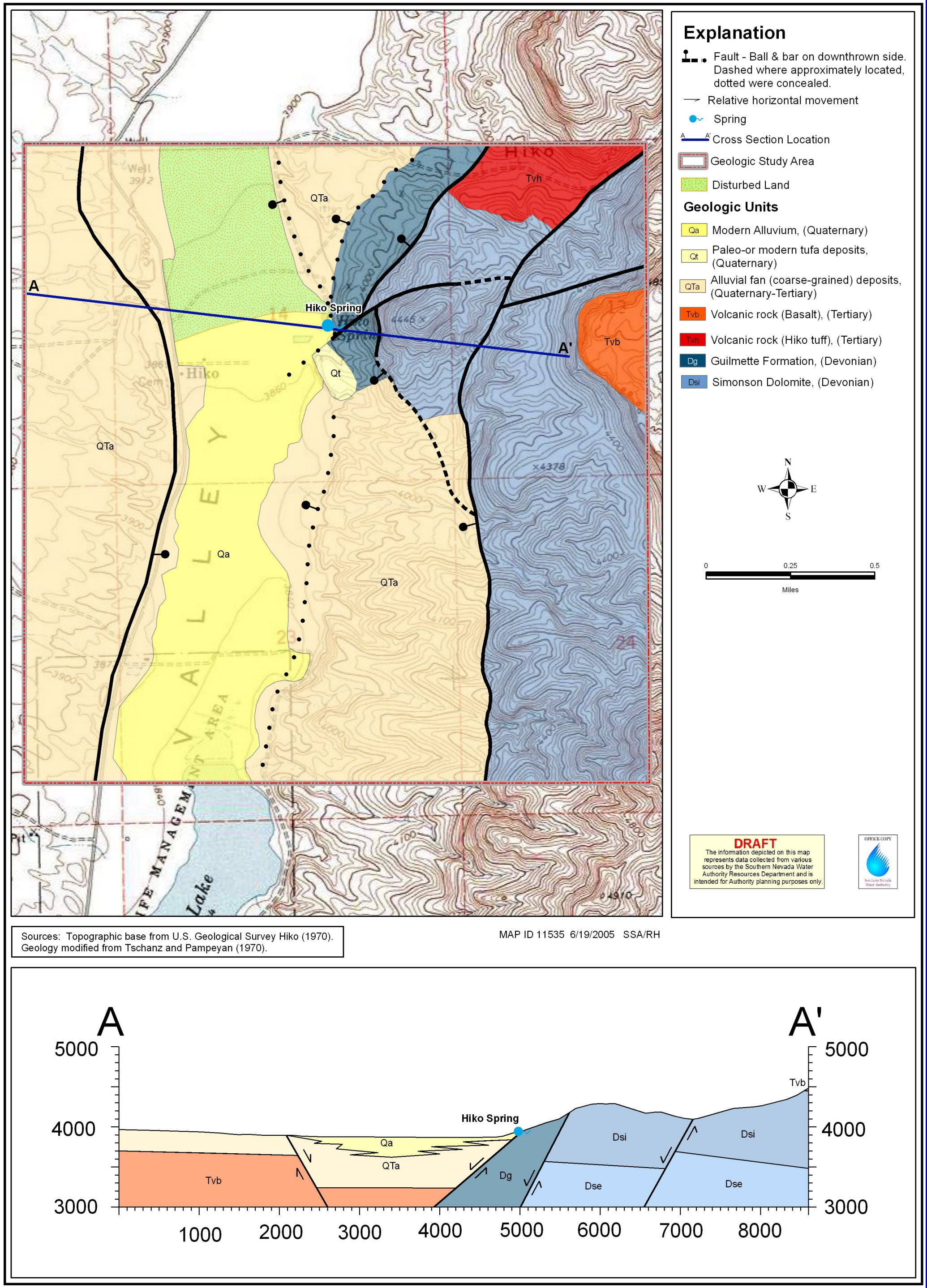
- Combined Discharge of in Muddy Springs Area
  - Second Order (> 47 cfs)
  - Discharge greatly exceeds local recharge
- Combined Discharge (Ash, Crystal and Hiko) of Springs in Pahranagat Valley
  - Second Order (> 30 cfs)
  - Discharge exceeds local recharge
- Combined Discharge (Rogers and Blue Point) in Black Mtns Area
  - Third order (> 1 cfs)
  - Discharge may exceed local recharge
- All warm springs and records are effected by diversions

Springs Evaluated In Eastern Nevada

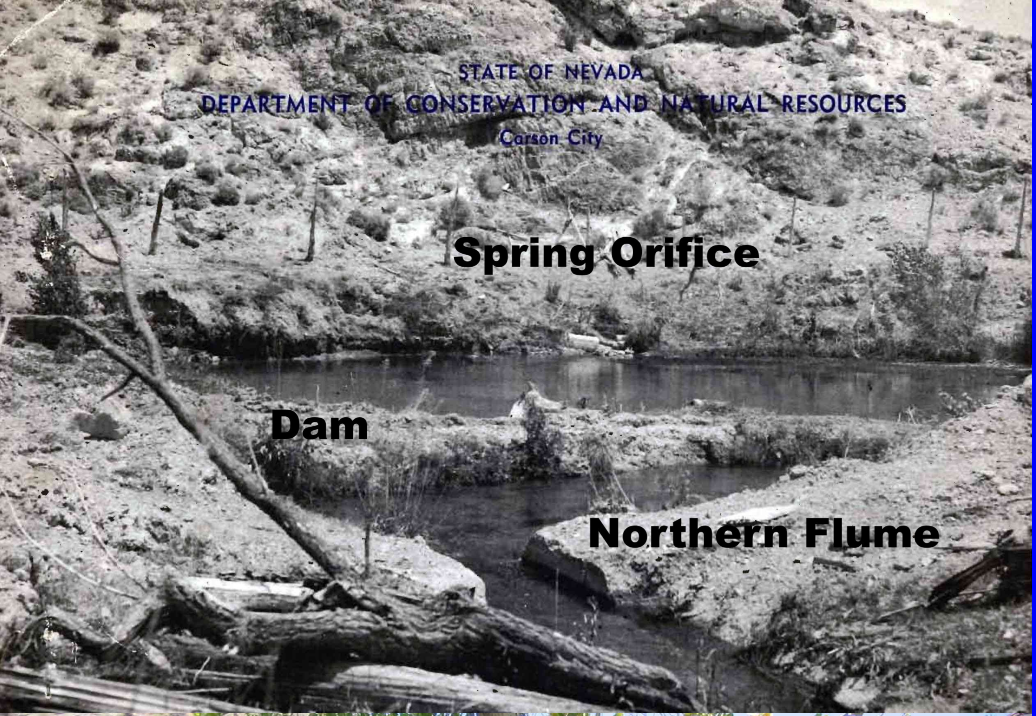


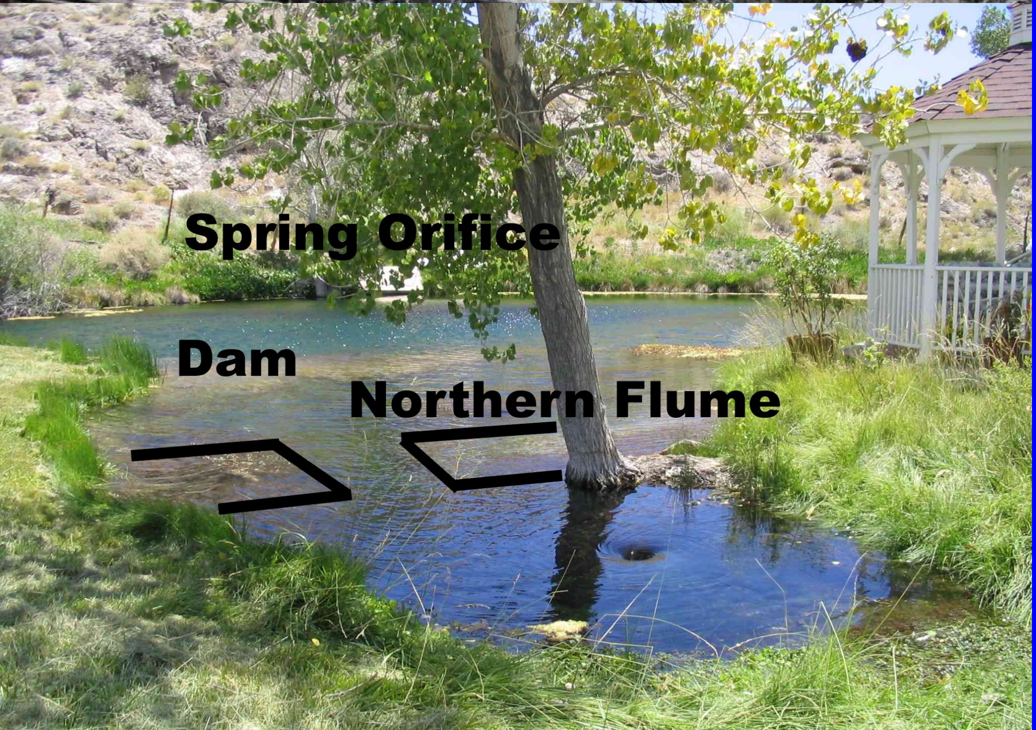


Pahranagat Valley



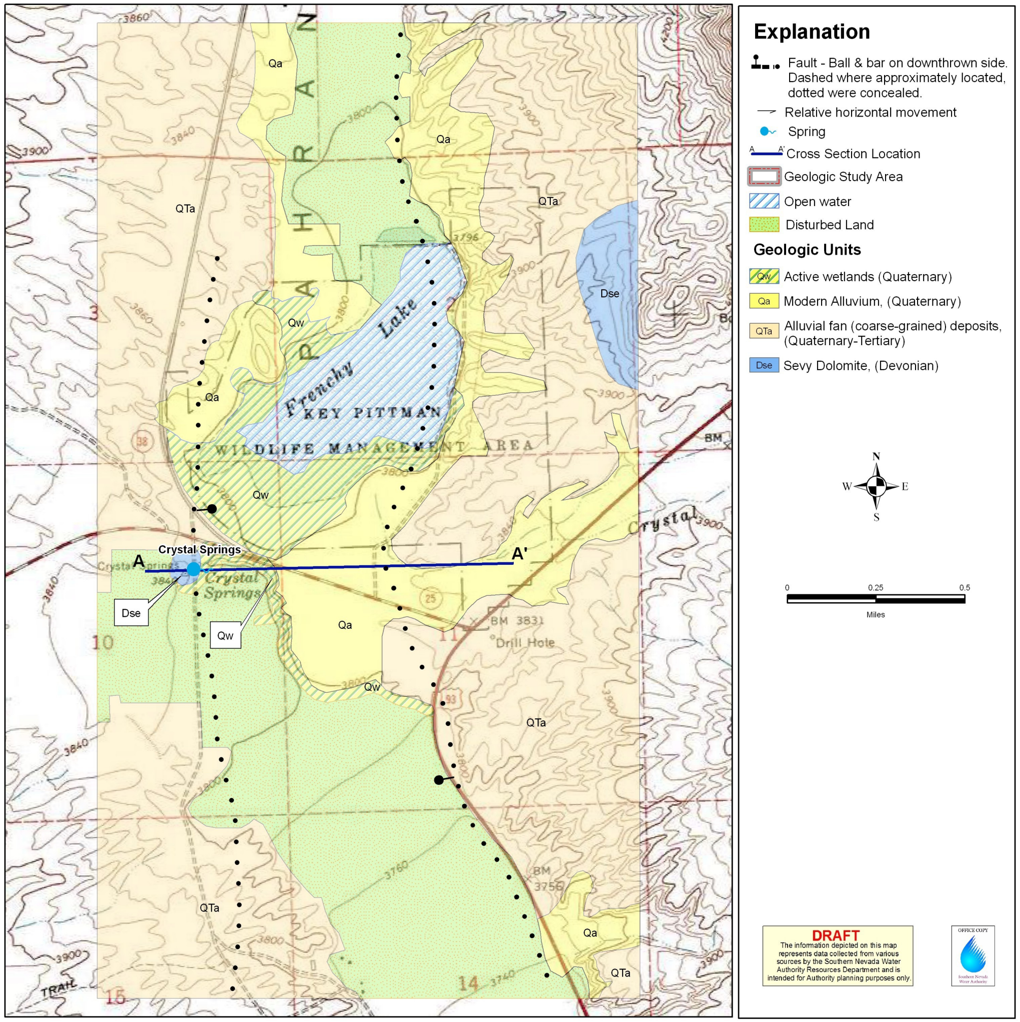
Hiko Springs Geology





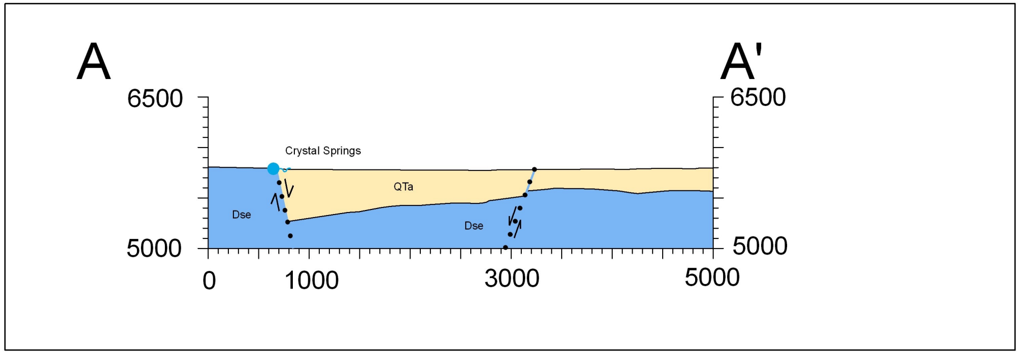
Hiko Springs Photo Comparison

Crystal Springs Geology



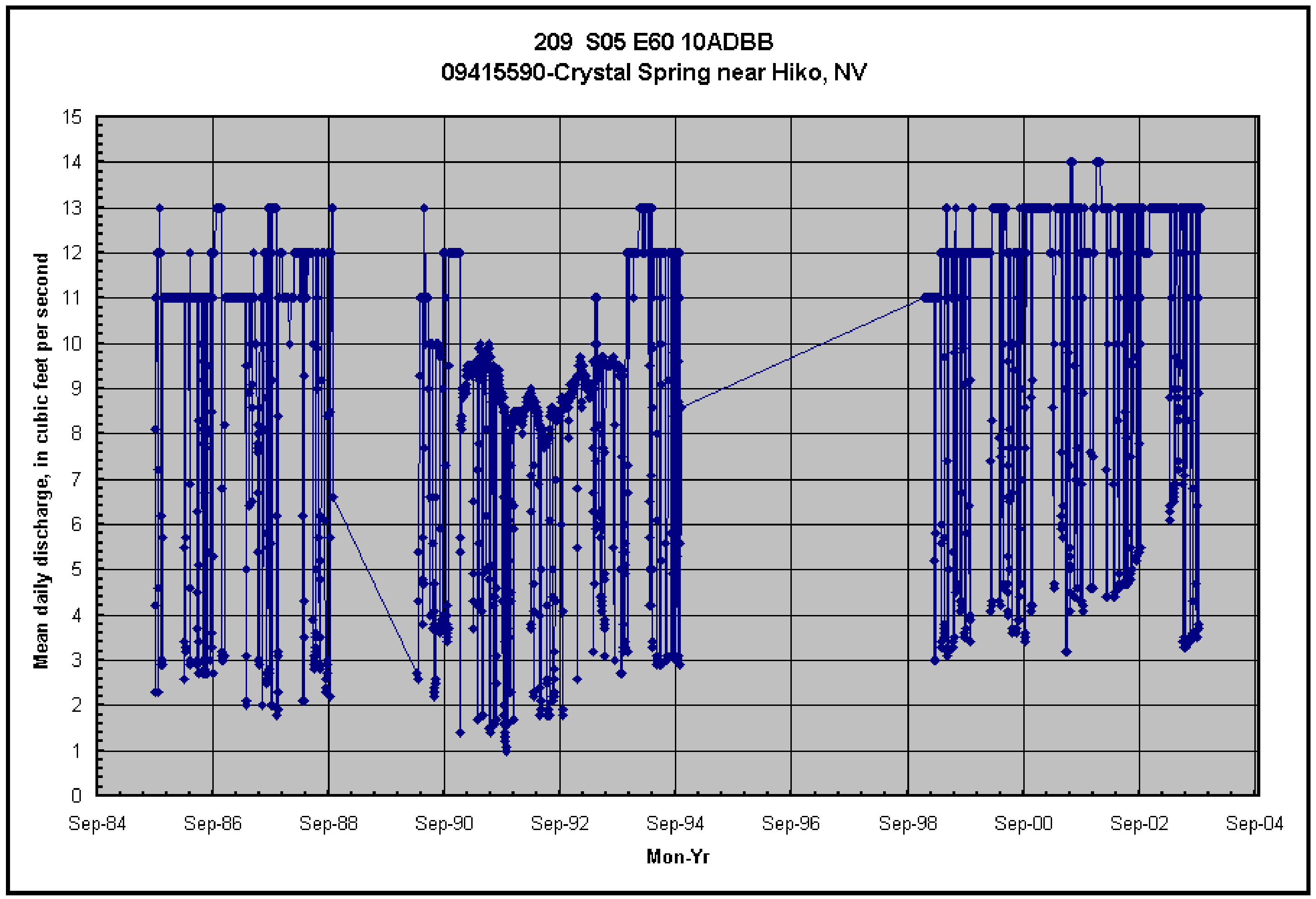
Sources: Topographic base from U.S. Geological Survey Hiko (1970). Geology modified from Tschanz and Pampeyan (1970).

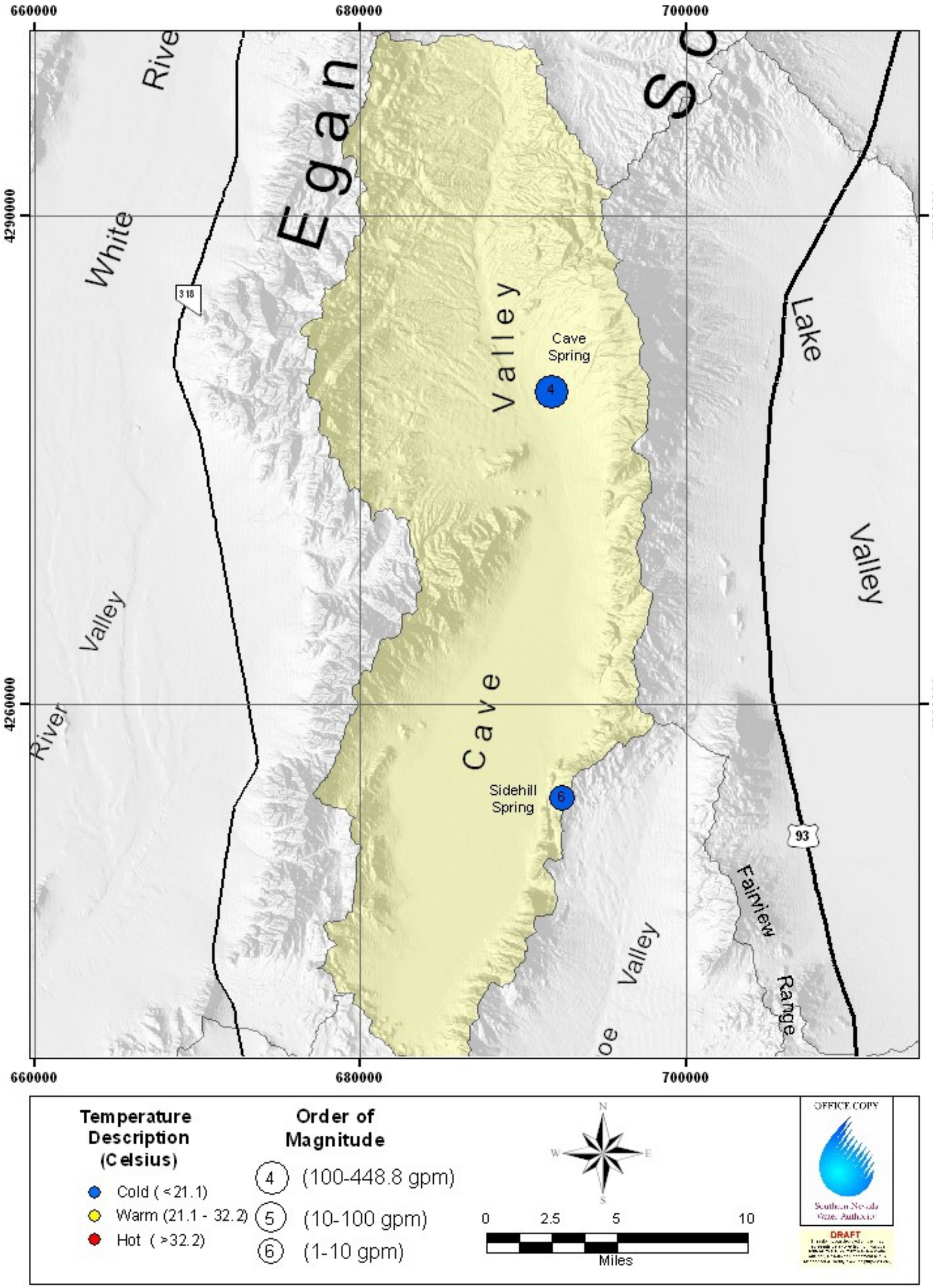
MAP ID 11552 6/19/2004 SSA/RH



Crystal Springs

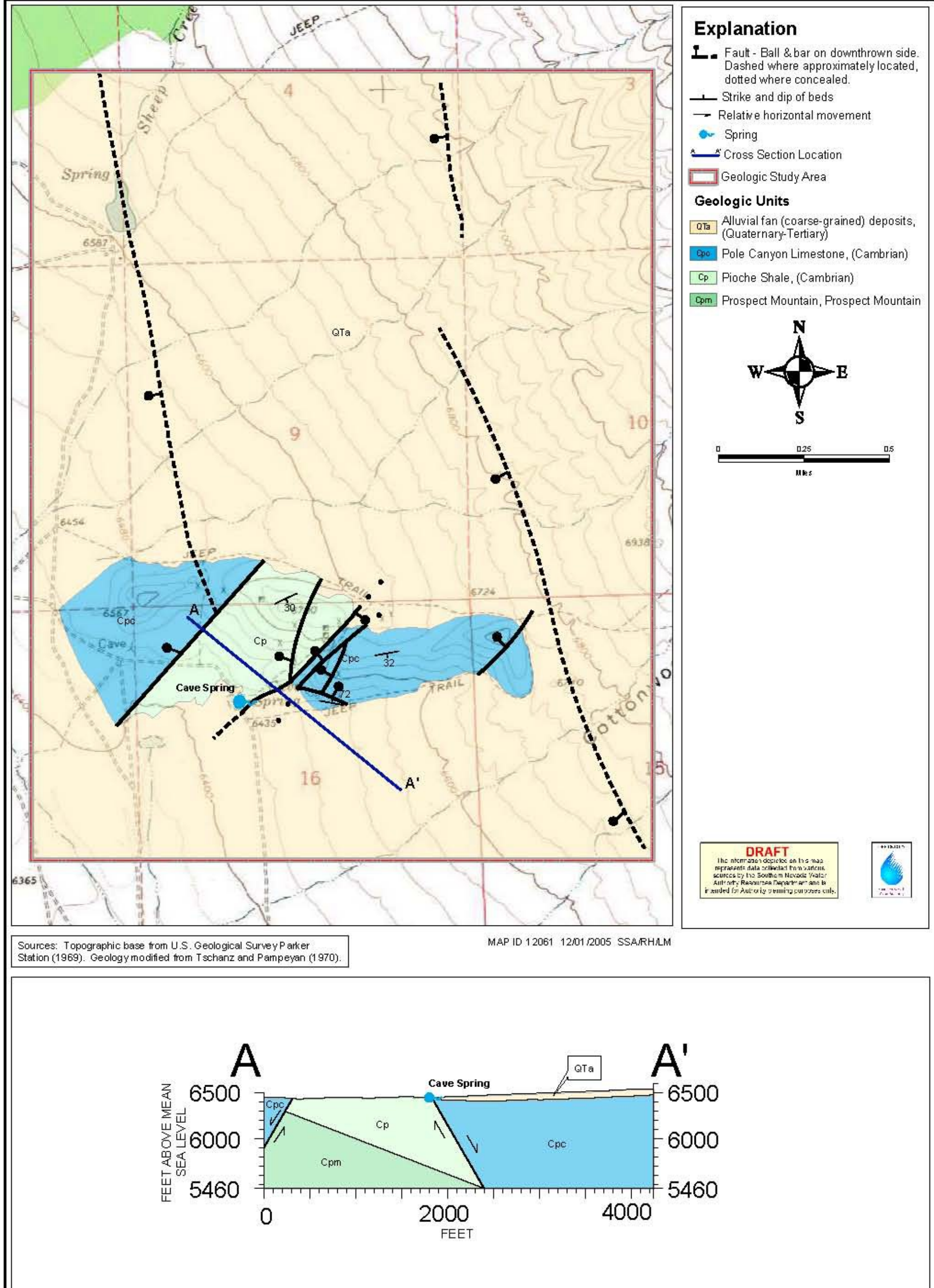
Crystal Springs Hydrograph



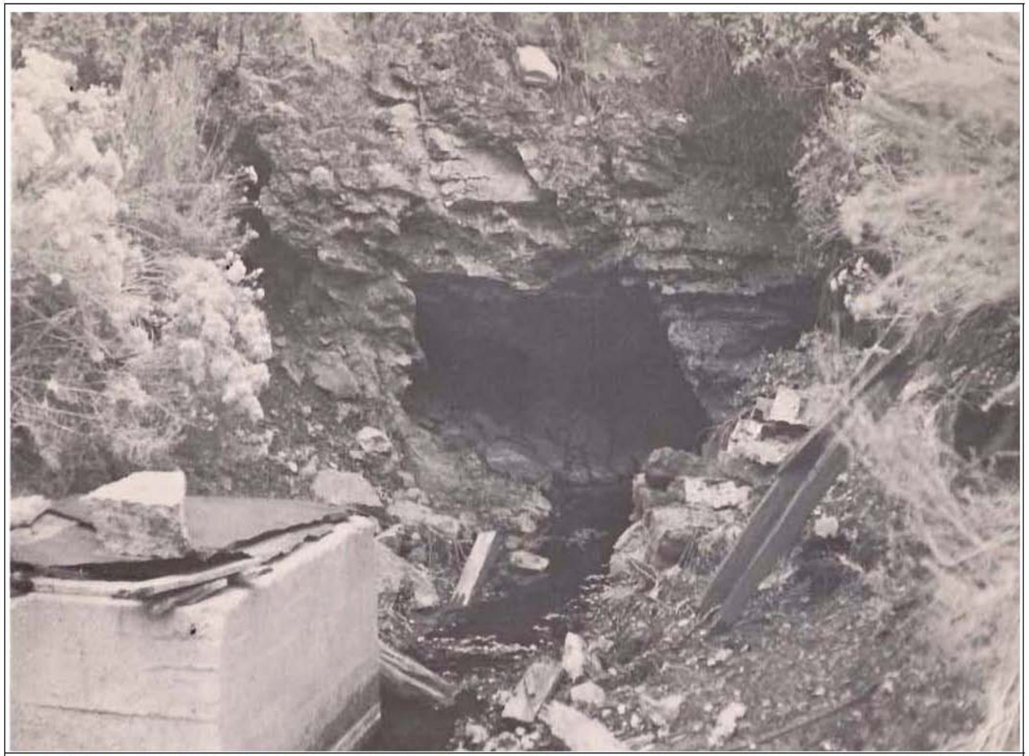


660000
680000
700000
4290000
4260000
White River Valley
Egan
Cave Valley
Cave Spring
Sidehill Spring
Lake Valley
Fairview Range
318
93
Temperature Description (Celsius)
Cold (<21.1)
Warm (21.1 - 32.2)
Hot (>32.2)
Order of Magnitude
4 (100-448.8 gpm)
5 (10-100 gpm)
6 (1-10 gpm)
0 2.5 5 10
Miles
OFFICE COPY
DRAFT

Cave Valley



Cave Spring Geology



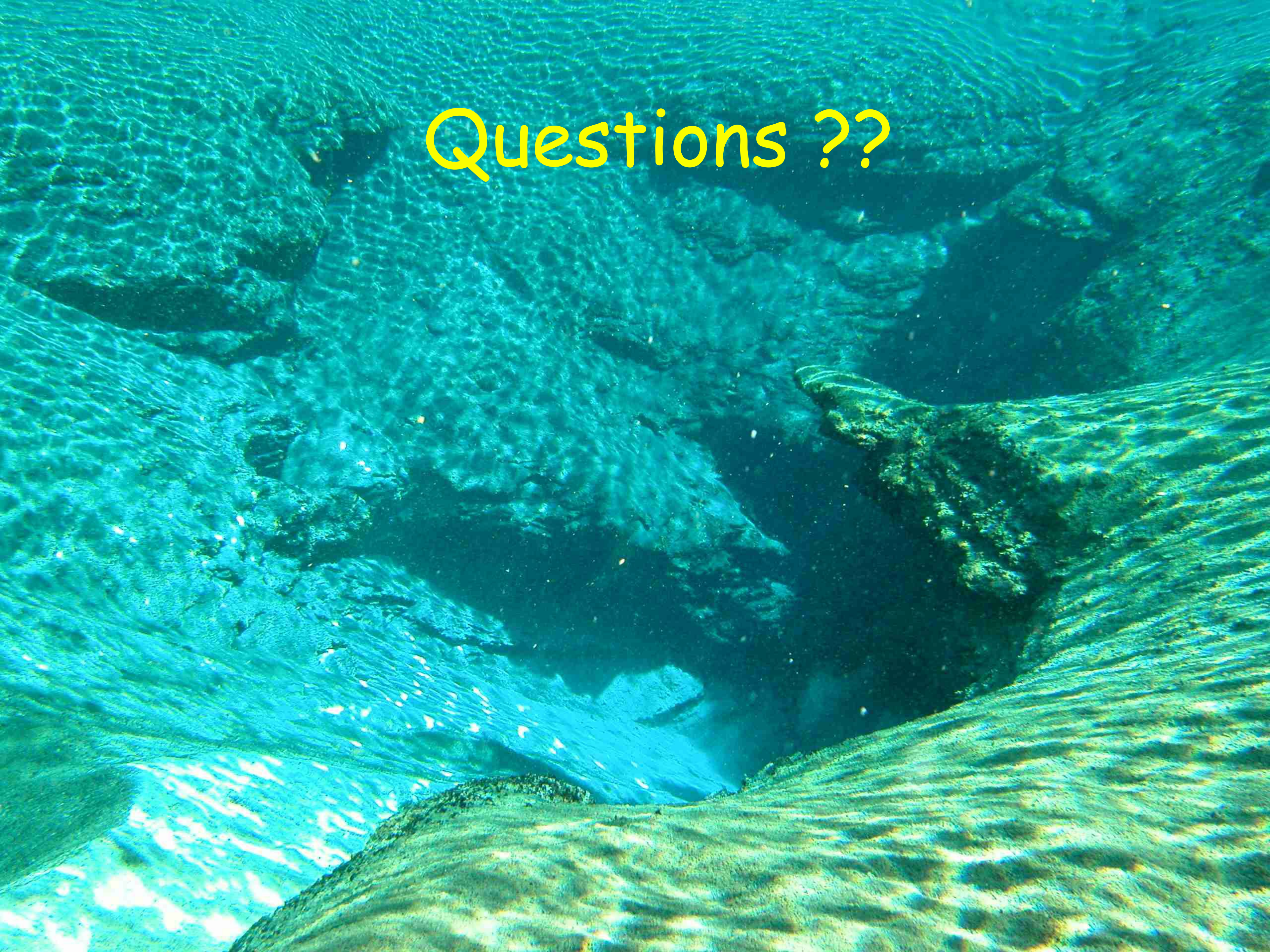
Cave Spring Photo Comparison

Additional parallel studies

- Significance of spring may be related to non hydrologic criteria
  - Endangered species
- Additional geochemical studies
- Hydrogeologic regional framework analysis
- Surface-water characterization
- Estimates of steady state and historical changes for modeling purposes

Summary

- Site visit most important part of characterization
- Anthropogenic modification (common) can have a strong effect on flow record
- All Springs have been diverted at one time or another
- Springs characterized using multiple parameters


Questions ??