# Las Vegas Valley Artificial Recharge Program:

# 25 Years as a Water Resource Management Tool

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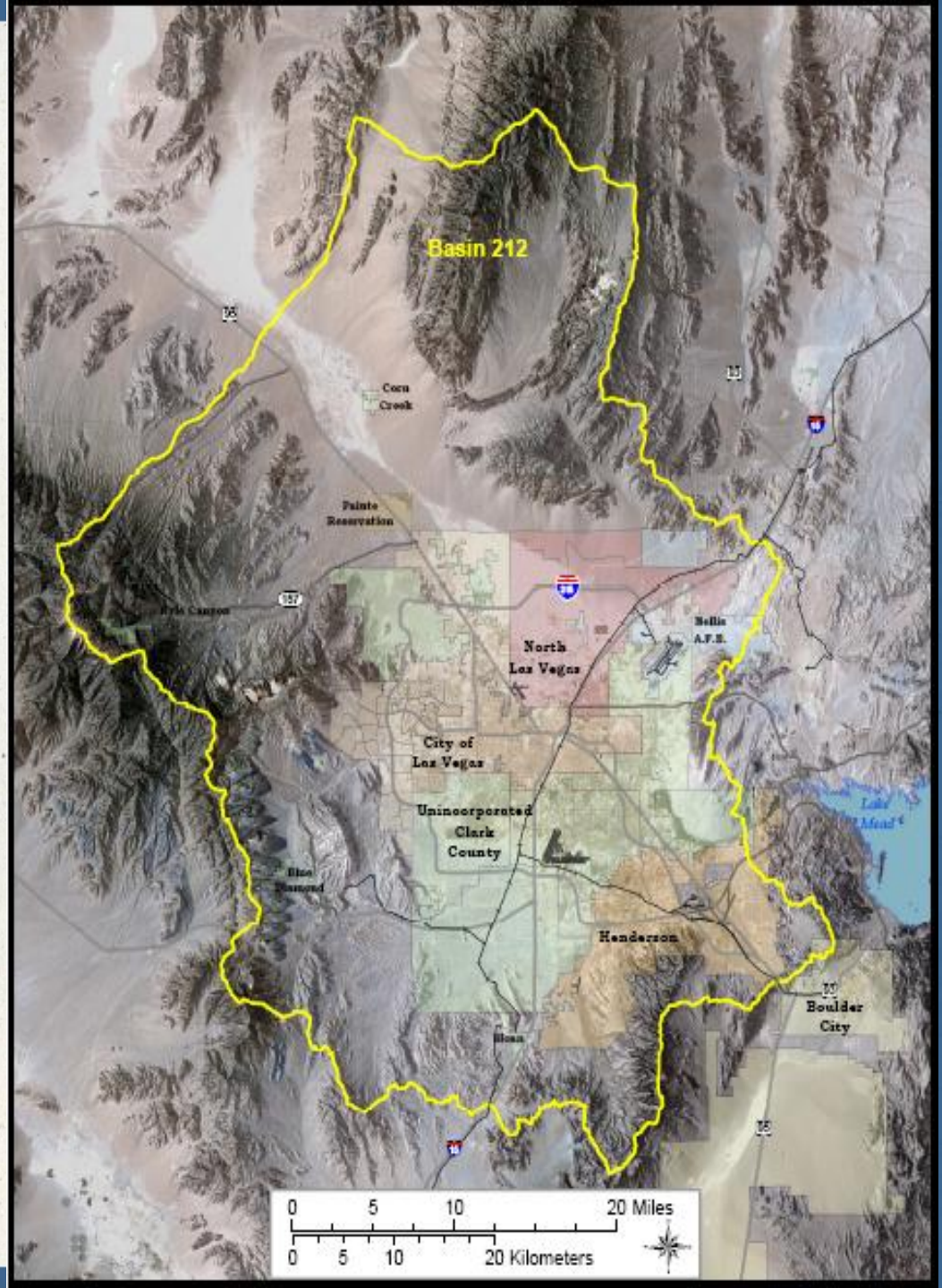
*Southern Nevada Water Authority*

# Overview of Las Vegas Valley Artificial Recharge and Hydrologic Monitoring Program

- Hydrology and hydrogeology
- Historical perspective
- AR Program 1987-2014
- Monitoring network
- Current status

# Brief Overview of Las Vegas Valley Hydrology and Hydrogeology

# Las Vegas Hydrographic Basin

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# Water in Las Vegas Valley

Nevada is the driest state in the U.S.

Las Vegas is one of the driest cities of its size in the world.

The  L.V. Valley floor receives approximately 4.14 inches average annual precipitation over 1937 - 2013 period of record.

Mountain areas averaged 24 inches at Kyle Canyon and 21 inches at Lee Canyon over 1986 - 2013 period of record.

Potential evaporation exceeds 72 in/year

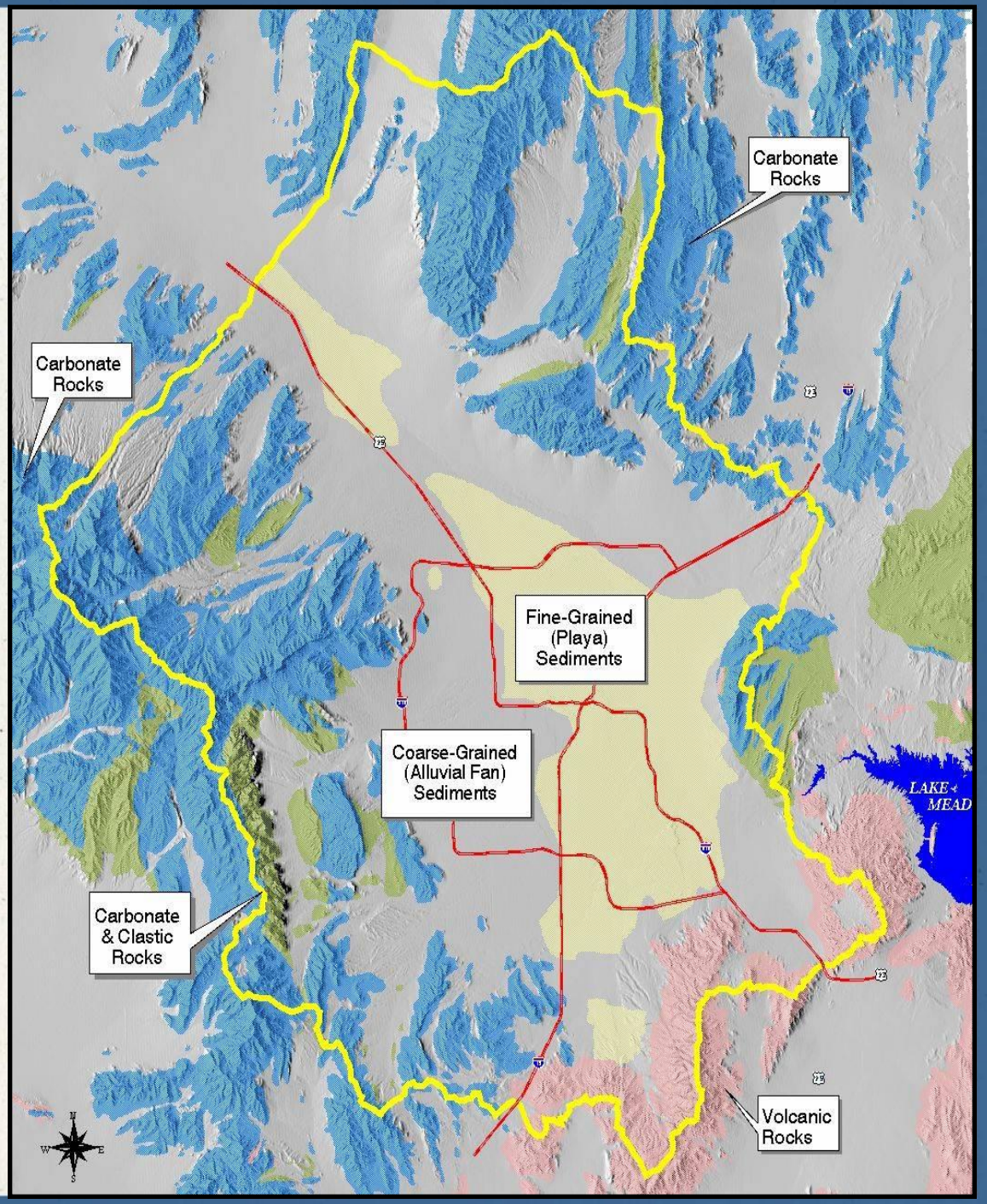
Approximately 90% of water supply comes from Colorado River via Lake Mead

Approximately 10% of water supply comes from groundwater

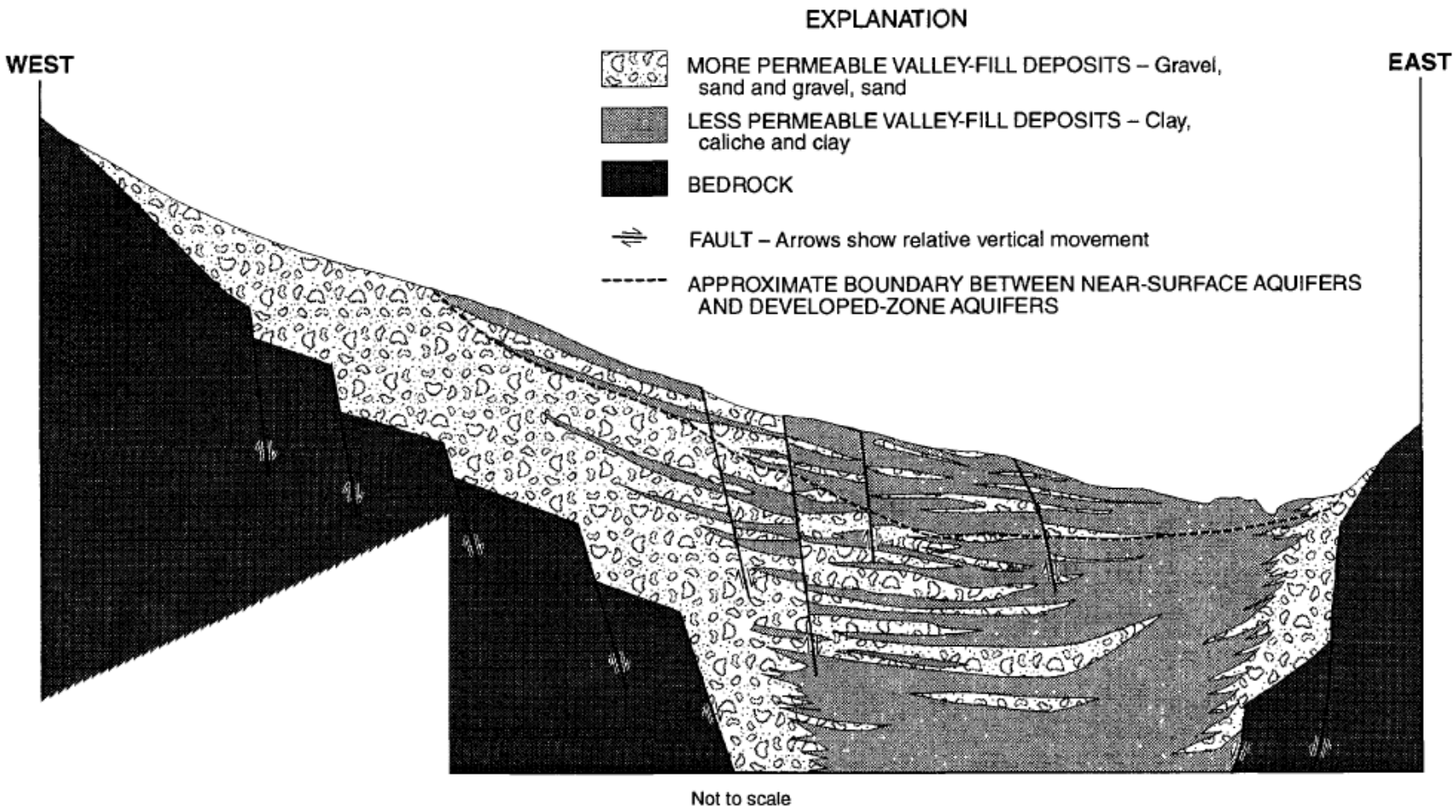
# Las Vegas Hydrographic Basin

- 1,640 miles$^2$
- Elevations range from 11,900 ft to 1,500 ft above sea level
- Structurally formed alluvial-filled basin
- Alluvial thickness from 0 ft to ~13,000 ft thick

# Generalized Surface Geologic Map of the Las Vegas Hydrographic Basin



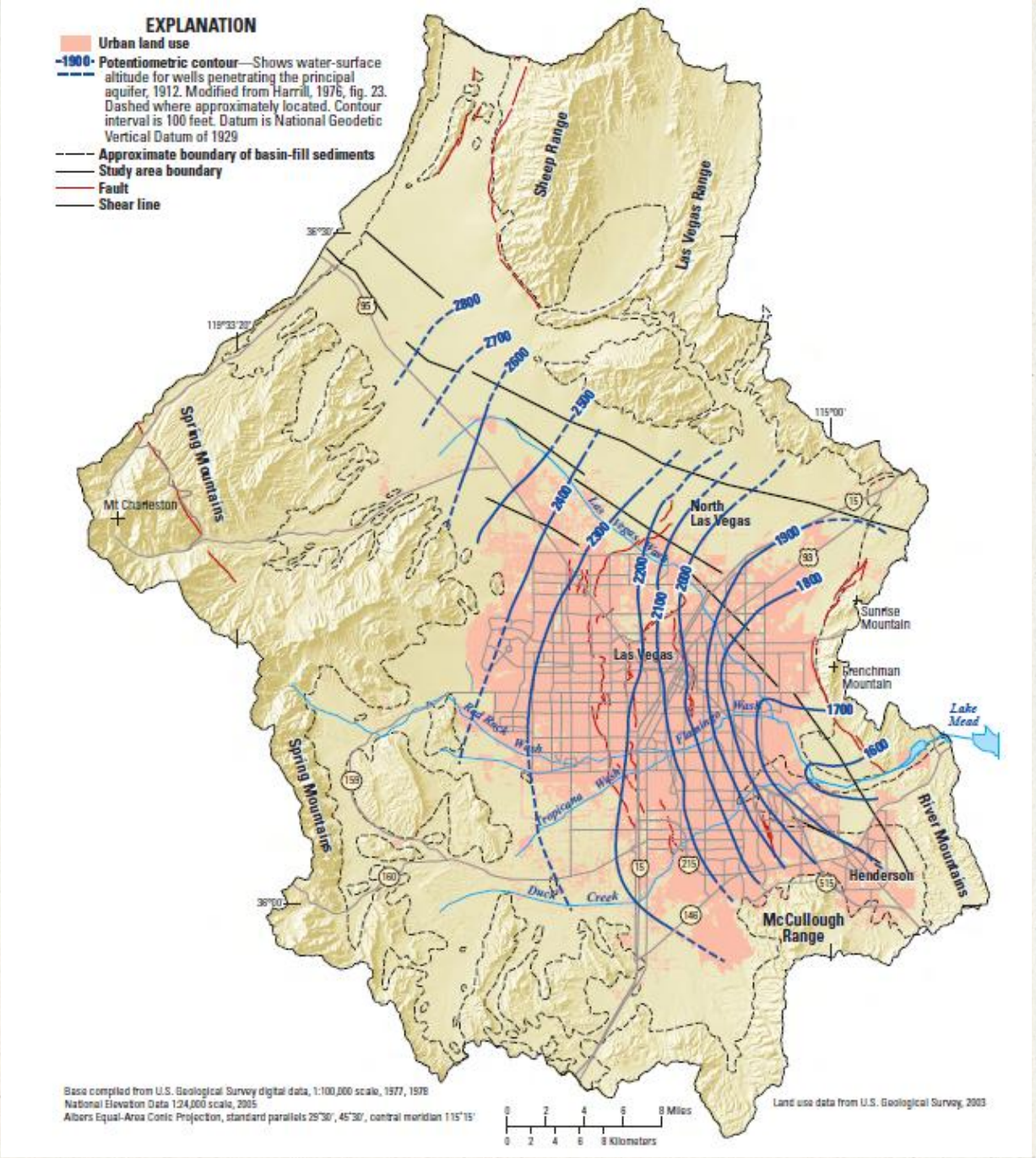
# Las Vegas Valley Geologic Cross-Section




Source: Morgan and Dettinger (1996)

# Historic Perspective

# Principal Aquifer Potentiometric Surface Under Predevelopment Conditions

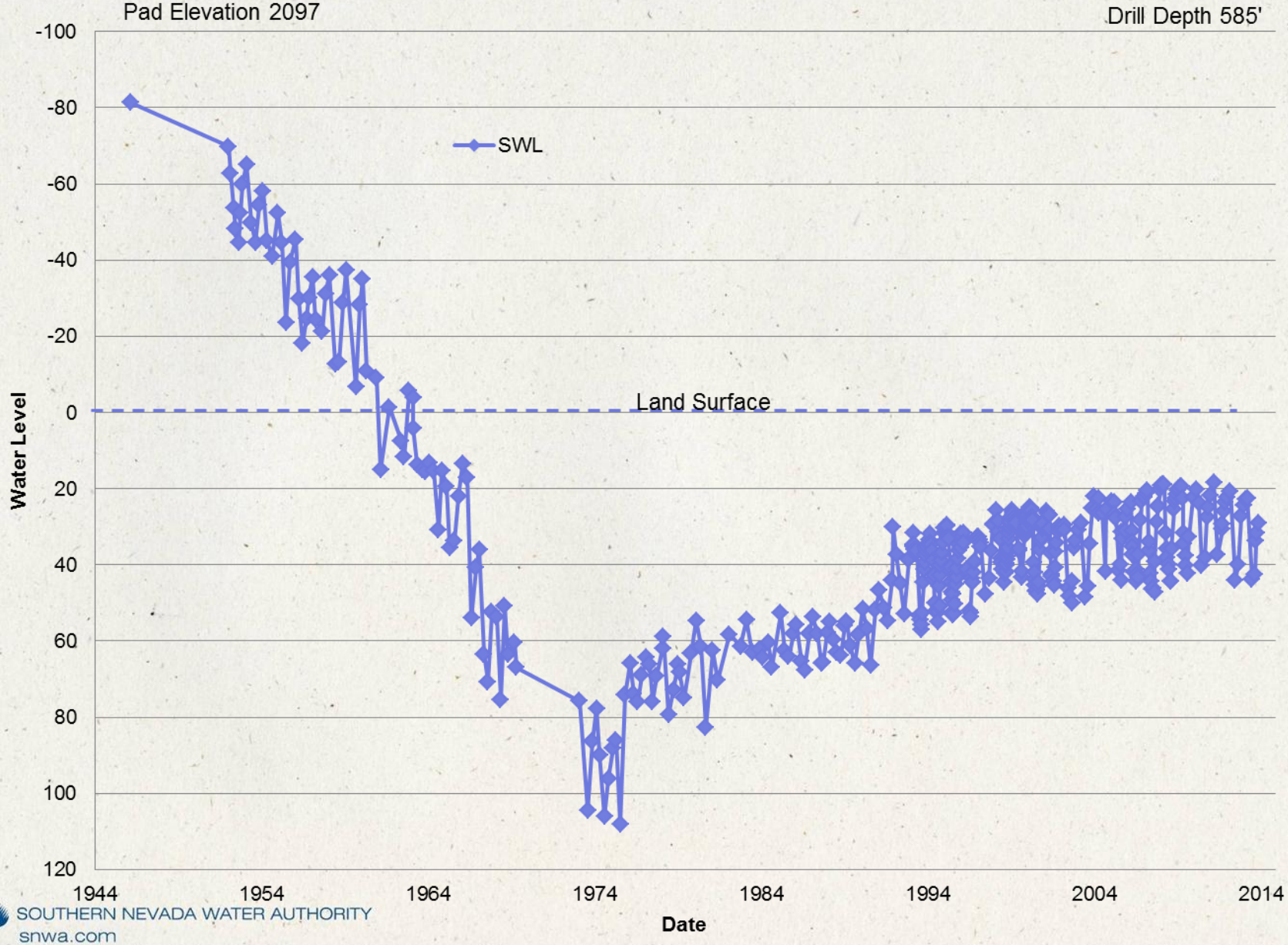



**Source: Huntington, USGS PP 1781 (2010)**

# Las Vegas Valley Artesian Well 1912

# LVVWD Well #3 (1943)

# Campbell 1946 to 2014

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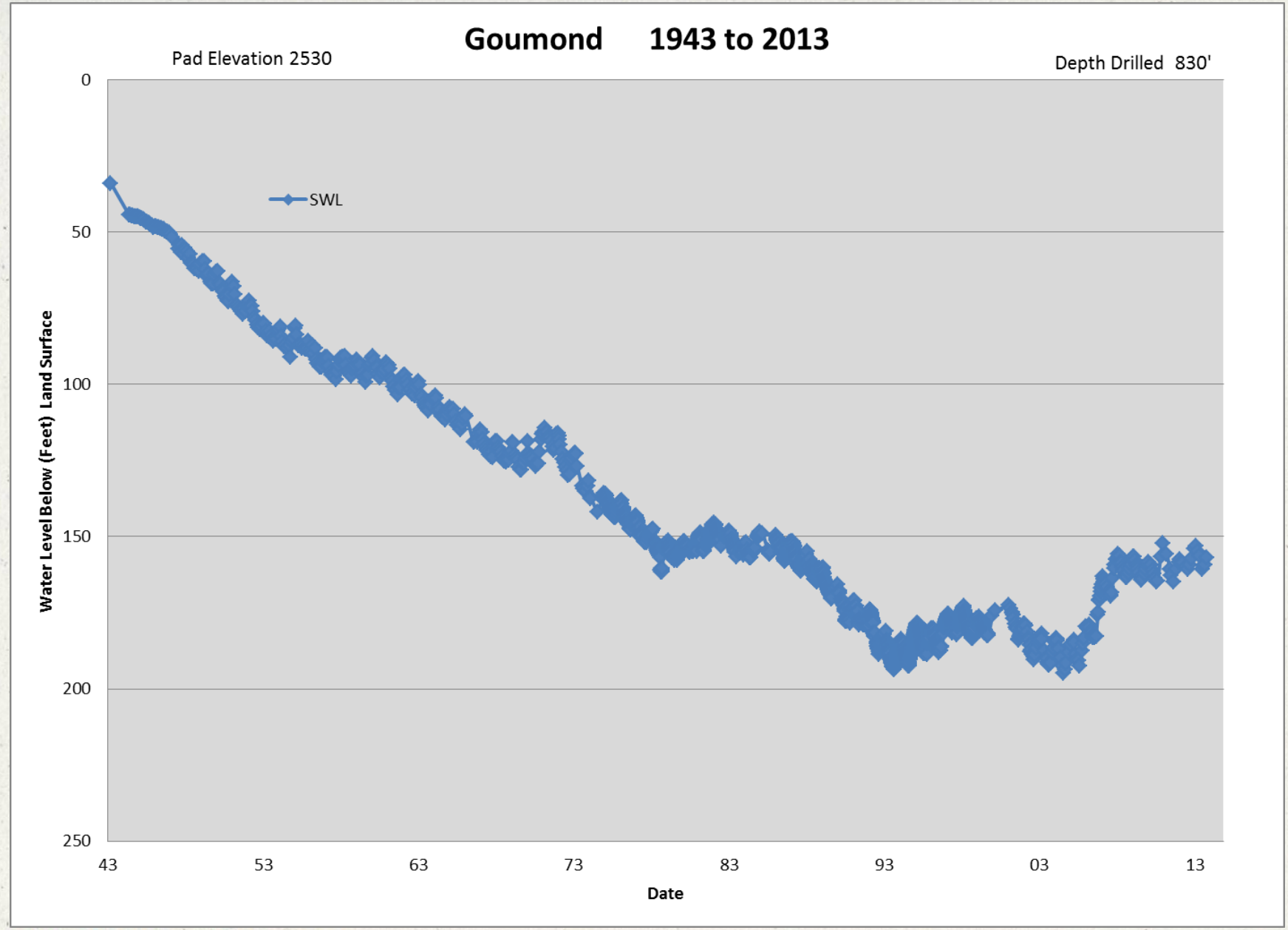
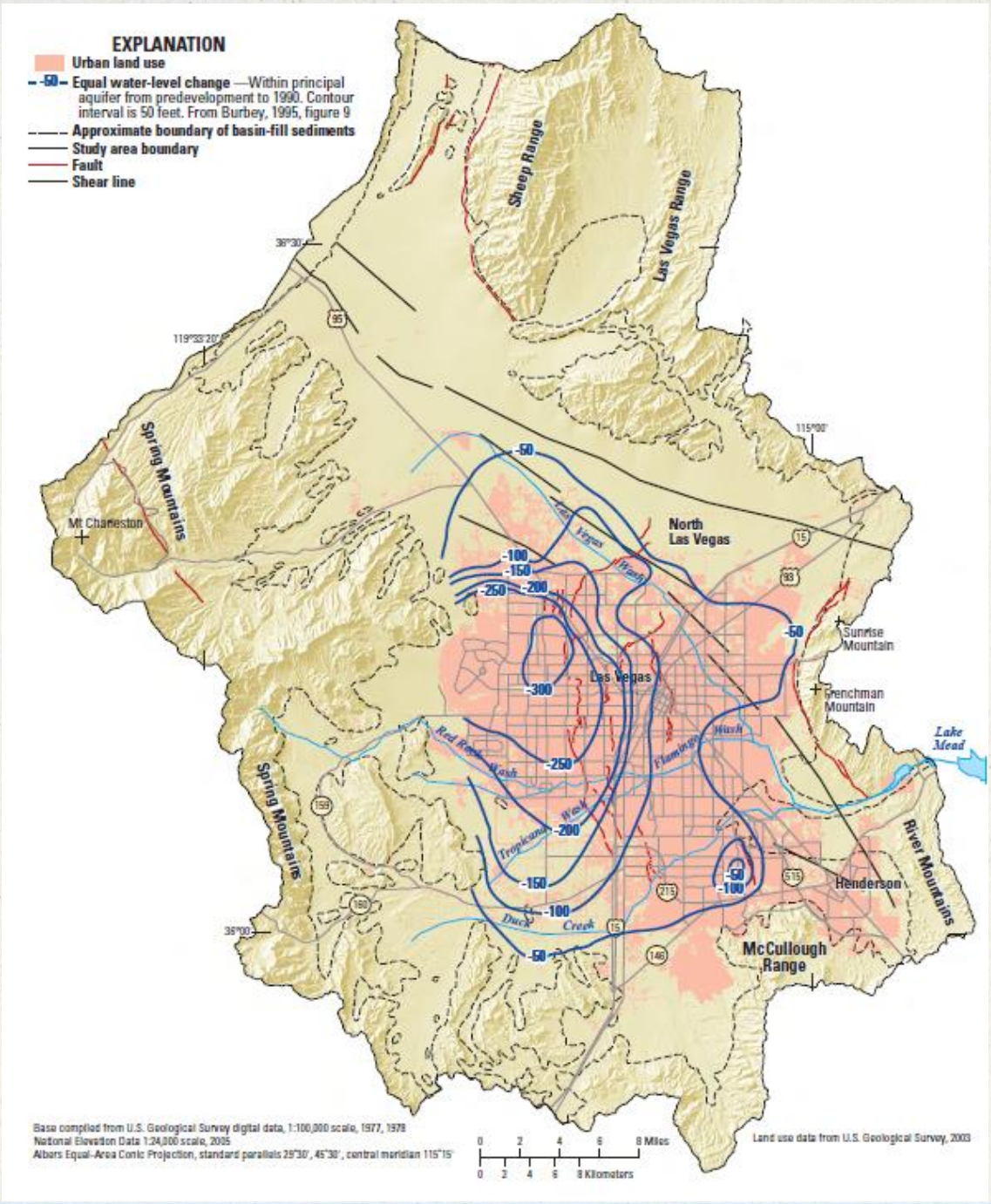

Goumond 1943 to 2013
Pad Elevation 2530
Depth Drilled 830'
SWL
Water Level Below (Feet) Land Surface
0
50
100
150
200
250
43
53
63
73
83
93
03
13
Date

# Groundwater Level Declines from Predevelopment Conditions to 1990




Source: Huntington, USGS PP 1781 (2010)

# Artificial Recharge Program

**Artificial recharge (AR) is the process of designed (as opposed to natural) replenishment of groundwater storage through saturated or unsaturated geologic materials.**

- Provides a tool for basin water resource management
- Provides water system operational flexibility
- Provides an emergency reserve supply in case of drought or a water facility failure
- Reduces pumping cost through less lift and lower electrical cost
- Stabilizes groundwater levels in the principal aquifer

# Regulatory Permits for AR

Nevada Division of Water Resources,
Permit Numbers R-001, R-003, and R-012

Nevada Division of Environmental Protection (NDEP), Underground Injection Control Class V Injection Well Permit UIC Number UNEV87054. Renewed through 2016 by NDEP in 2011

# Artificial Recharge Pilot/Demonstration Projects and Expansion

Pilot Project in 1987

- Injected 525,000 gallons of treated Colorado water

Demonstration Project in 1988

- Evaluated chemical compatibility of formation water with treated Colorado River water
- Injected 1,153 acre-feet of water

1989 Program operational

1989 to 1992 - Converted several existing production wells to dual-use wells

1993 - Began constructing dedicated AR wells

# LVVWD Production and AR Well Network

- 105 total system wells
- 67 wells currently equipped for production
- 78 permitted injection wells

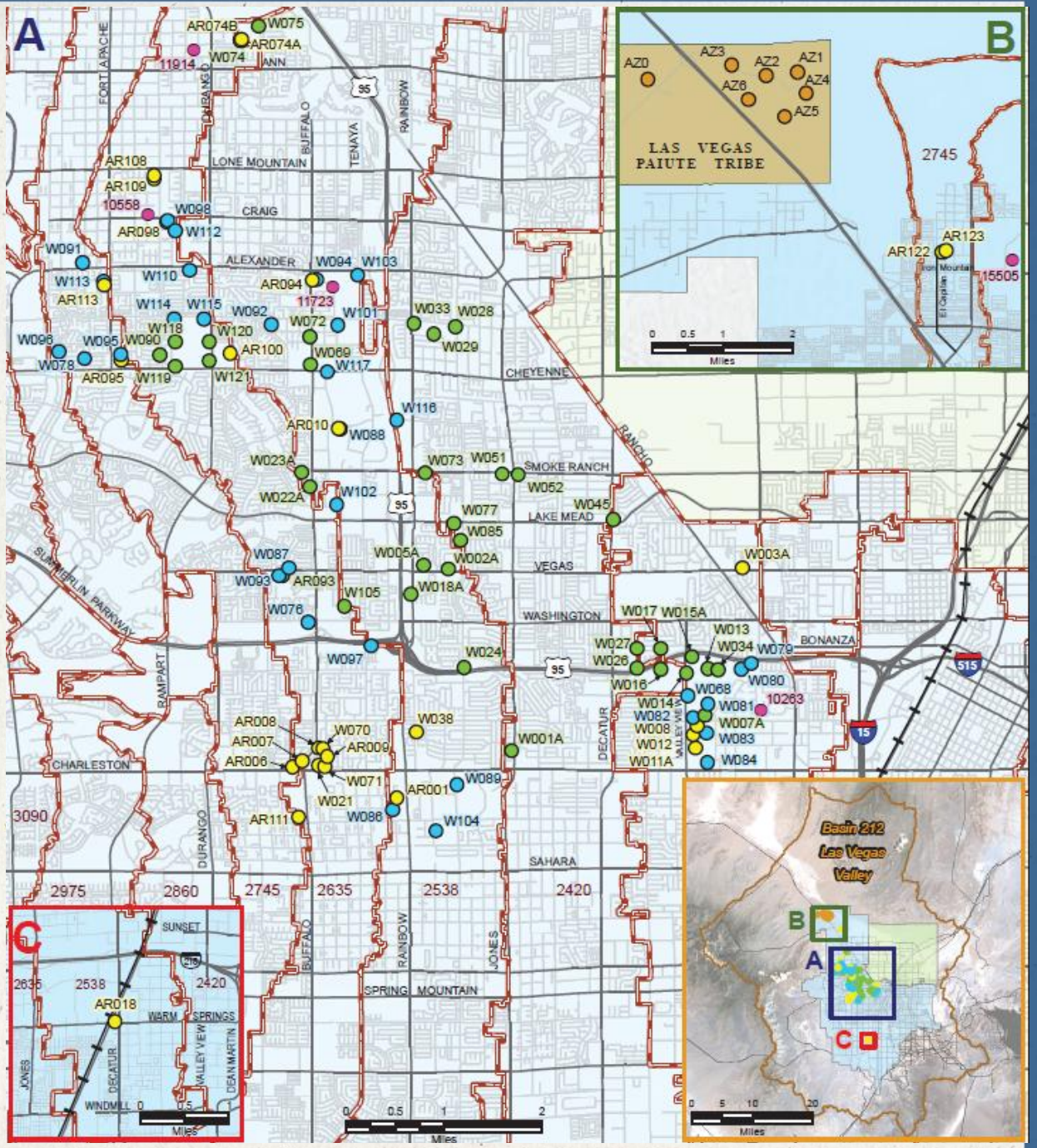
# SNWA Las Vegas Monitor Well Network

- 110 valley-wide monitor wells
- 60 shallow system monitor wells

# North Las Vegas AR Program

# LVVWD Production and Recharge Wells

- Dedicated AR Wells
- Dual Use Wells
- Production Wells
- LVPT Wells

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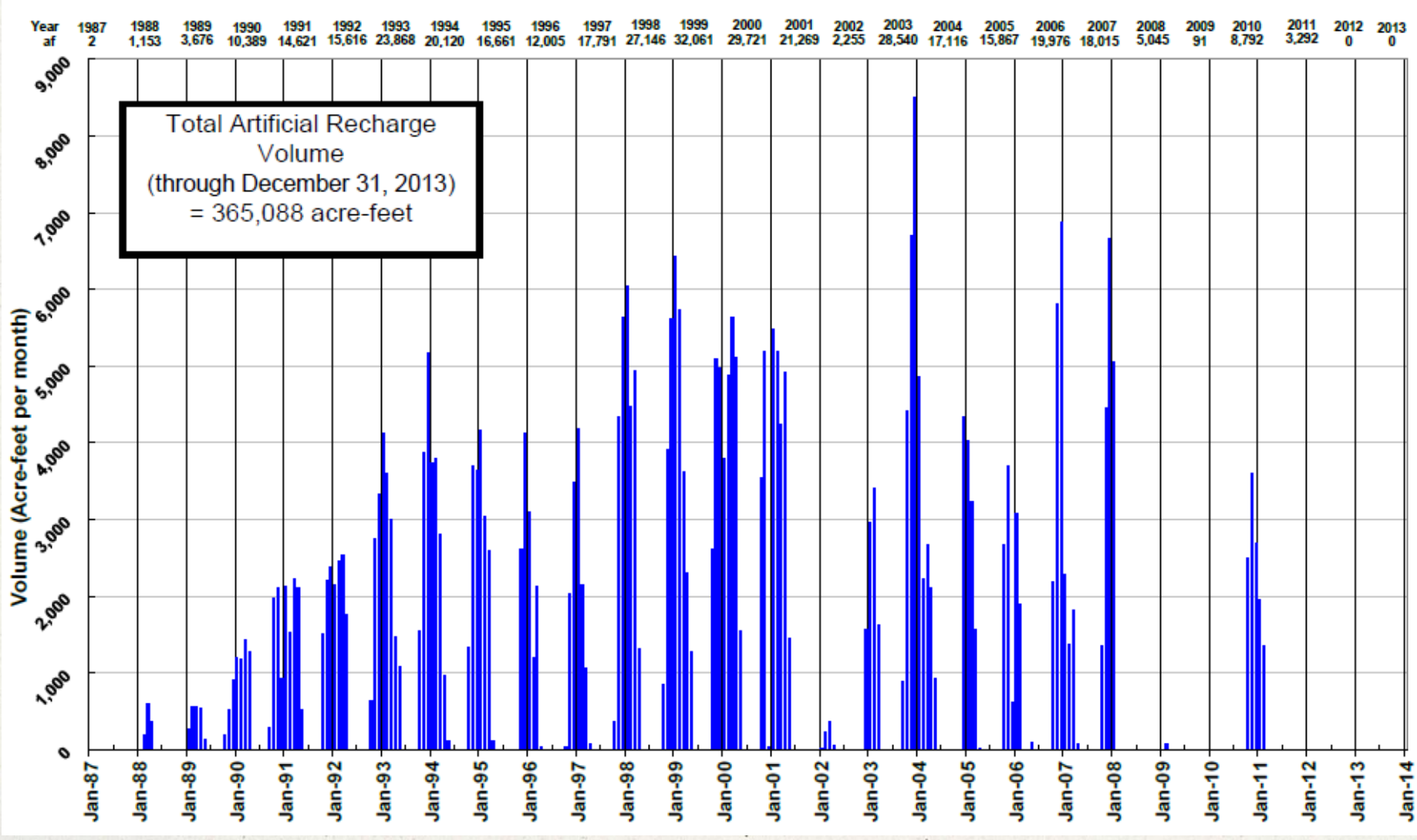
# Well W016

# Monthly Volumes of Artificial Recharge Water

## 1987 - 2014



# In-Lieu Recharge

# Order 1176

# (2004)

**IN THE OFFICE OF THE STATE ENGINEER**

**OF THE STATE OF NEVADA**

**1176**

**IN-LIEU RECHARGE ORDER**

**WHEREAS**, under the provisions of Chapter 534 of Nevada Revised Statutes, the State Engineer has issued a series of orders designating various portions of the Las Vegas Valley Artesian Basin, Clark County, Nevada;

**WHEREAS**, the State Engineer, pursuant to NRS 534.030 and by Order No. 833 dated December 27, 1983, designated the entire drainage basin of the Las Vegas Valley Groundwater Basin, Clark County, Nevada;

**WHEREAS**, the Las Vegas Valley Water District currently holds non-revocable groundwater rights and may acquire additional non-revocable groundwater rights within the Las Vegas Valley Groundwater Basin;

**WHEREAS**, the City of North Las Vegas, currently holds non-revocable water rights and may acquire additional non-revocable water rights within the Las Vegas Valley Groundwater Basin;

**WHEREAS**, the Las Vegas Valley Water District develops and places to a beneficial use on an annual basis a substantial majority of its permitted and certificated groundwater rights;

**WHEREAS**, the City of North Las Vegas develops and places to a beneficial use on an annual basis a substantial majority of its permitted and certificated groundwater rights;

**WHEREAS**, the Southern Nevada Water Authority has constructed additional works of diversion, and said improvements will allow the Las Vegas Valley Water District and the City of North Las Vegas to deliver additional volumes of surface water from the Colorado River;

# LVVWD Groundwater Production and Artificial Recharge 1987-2014

## Annual Well Production, Recharge, Recovery, and Yearly Totals since 1987 (af)

| Year | LVVWD Injected CRW and In-Lieu Recharge | | | | Groundwater Production and Recharge Recovery | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | LVVWD | | | | LVPT CRW Recovery |
| | Injected CRW | Recoverable In-Lieu | Unrecoverable In-Lieu | Total In-Lieu | Well Production | Groundwater Rights | In-Lieu Recovery | CRW Recovery | |
| 1987 | 2 | 0 | 0 | 0 | 37,145 | 39,682 | 0 | 0 | 0 |
| 1988 | 1,153 | 0 | 0 | 0 | 37,096 | 39,772 | 0 | 0 | 0 |
| 1989 | 3,676 | 0 | 0 | 0 | 34,025 | 39,890 | 0 | 0 | 0 |
| 1990 | 10,389 | 0 | 0 | 0 | 33,925 | 39,920 | 0 | 0 | 0 |
| 1991 | 14,621 | 0 | 0 | 0 | 36,653 | 40,314 | 0 | 0 | 0 |
| 1992 | 15,616 | 0 | 0 | 0 | 39,937 | 40,314 | 0 | 0 | 0 |
| 1993 | 23,868 | 0 | 0 | 0 | 35,647 | 40,314 | 0 | 0 | 0 |
| 1994 | 20,120 | 0 | 0 | 0 | 37,907 | 40,314 | 0 | 0 | 0 |
| 1995 | 16,661 | 0 | 0 | 0 | 42,720 | 40,247 | 0 | 2,473 | 0 |
| 1996 | 12,005 | 0 | 0 | 0 | 41,543 | 39,947 | 0 | 1,596 | 0 |
| 1997 | 17,791 | 0 | 0 | 0 | 40,316 | 40,152 | 0 | 164 | 0 |
| 1998 | 27,146 | 0 | 0 | 0 | 39,857 | 40,126 | 0 | 0 | 0 |
| 1999 | 32,061 | 0 | 0 | 0 | 39,028 | 40,126 | 0 | 0 | 0 |
| 2000 | 29,721 | 0 | 0 | 0 | 38,255 | 40,126 | 0 | 0 | 0 |
| 2001 | 21,269 | 0 | 0 | 0 | 40,620 | 40,126 | 0 | 494 | 1,205 |
| 2002 | 2,255 | 0 | 0 | 0 | 41,218 | 40,126 | 0 | 1,092 | 1,178 |
| 2003 | 28,540 | 0 | 0 | 0 | 40,127 | 40,126 | 0 | 1 | 985 |
| 2004 | 17,116 | 0 | 0 | 0 | 40,877 | 40,612 | 0 | 265 | 664 |
| 2005 | 15,867 | 7,621 | 1,345 | 8,966 | 31,661 | 40,626 | 0 | 0 | 572 |
| 2006 | 19,976 | 4,064 | 717 | 4,781 | 35,845 | 40,626 | 0 | 0 | 815 |
| 2007 | 18,015 | 0 | 0 | 0 | 40,932 | 40,629 | 0 | 303 | 923 |
| 2008 | 5,045 | 0 | 0 | 0 | 40,671 | 40,629 | 0 | 42 | 809 |
| 2009 | 91 | 0 | 0 | 0 | 40,640 | 40,629 | 0 | 11 | 614 |
| 2010 | 8,792 | 1,207 | 213 | 1,420 | 39,208 | 40,629 | 0 | 0 | 499 |
| 2011 | 3,292 | 0 | 0 | 0 | 40,785 | 40,629 | 0 | 156 | 375 |
| 2012 | 0 | 191 | 34 | 225 | 40,404 | 40,629 | 0 | 0 | 444 |
| 2013 | 0 | 0 | 0 | 0 | 44,199.48 | 40,628.60 | 3,570.88 | 0 | 344 |
| Total | 365,088 | 13,083 | 2,309 | 15,392 | 1,051,241 | | 3,571 | 6,597 | 9,427 |
| **Net Recoverable AR Storage[a] = 341,198 af** | | | | | | | | | |

Notes:
All volumes in acre-feet (af), +/-1af, due to rounding.
Yearly groundwater rights reflect revisions per Las Vegas Basin Adjudication (1999).
Las Vegas Paiute Tribe's temporary recovery of LVVWD-recharged water began in 2001.
[a]Net recoverable AR storage (341,198 af) = Total injected CRW (365,088 af) + recoverable in-lieu recharge (13,083 af) – in-lieu recovery (3,571 af) – LVVWD CRW recovery (6,597 af) – LVPT CRW recovery (9,427 af) - CRW Reserved for Groundwater Management Program (17,378 af).

# Recharge Program Volumes

Total Recharged CRW = 365,088 af

Recoverable In-Lieu Recharge Credits = 13,083 af (Non Recoverable = 2,309 af)

In-Lieu recovered = 3,571

CRW recovered = 6597 af (LVVWD) 9427 af (LVPT)

CRW reserved for Groundwater Management Program = 17,378 af

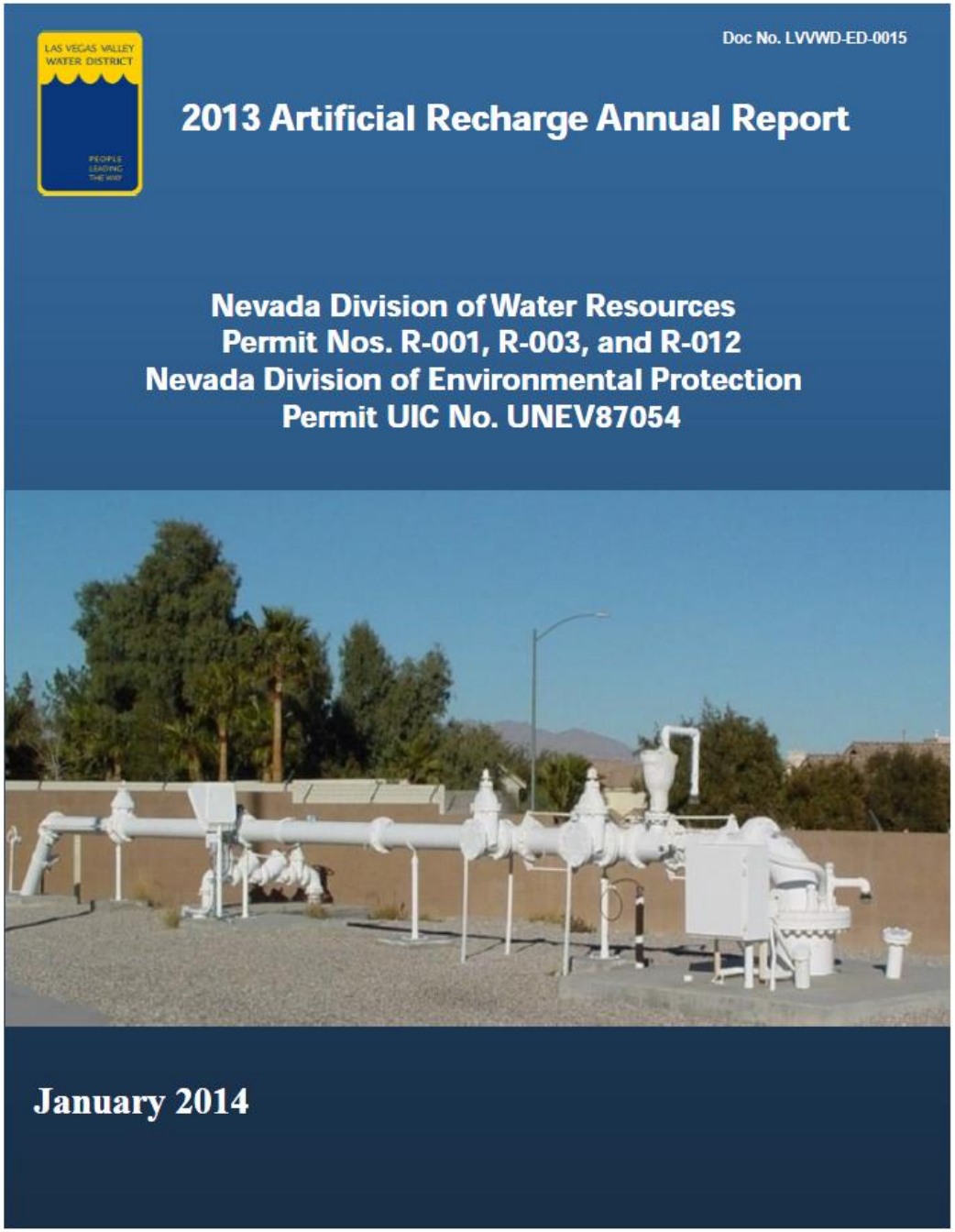
Net Recoverable Recharge = 341,198 af

# Permit Reporting

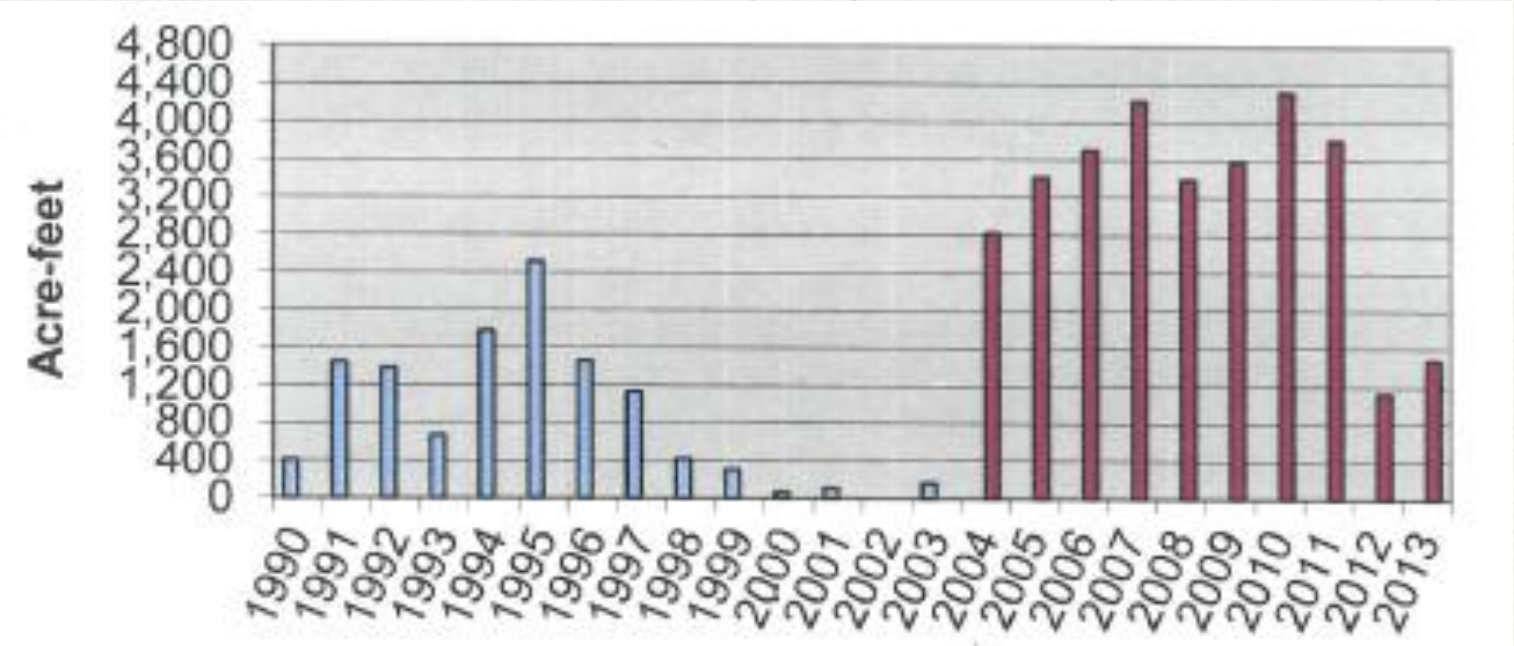
Monthly pumpage data to NDWR and CRC

Quarterly groundwater data to NDWR

Annual report to NDWR and NDEP



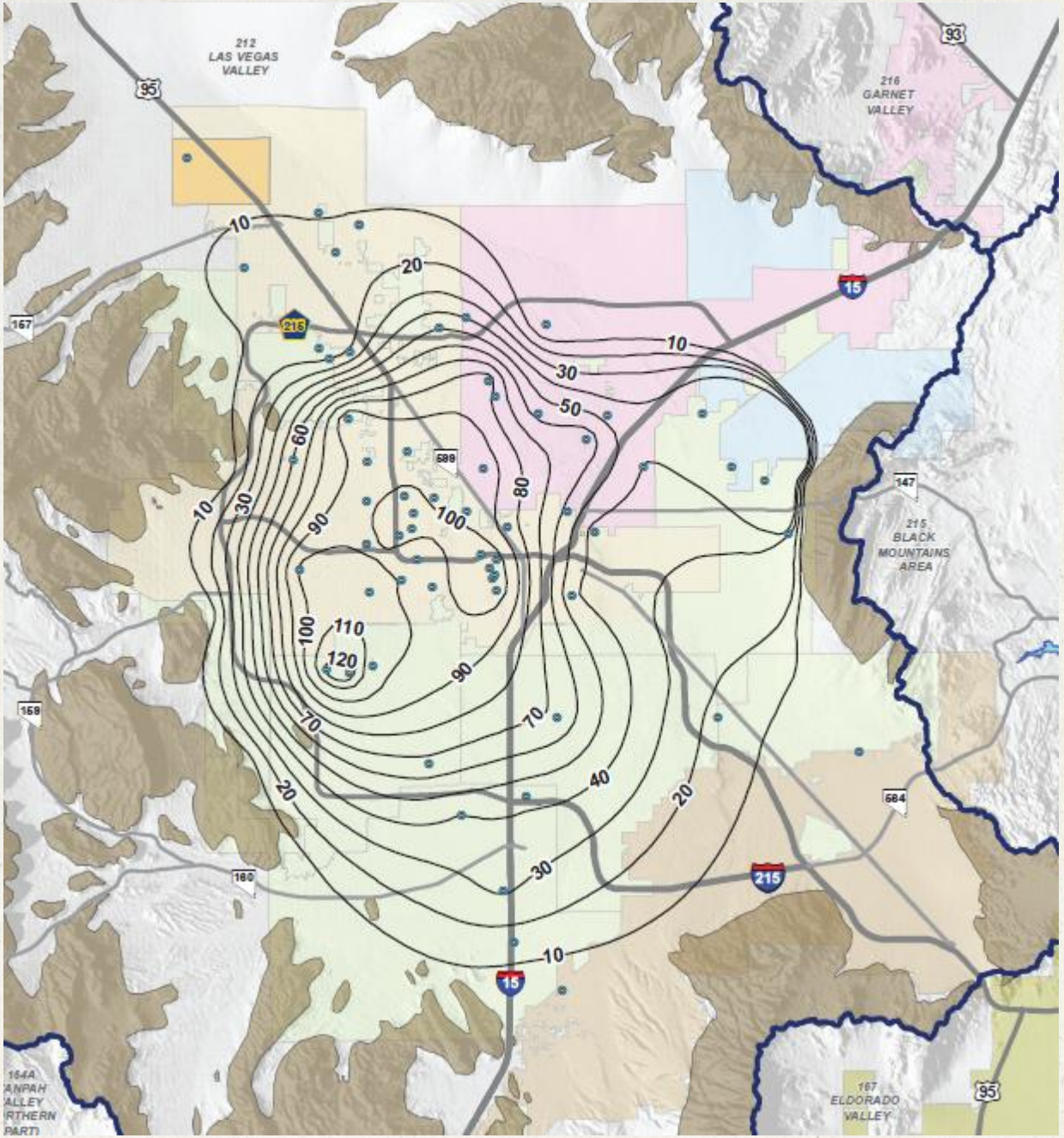
# North Las Vegas Injection and In-Lieu Recharge 1990 - 2013



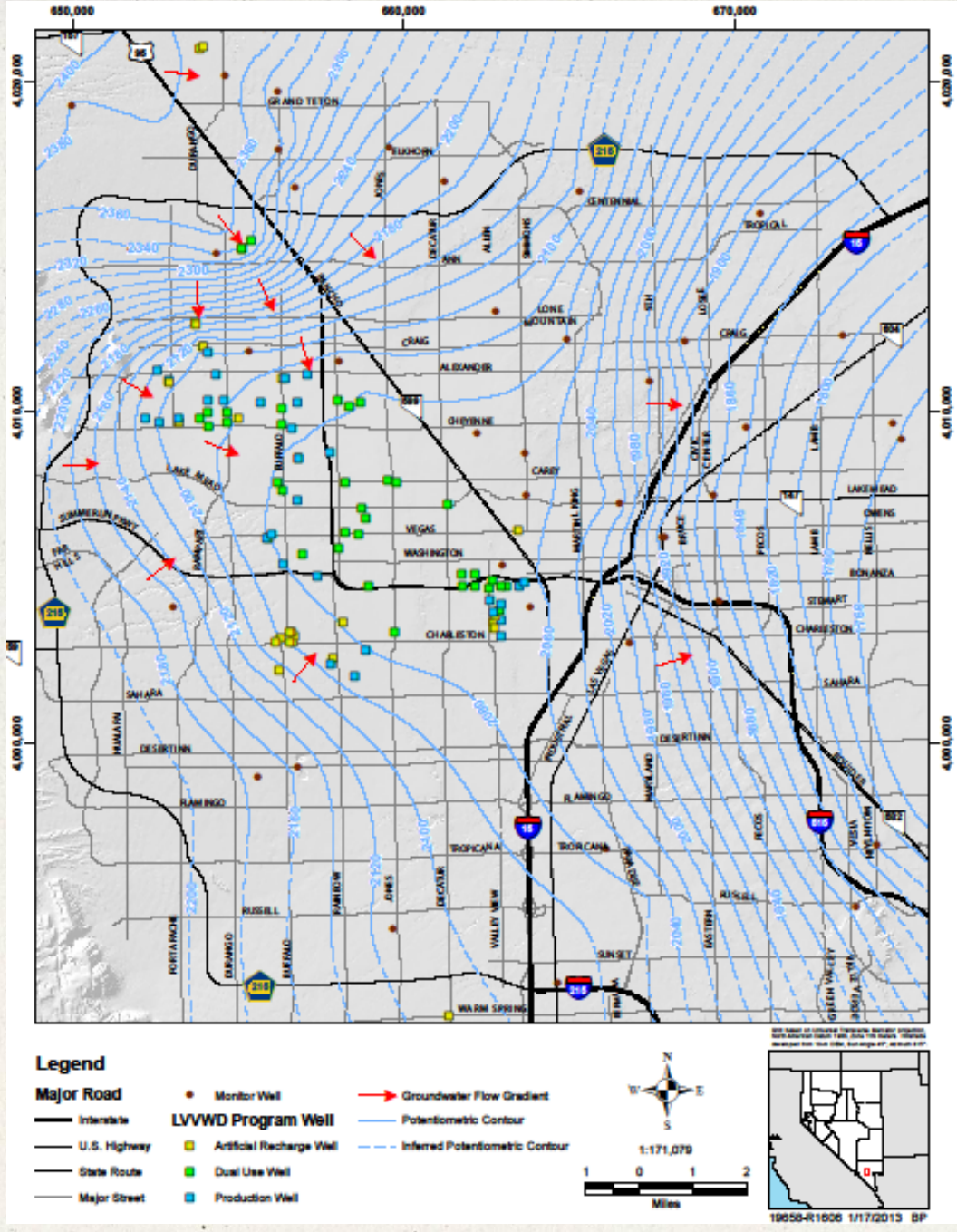

North Las Vegas 11,843 banked CRW recharge + 31,836 In-Lieu credits = 43,679 af

# Current Conditions

# Change in Potentiometric Surface of the Las Vegas Principal Aquifer, Fall 1990 to Fall 2013



# Las Vegas Valley Potentiometric Surface Groundwater Flow Map

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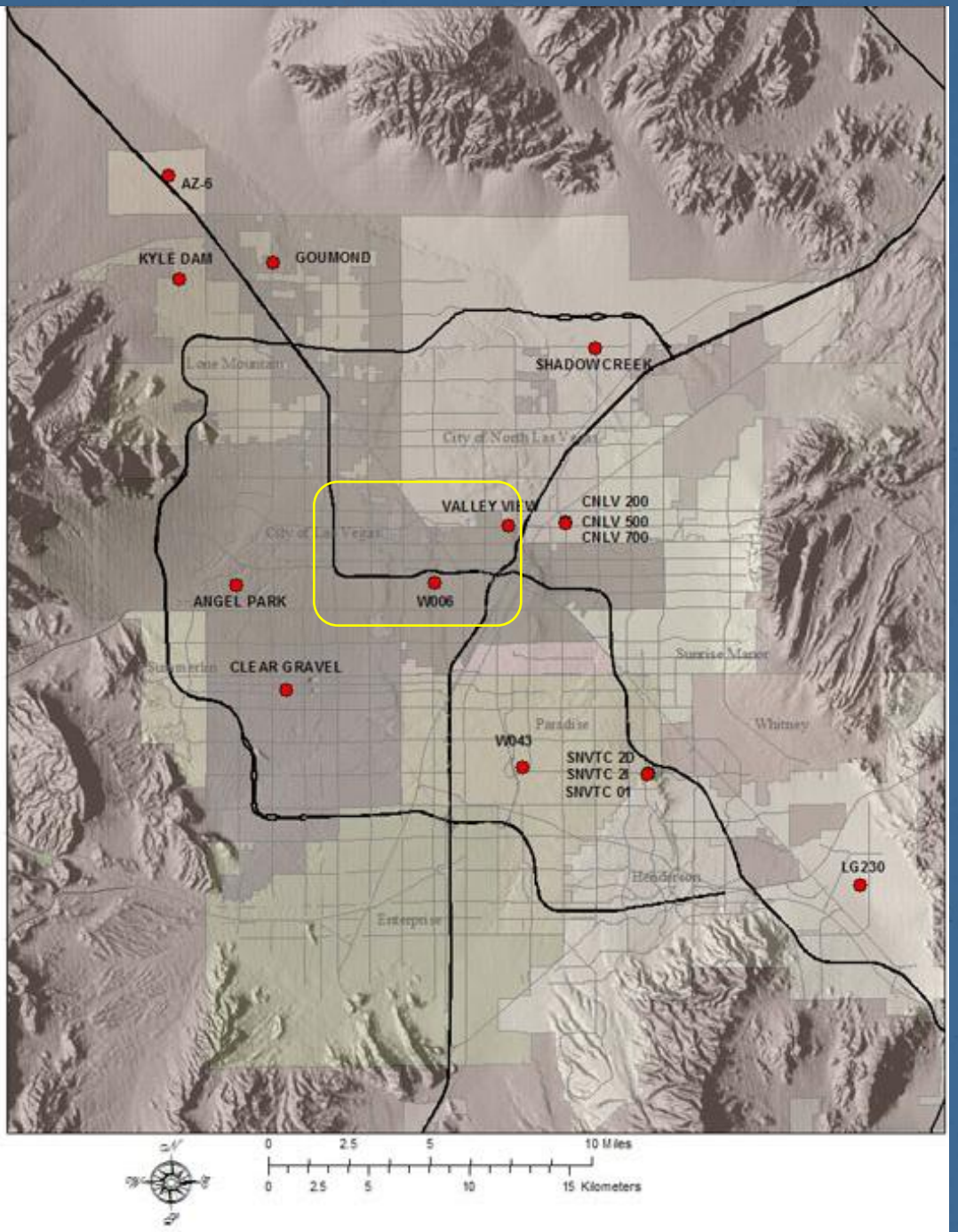
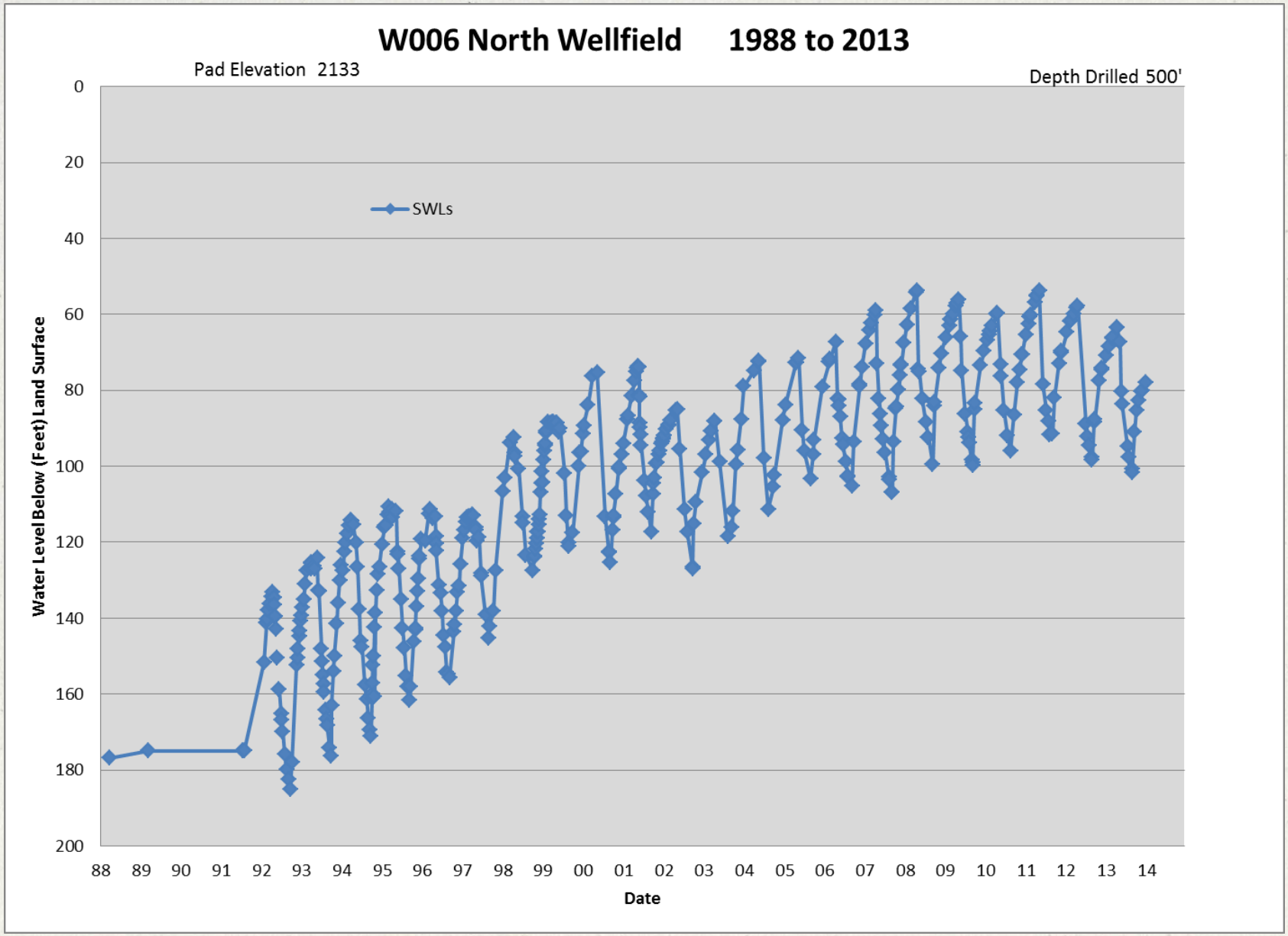
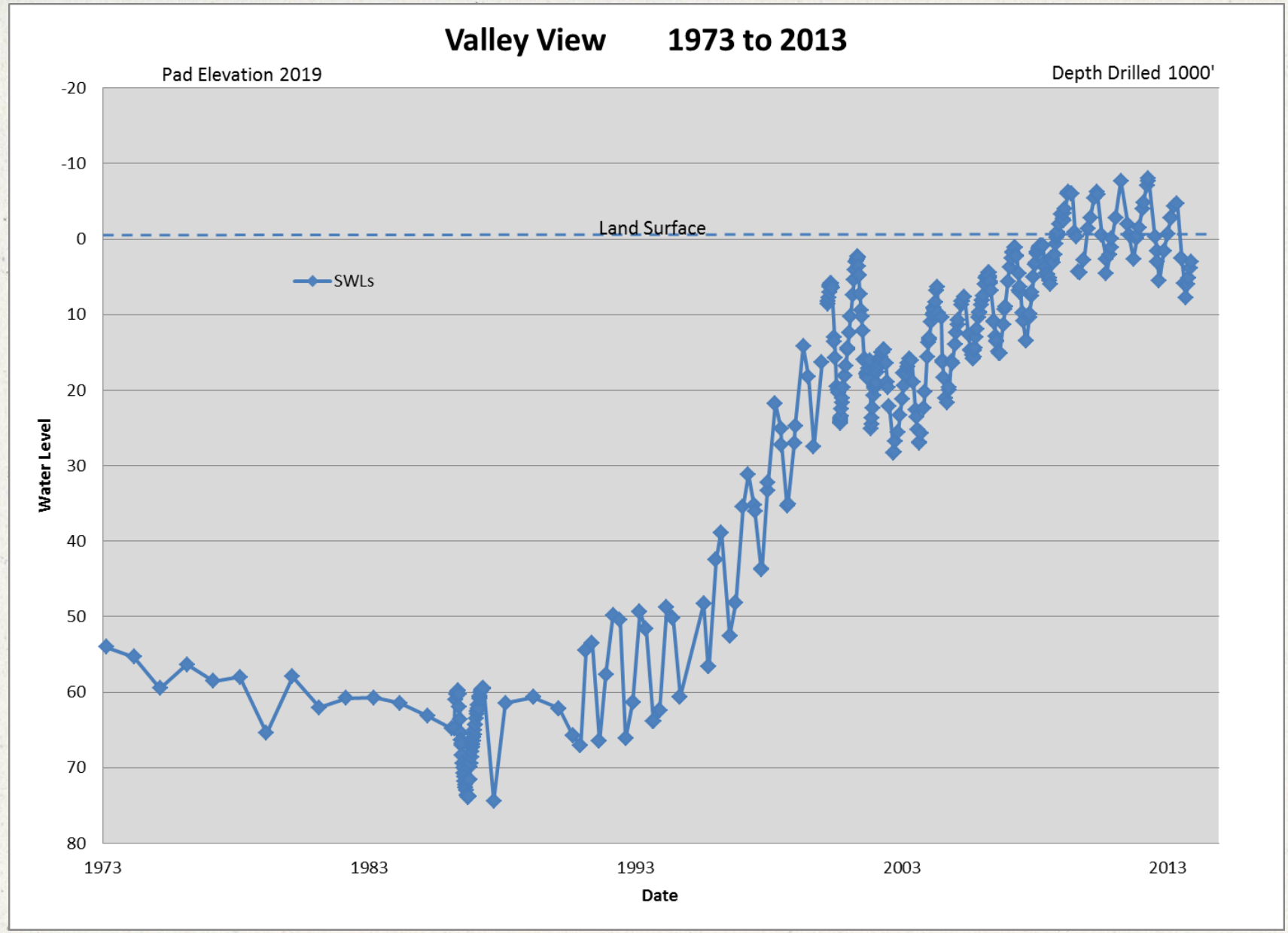
# HTS Program Monitoring Locations

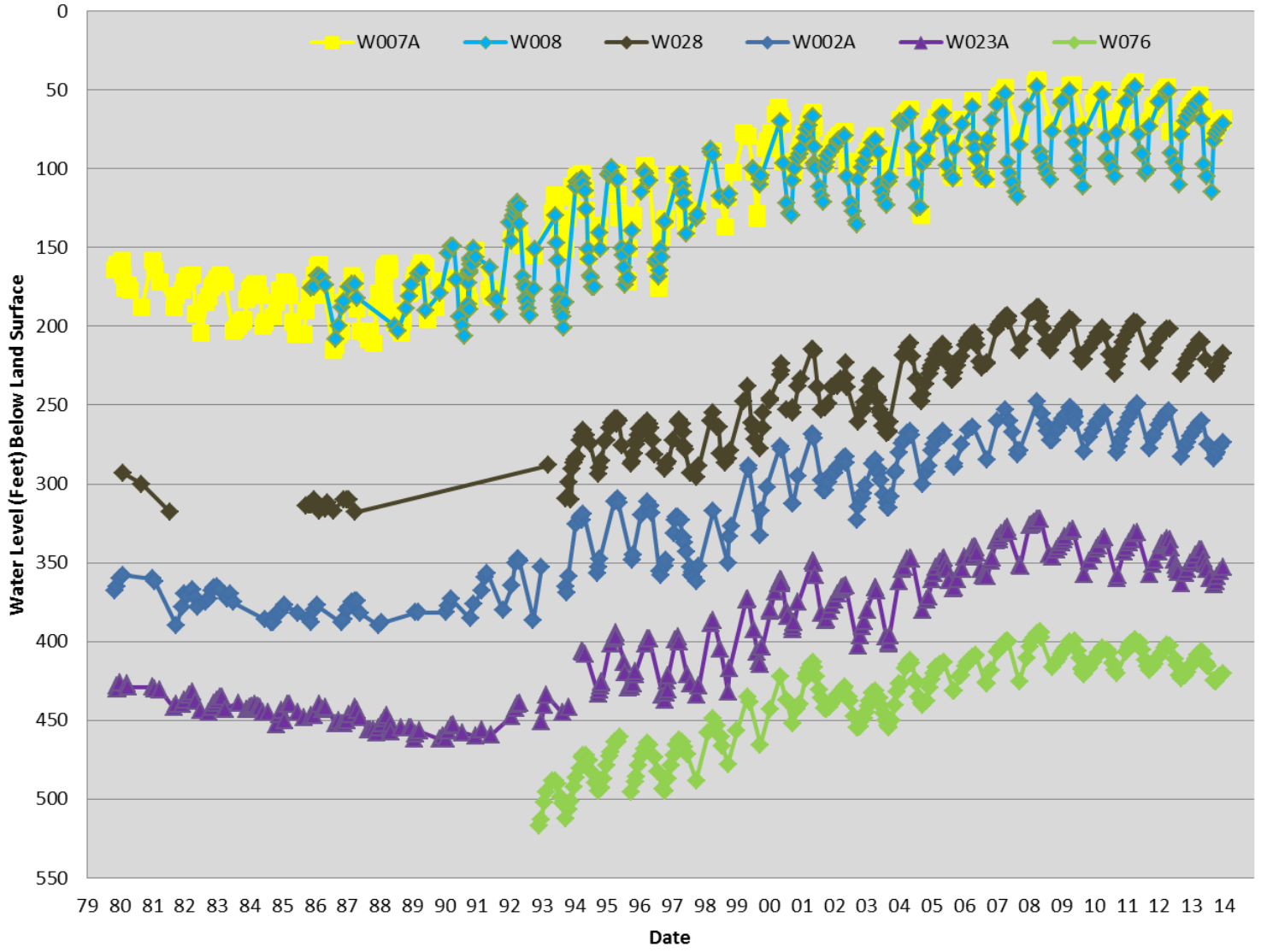
http://www.lasvegasgmp.com/html/telemetry_map.html



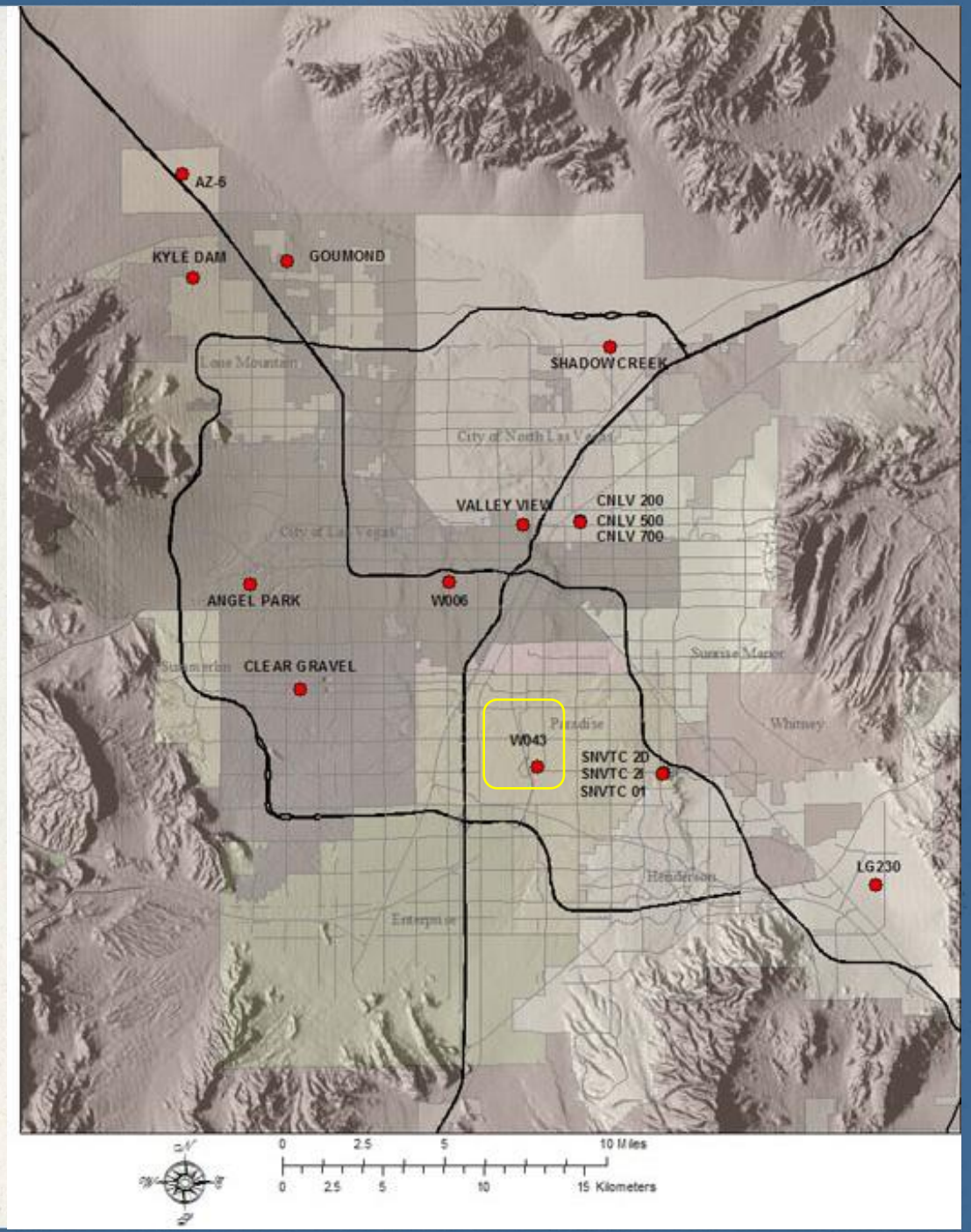

W006 North Wellfield 1988 to 2013
Pad Elevation 2133
Depth Drilled 500'
SWLs
Water Level Below (Feet) Land Surface
0
20
40
60
80
100
120
140
160
180
200
88 89 90 91 92 93 94 95 96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14
Date

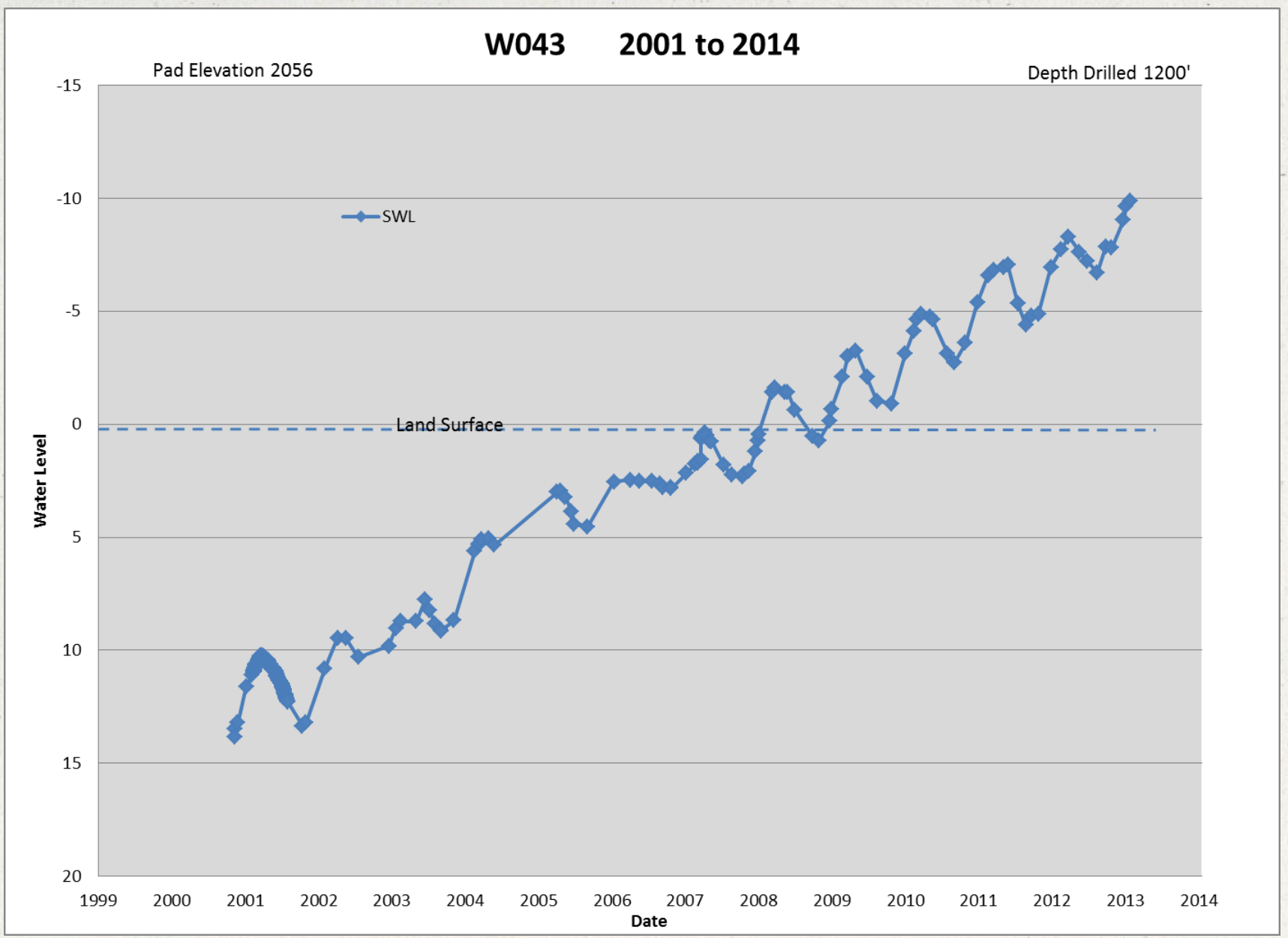

Valley View 1973 to 2013
Pad Elevation 2019
Depth Drilled 1000'
Land Surface
SWLs
Water Level
-20
-10
0
10
20
30
40
50
60
70
80
1973
1983
1993
2003
2013
Date

# Groundwater Levels 1979-2014

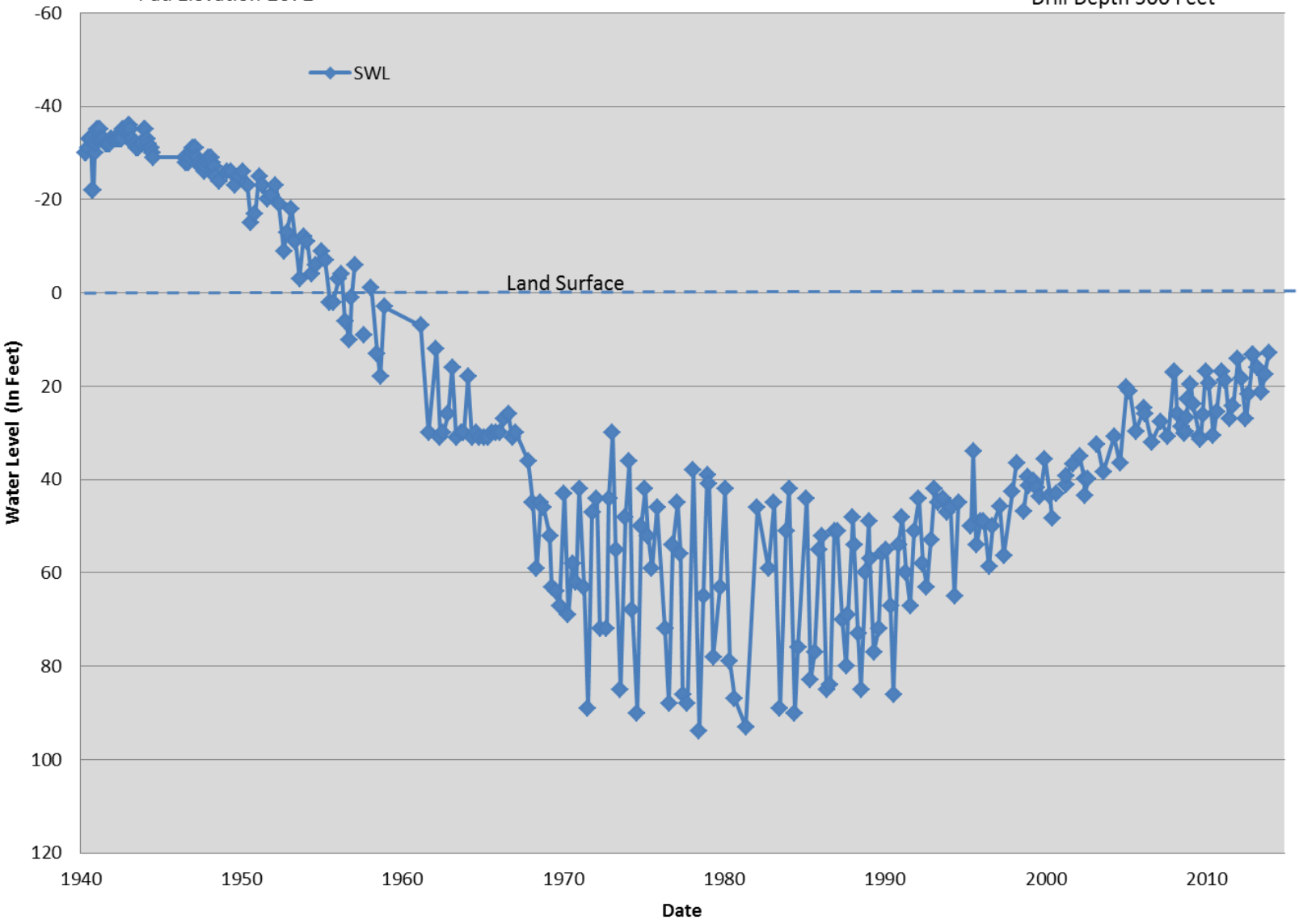


# HTS Program Monitoring Locations

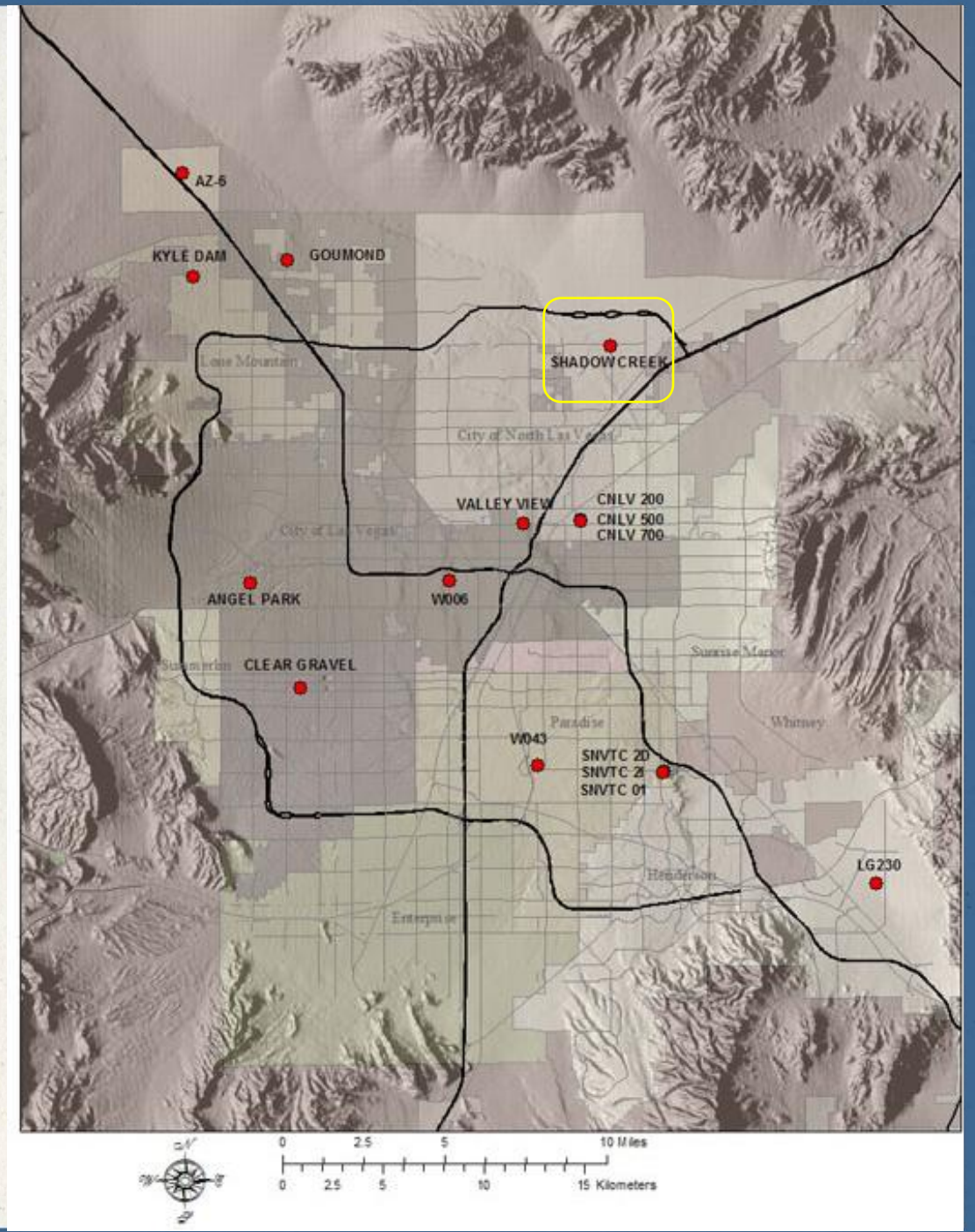



W043 2001 to 2014
Pad Elevation 2056
Depth Drilled 1200'
SWL
Land Surface
Water Level
Date
-15
-10
-5
0
5
10
15
20
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014

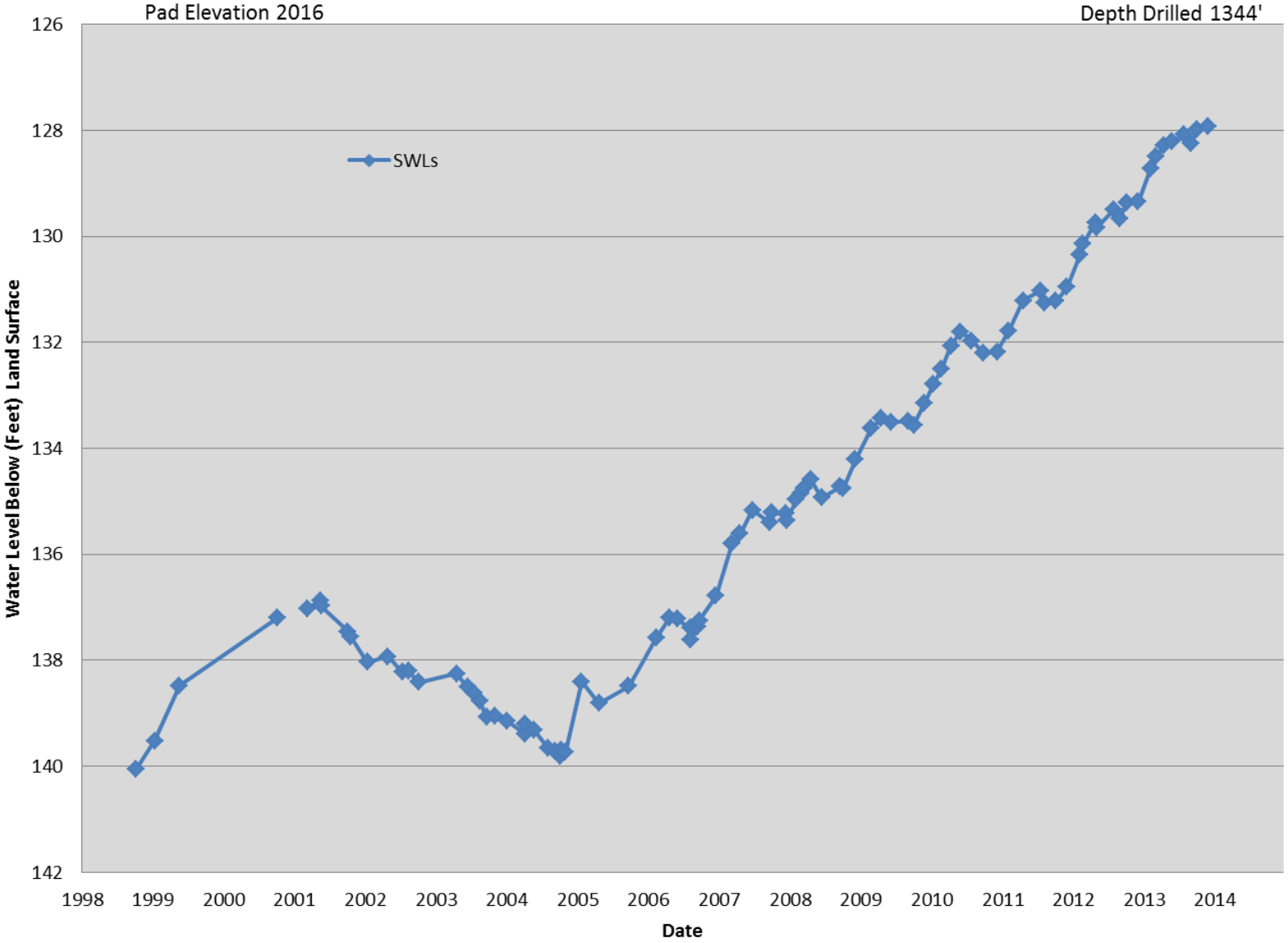
# Baker Well 1940 to 2014



# HTS Program Monitoring Locations



# Shadow Creek 1998 to 2013



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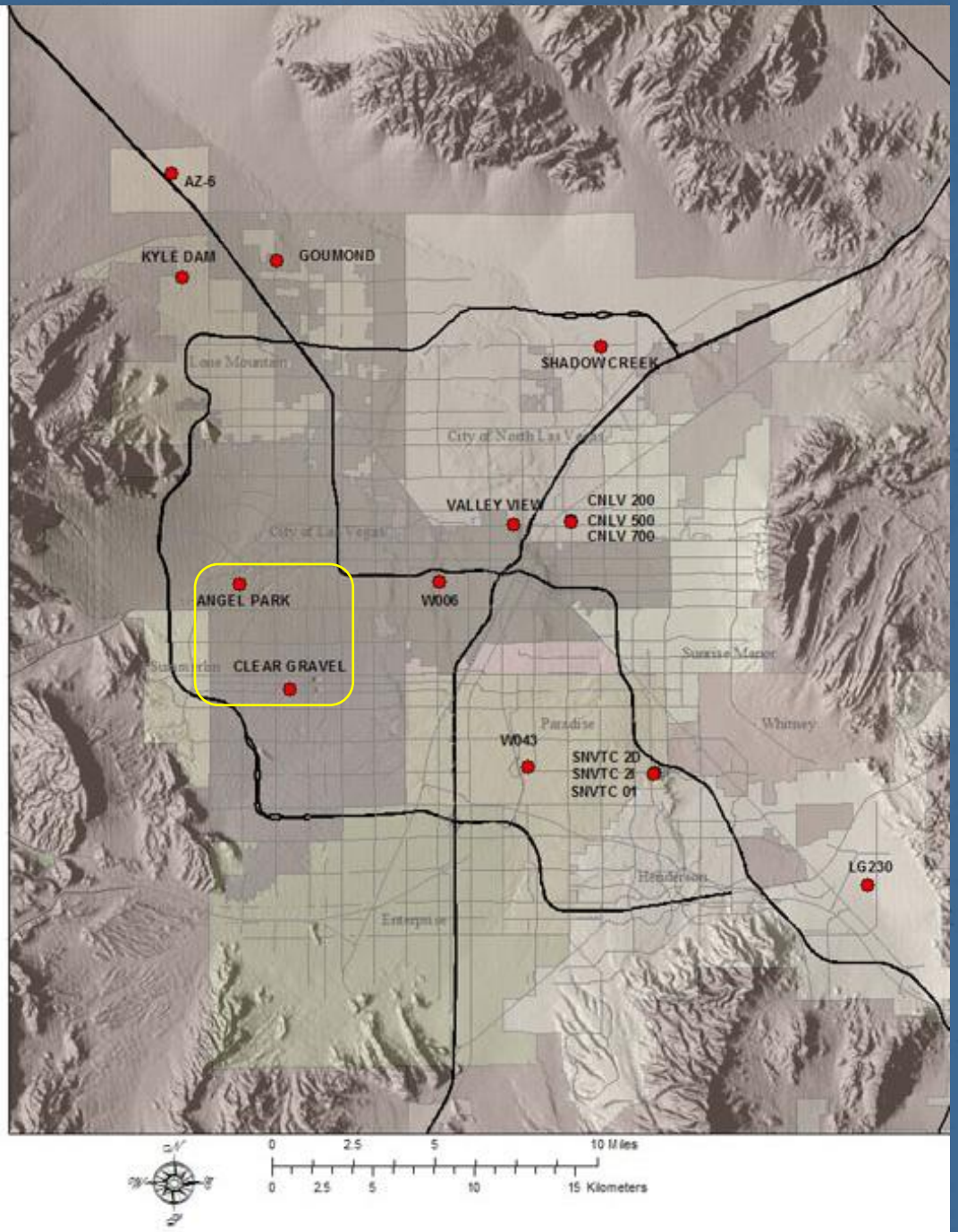
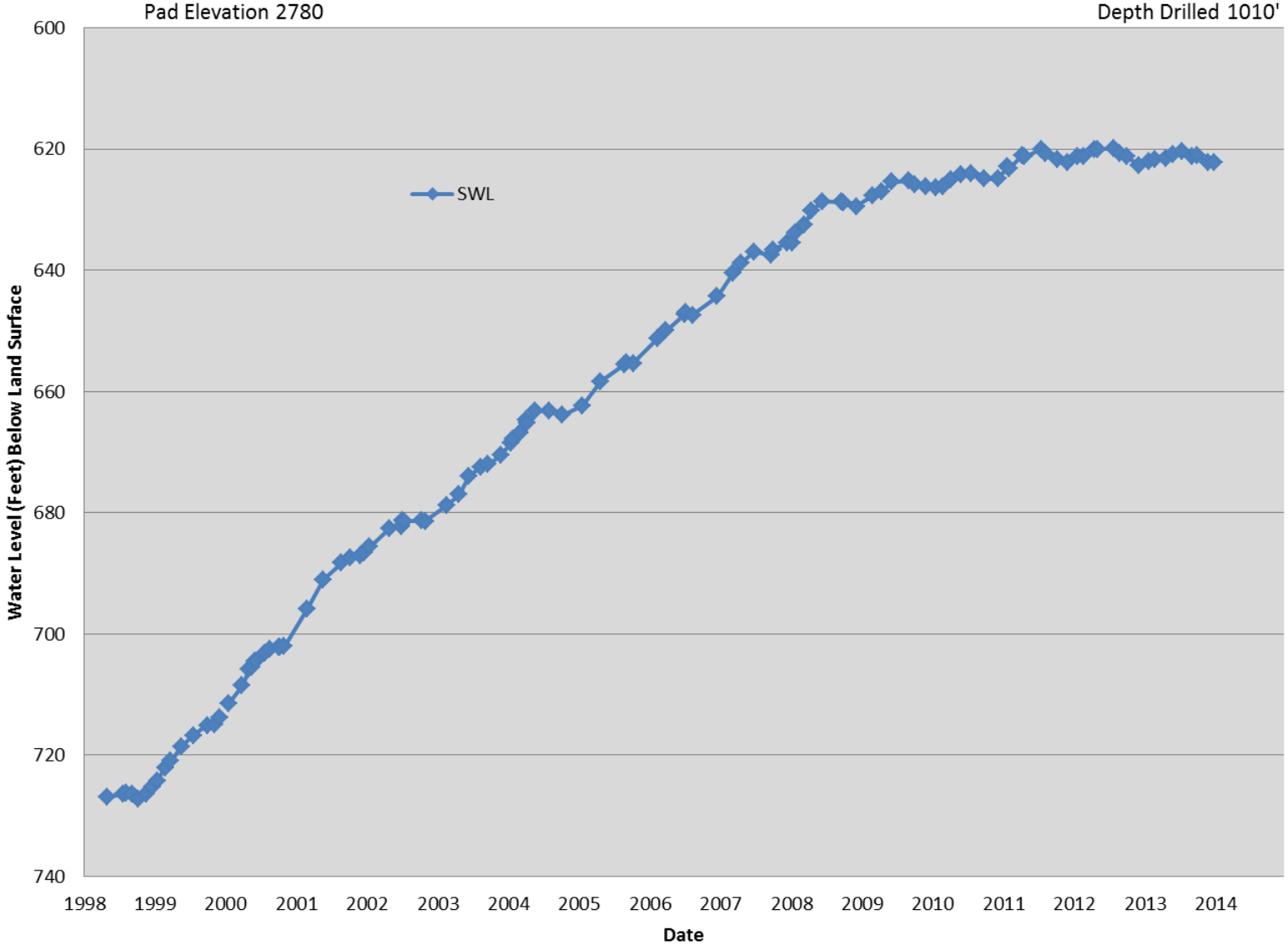
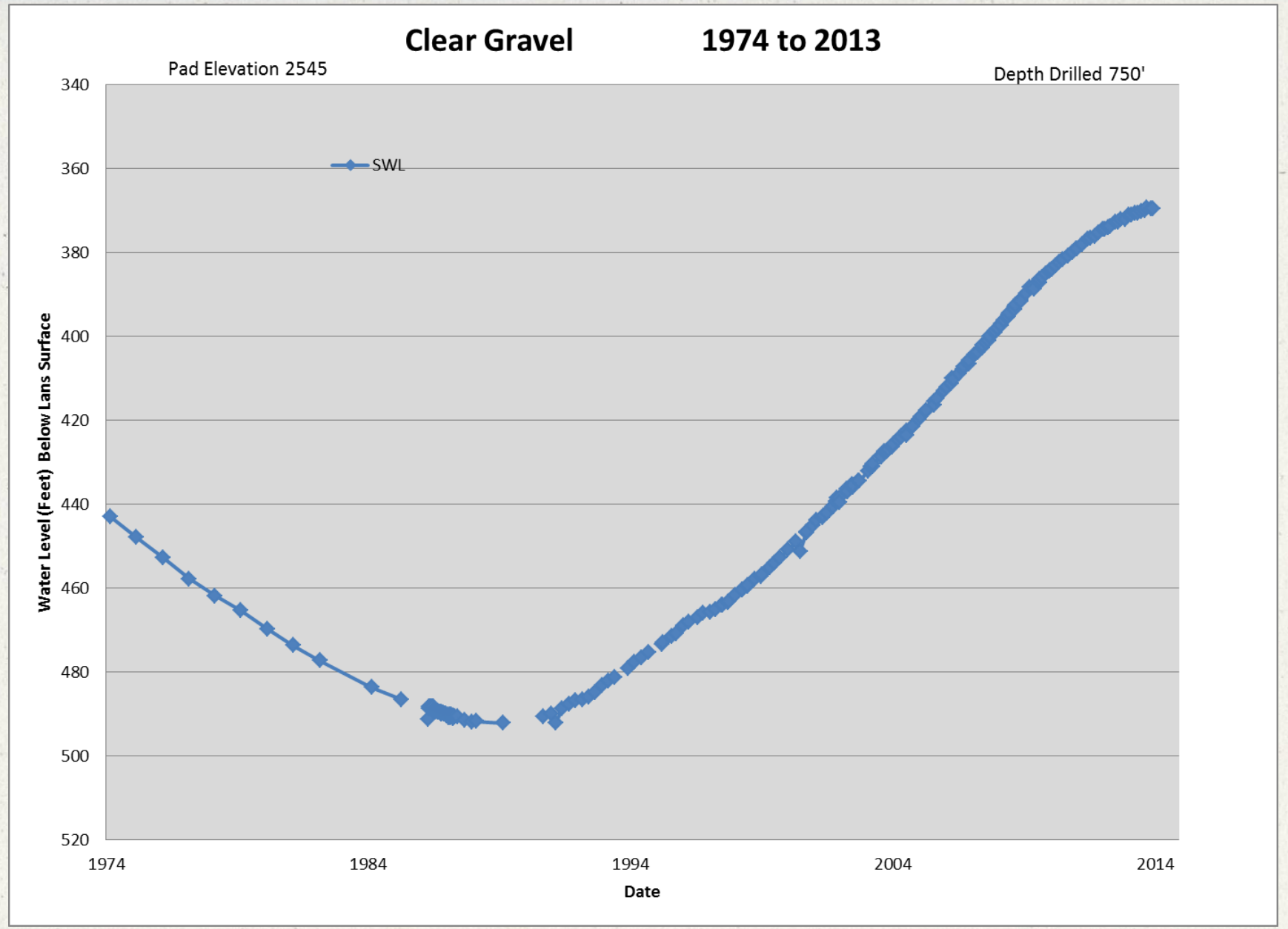


# ANGPRK2 1998 to 2014




Clear Gravel 1974 to 2013
Pad Elevation 2545
Depth Drilled 750'
SWL
Water Level (Feet) Below Lans Surface
340
360
380
400
420
440
460
480
500
520
1974
1984
1994
2004
2014
Date

# Questions?

**http://www.lasvegasgmp.com/html/telemetry_map.html**

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