HOMESTAKE MINING COMPANY SITE

Background Ground Water Investigation

September 24, 2015

DRAFT

For Discussion Purposes Only

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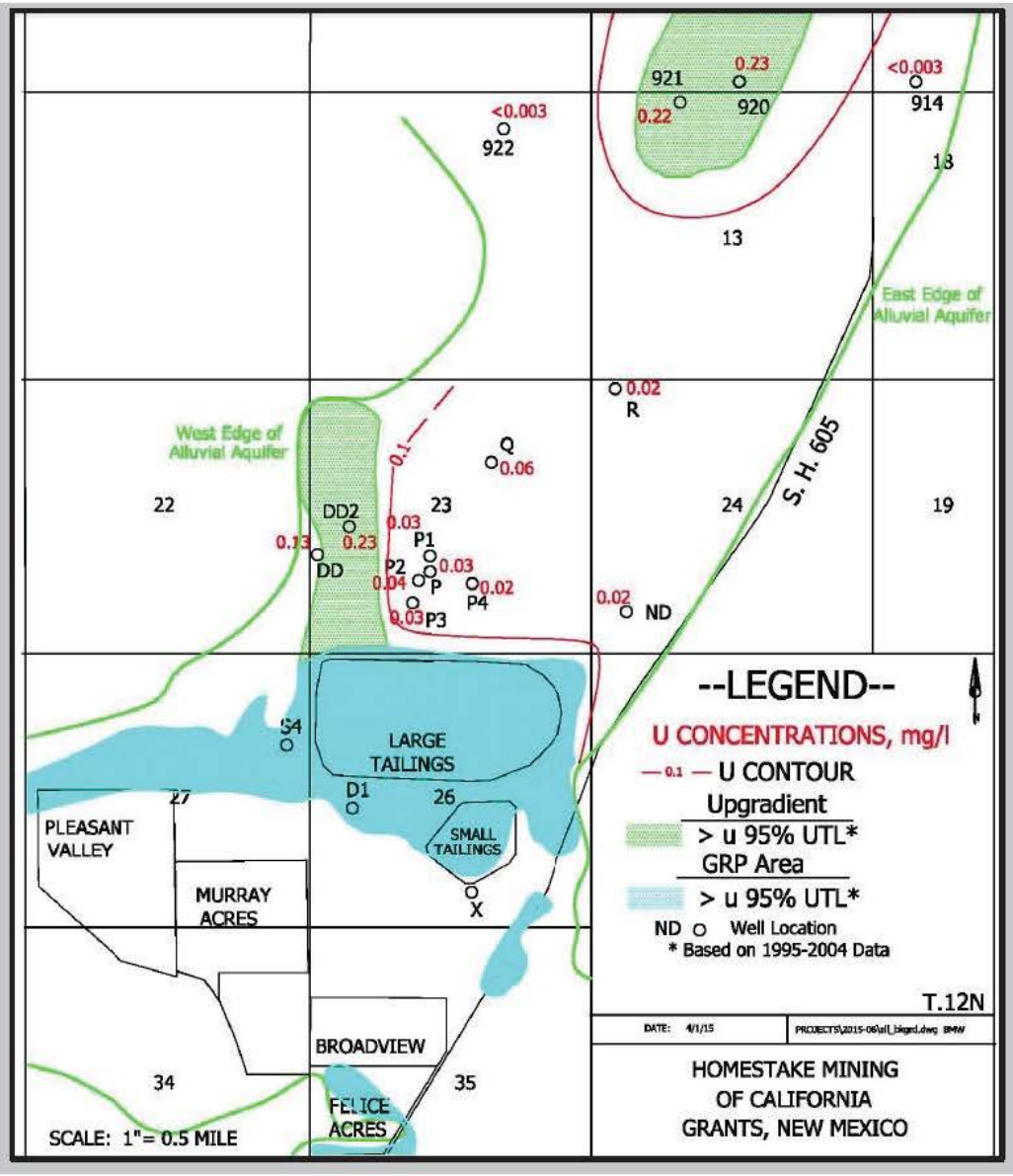
U.S. EPA Region 6

9787539

HIGH URANIUM LEVELS IN ALLUVIAL GROUND WATER UPGRADIENT OF HOMESTAKE

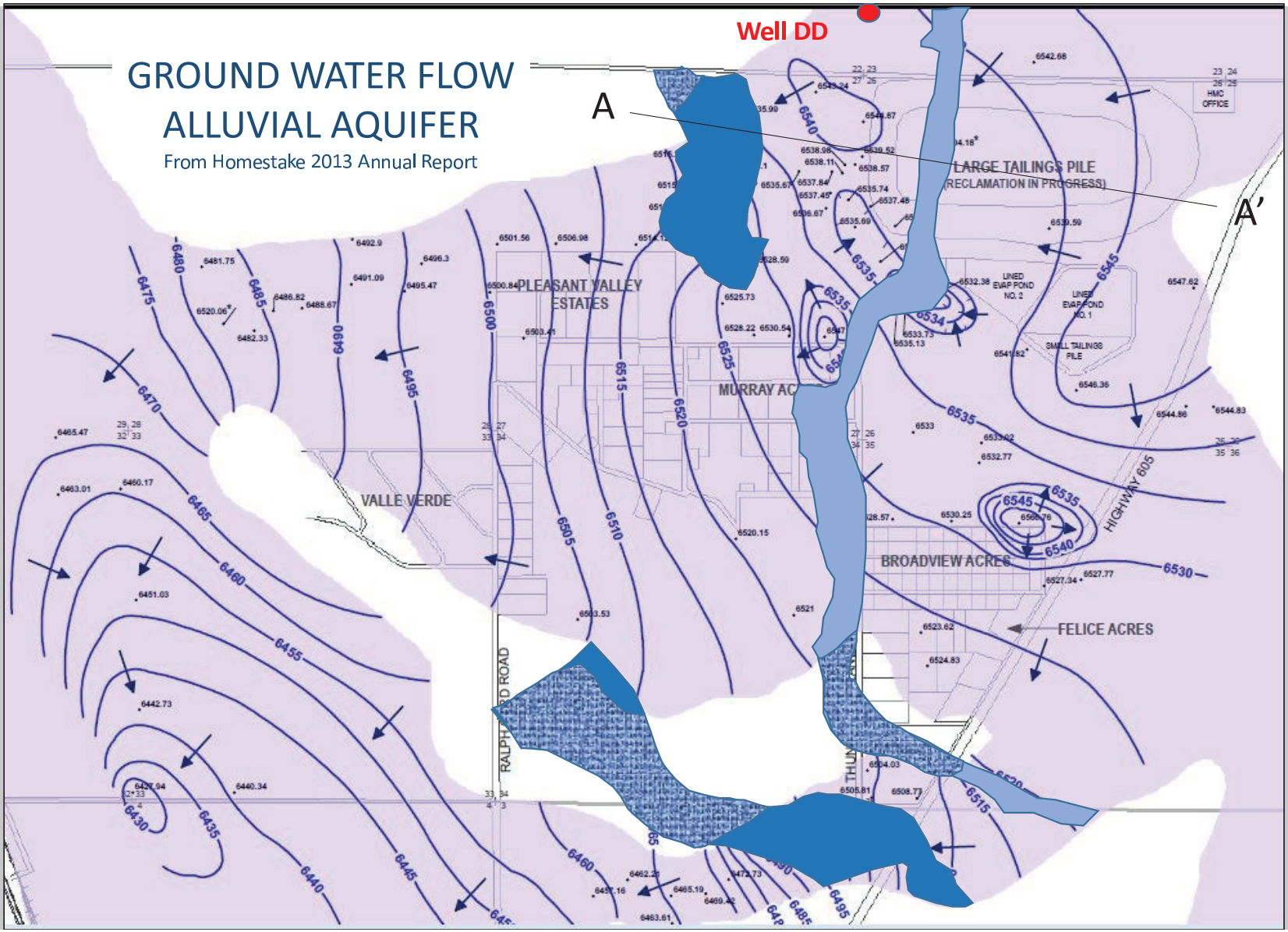
What is Source of Uranium Levels in Wells DD/DD2?

If natural Uranium levels, what Chinle Aquifers were Impacted by DD/DD2 Water Prior to Milling?



GROUND WATER FLOW
ALLUVIAL AQUIFER

From Homestake 2013 Annual Report



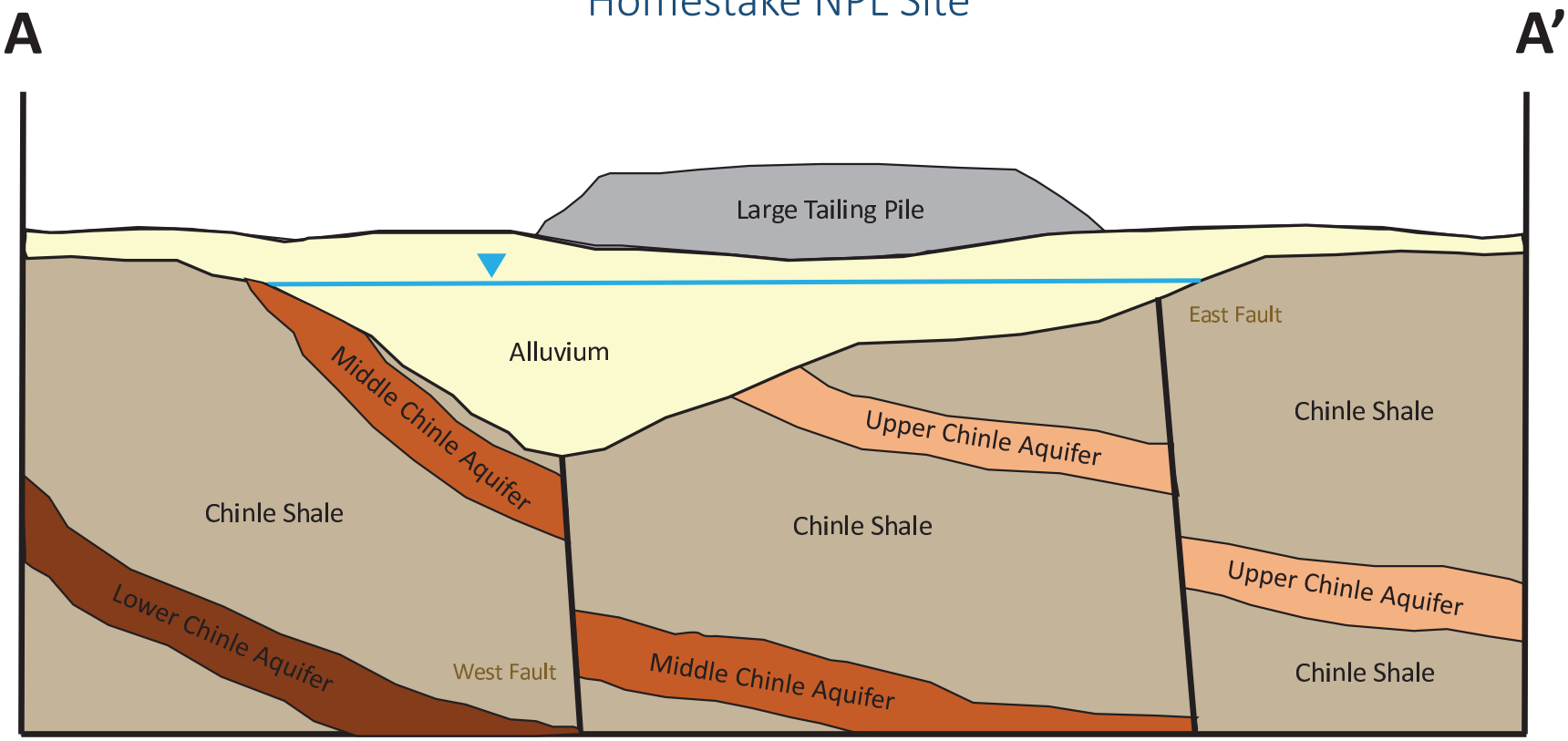
Upper Chinle Subcrop

Middle Chinle Subcrop

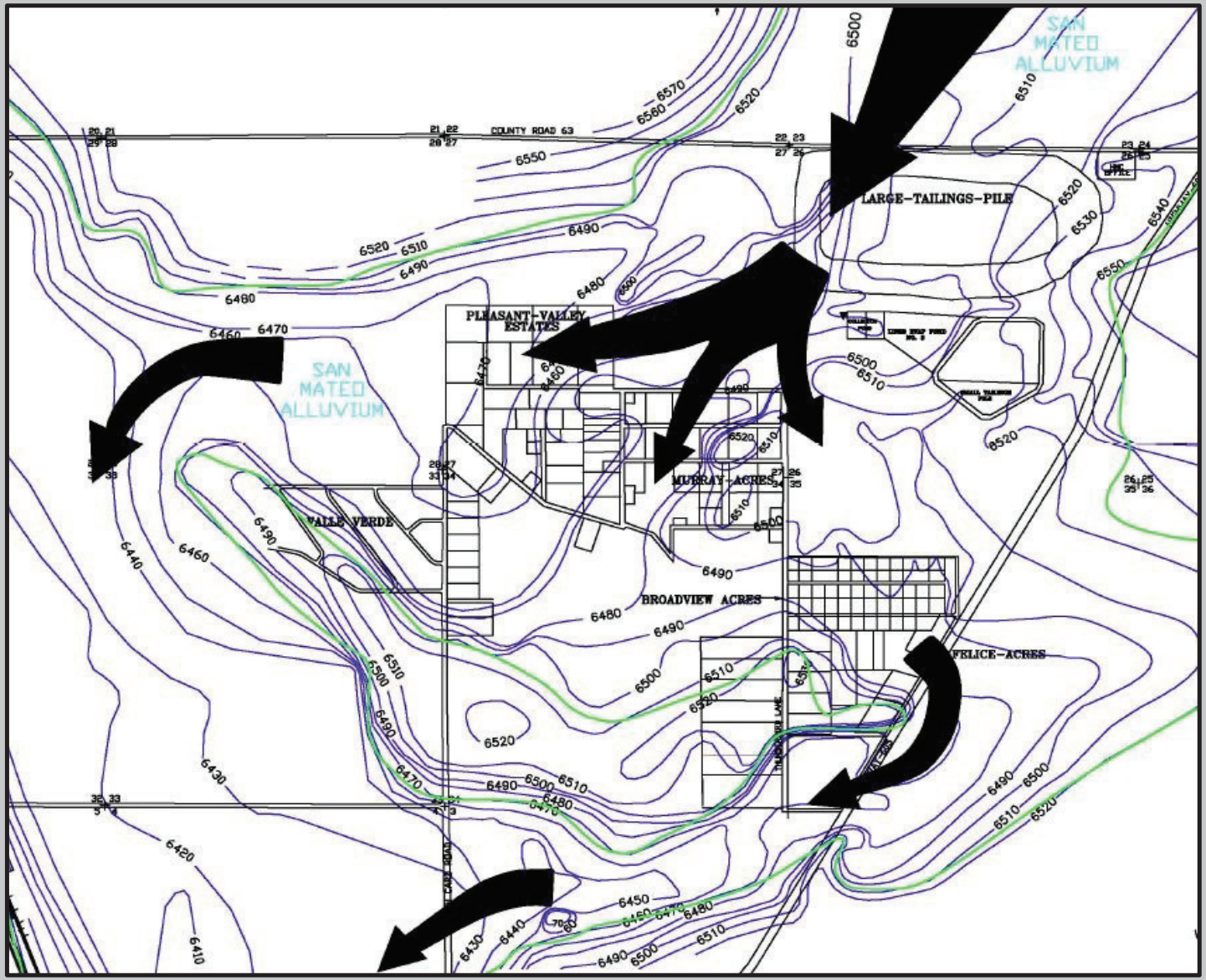
Unsaturated Chinle

CROSS-SECTION A-A’

Homestake NPL Site



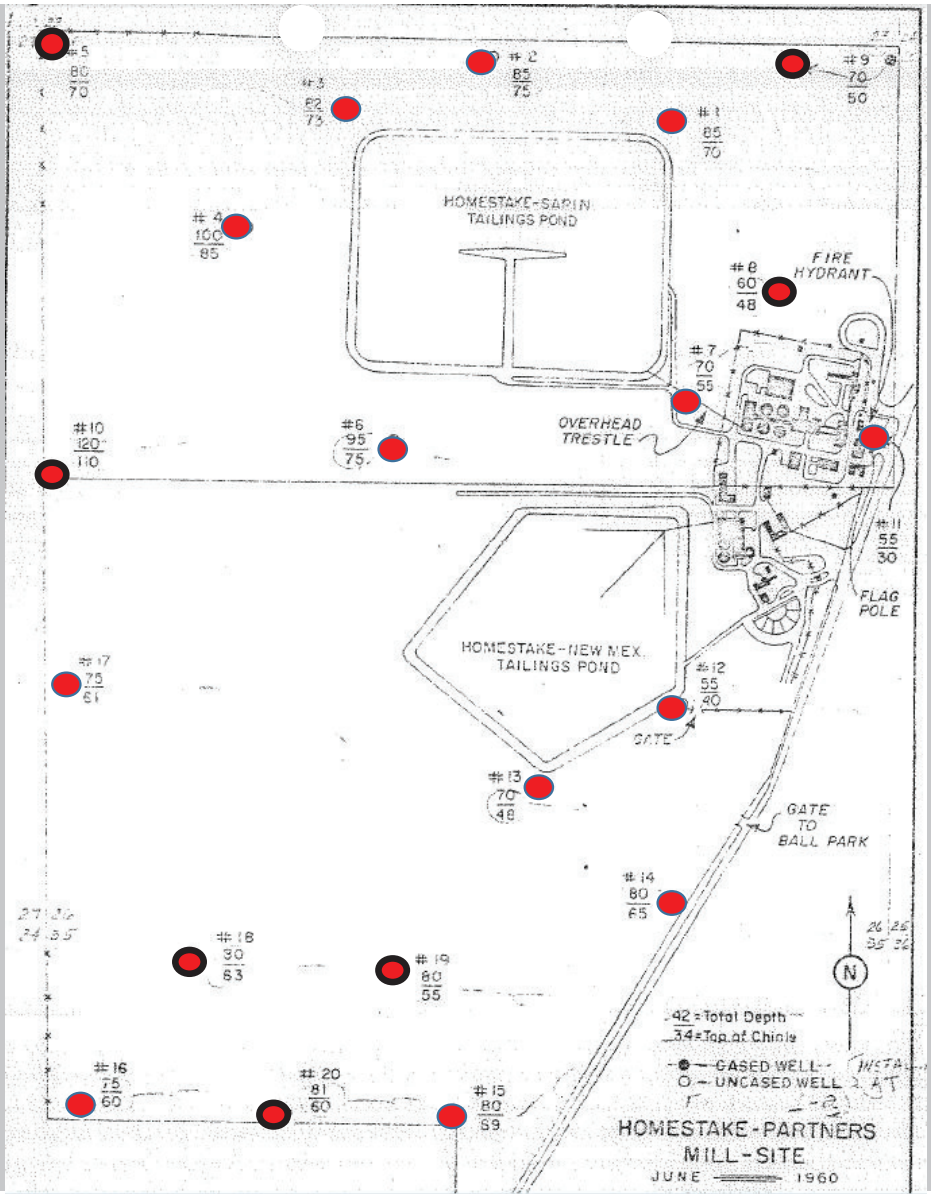
Illustrative Cross Section - Not to Scale



BASE FLOW ALLUVIAL AQUIFER

Base of Alluvium Structure Contour Map

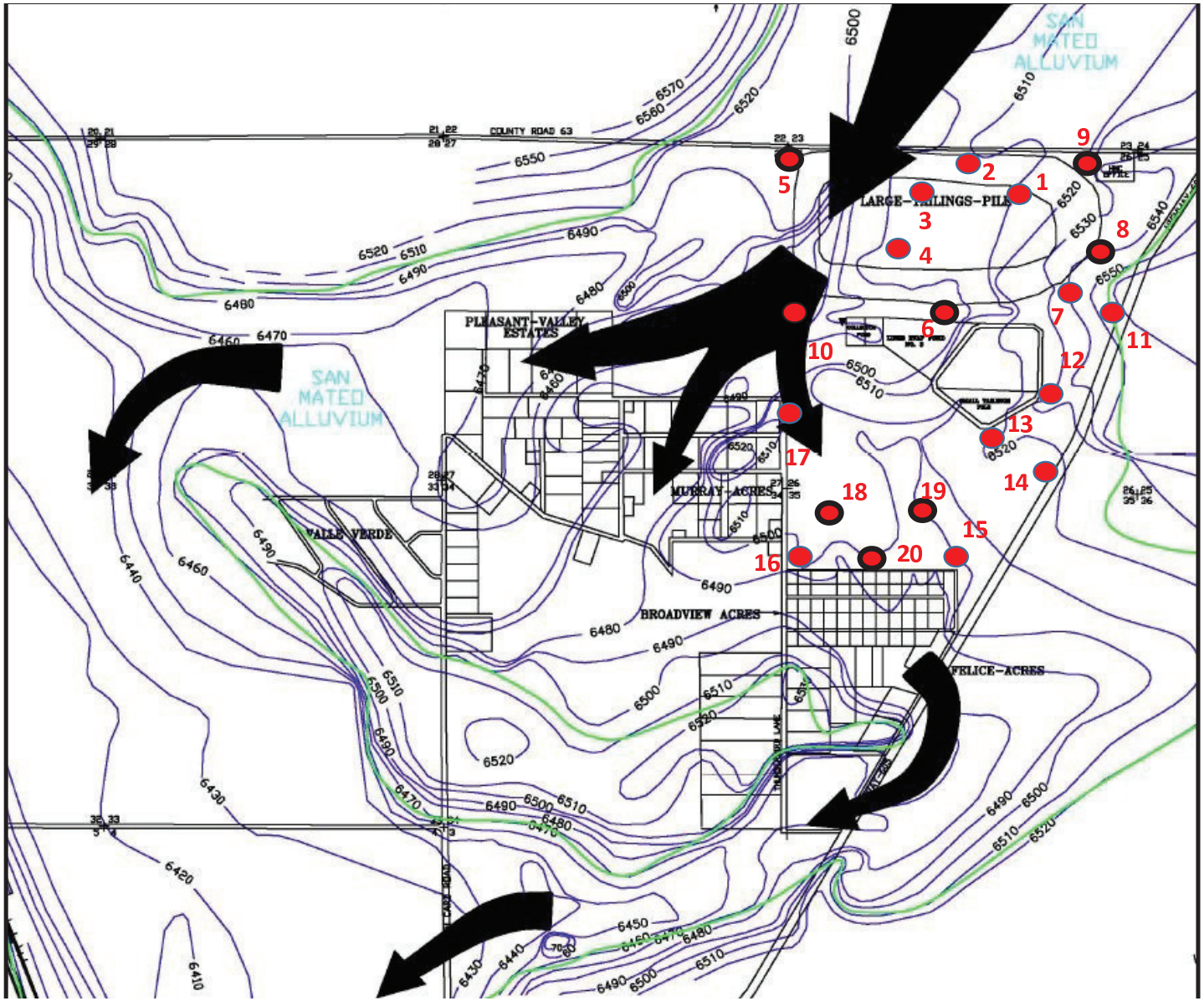
From HMC
Background Report



HISTORICAL 1960 GROUND WATER INVESTIGATION

From Chavez, 1961

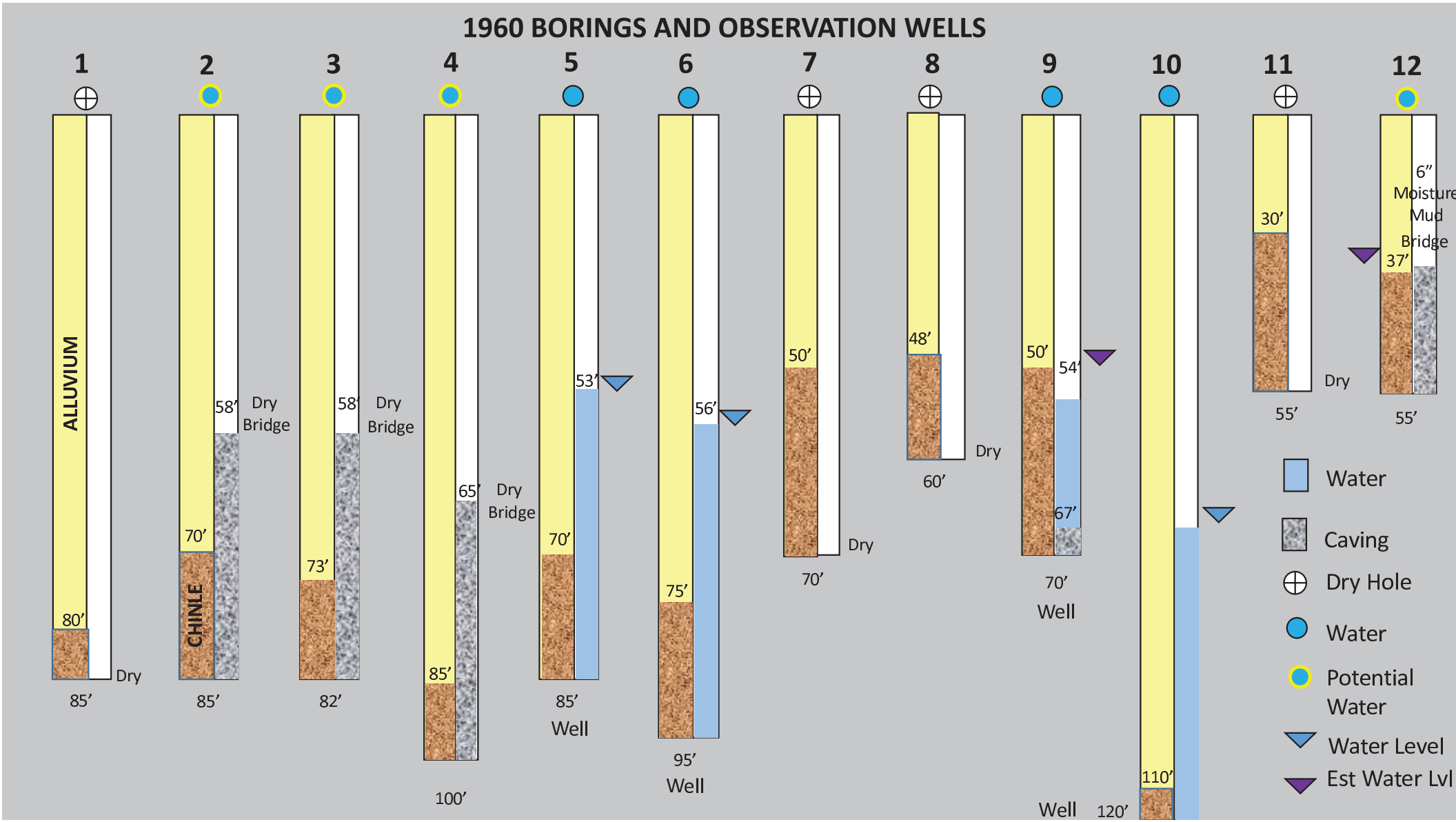
- Borehole
- Monitoring Well

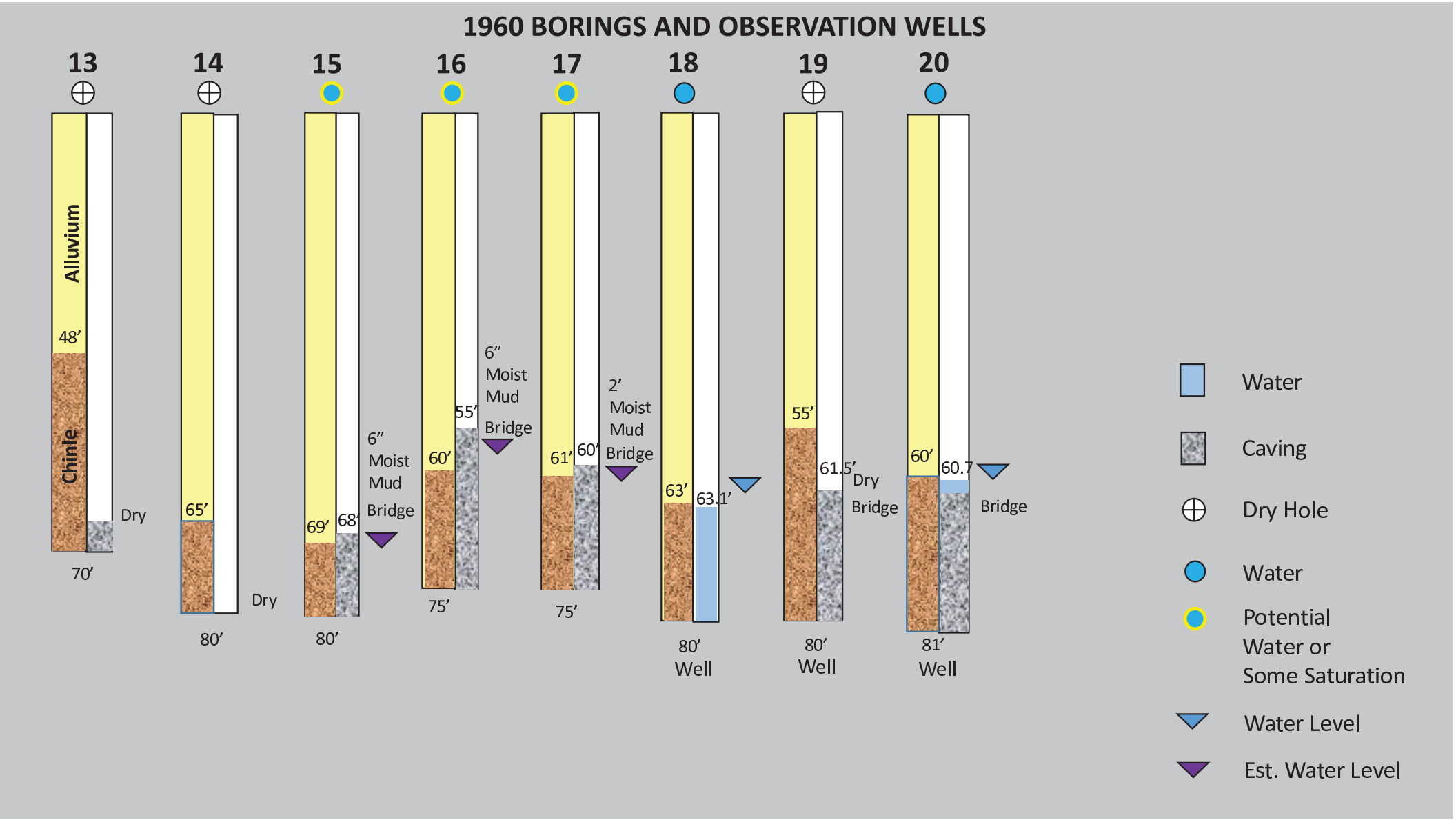


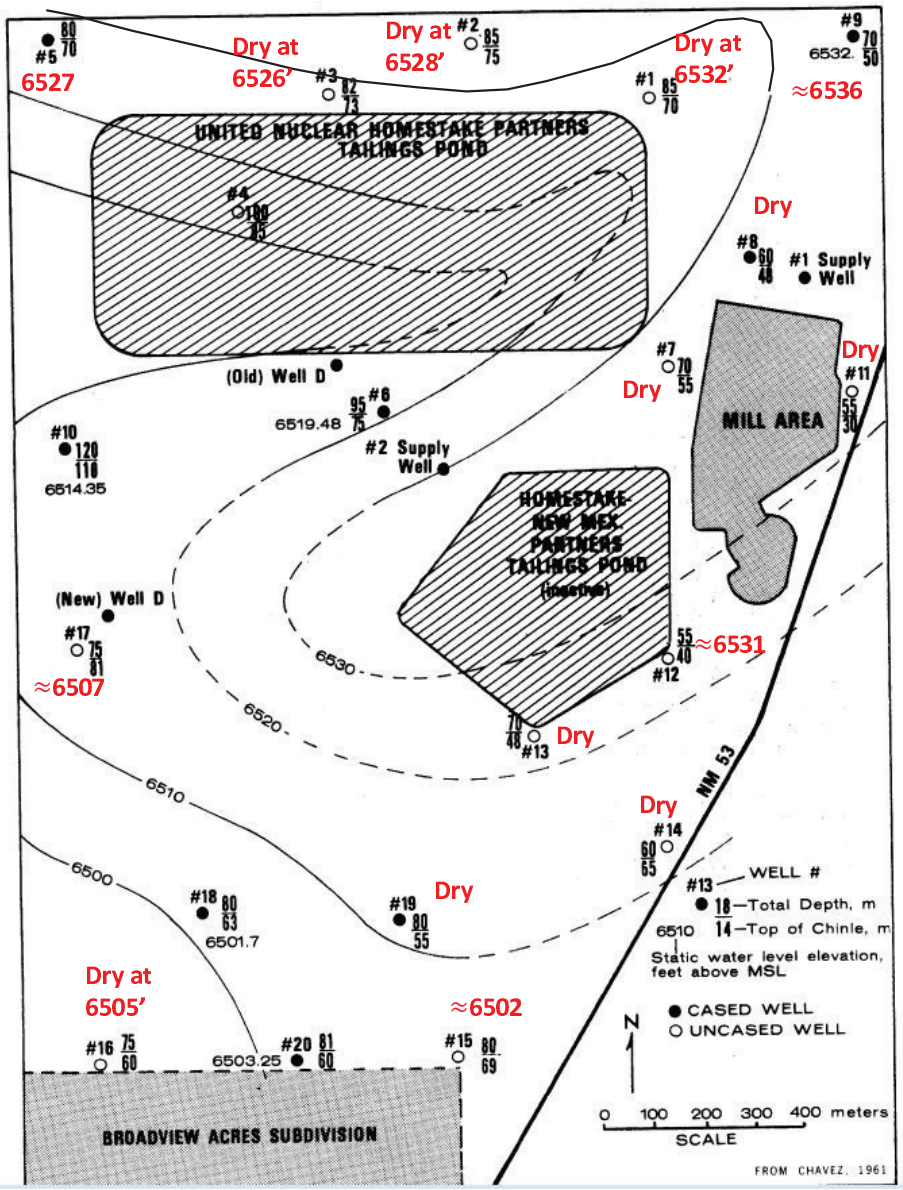
BASE FLOW ALLUVIAL AQUIFER

From HMC Background Report

- 1960 Boring
- 1960 Monitoring Well


1960 BORINGS AND OBSERVATION WELLS
1
2
3
4
5
6
7
8
9
10
11
12
ALLUVIUM
CHINLE
80’
Dry
85’
70’
58’
Dry
Bridge
85’
73’
58’
Dry
Bridge
82’
85’
65’
Dry
Bridge
100’
70’
53’
85’
Well
75’
56’
95’
Well
50’
Dry
70’
48’
Dry
60’
50’
54’
67’
70’
Well
110’
Well
120’
30’
Dry
55’
6”
Moisture
Mud
Bridge
37’
55’
Water
Caving
Dry Hole
Water
Potential
Water
Water Level
Est Water Lvl


1960 BORINGS AND OBSERVATION WELLS
13
14
15
16
17
18
19
20
Alluvium
Chinle
48'
Dry
70'
65'
Dry
80'
69'
68'
6" Moist Mud
Bridge
80'
60'
55'
6" Moist Mud
Bridge
75'
61'
60'
2' Moist Mud
Bridge
75'
63'
63.1'
80' Well
55'
61.5'
Dry
Bridge
80' Well
60'
60.7
Bridge
81' Well
Water
Caving
Dry Hole
Water
Potential Water or Some Saturation
Water Level
Est. Water Level

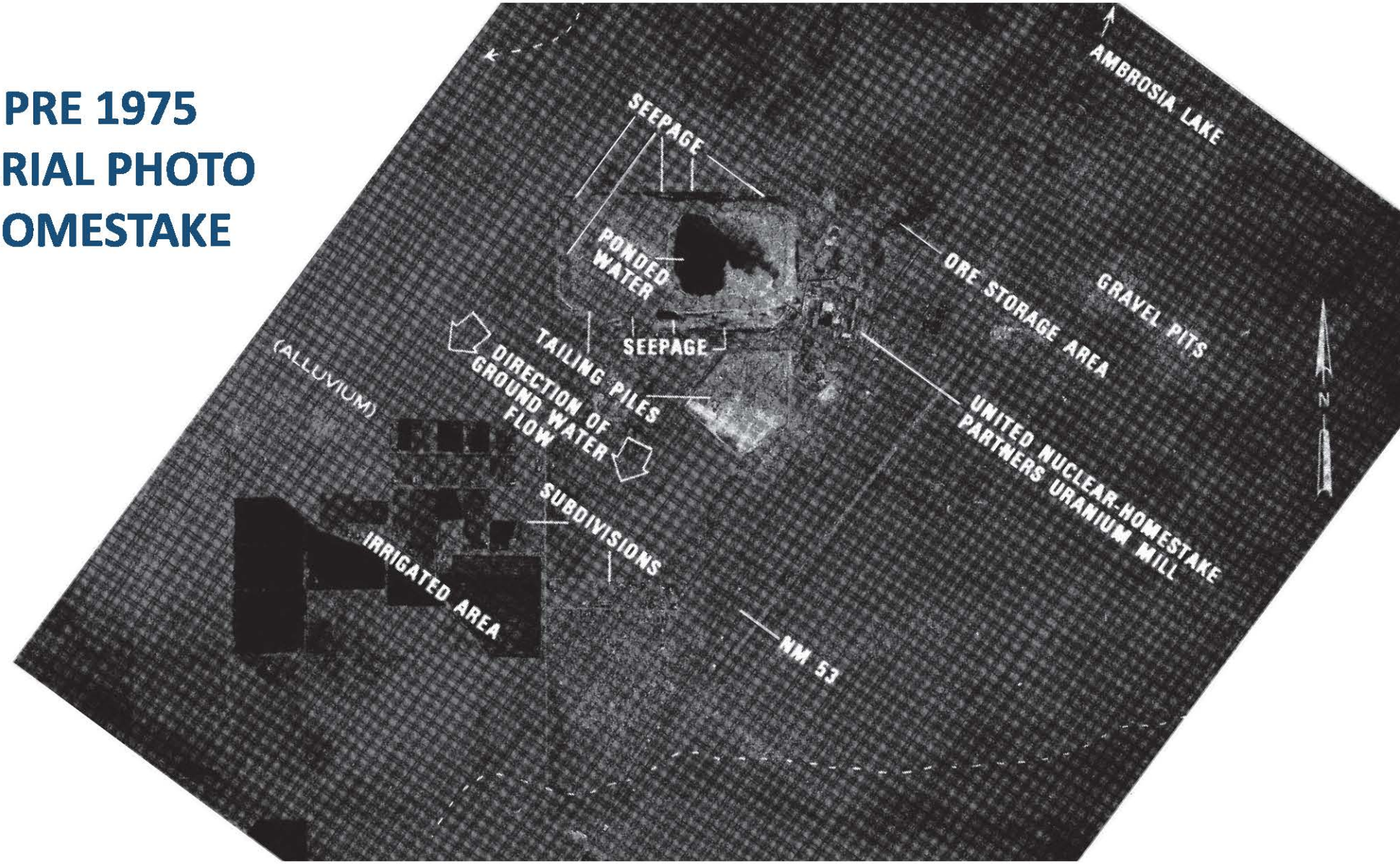


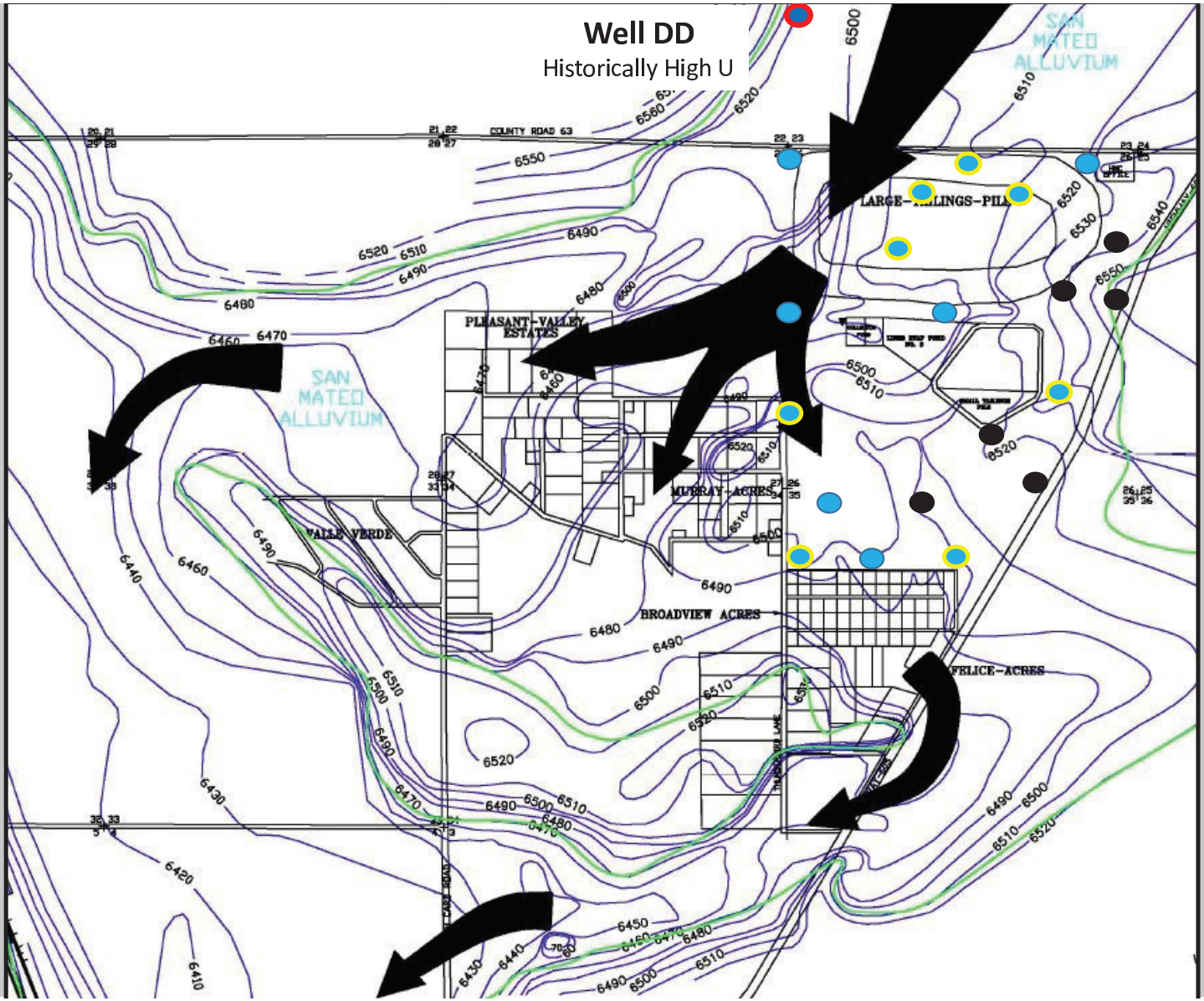
ALLUVIUM WATER ELEVATION MAP

1960 GROUND WATER INVESTIGATION

From Chavez, 1961 and EPA, 1975

PRE 1975
AERIAL PHOTO
HOMESTAKE



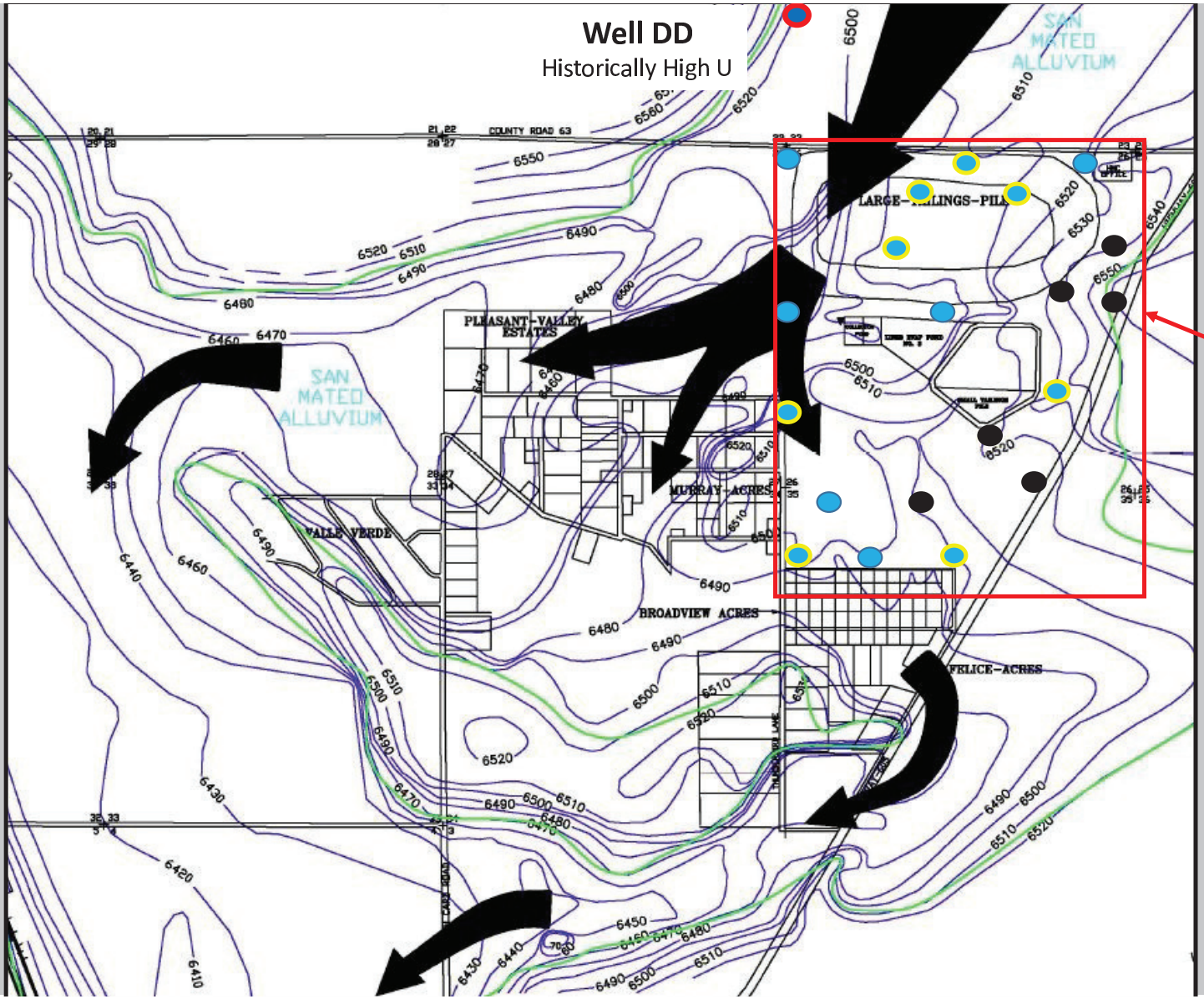


1960 Borings/Wells

- Dry Boring
- Potential Water
- Water

BASE FLOW ALLUVIAL AQUIFER

From HMC Background Report



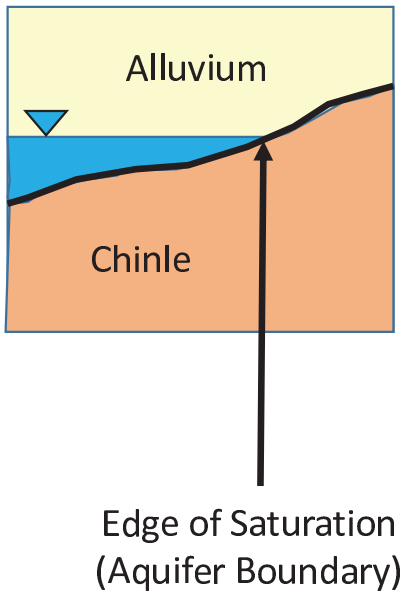
1960 Borings

- Dry Boring
- Potential Water
- Water

Determine Ground Water Flow from 1960 Data

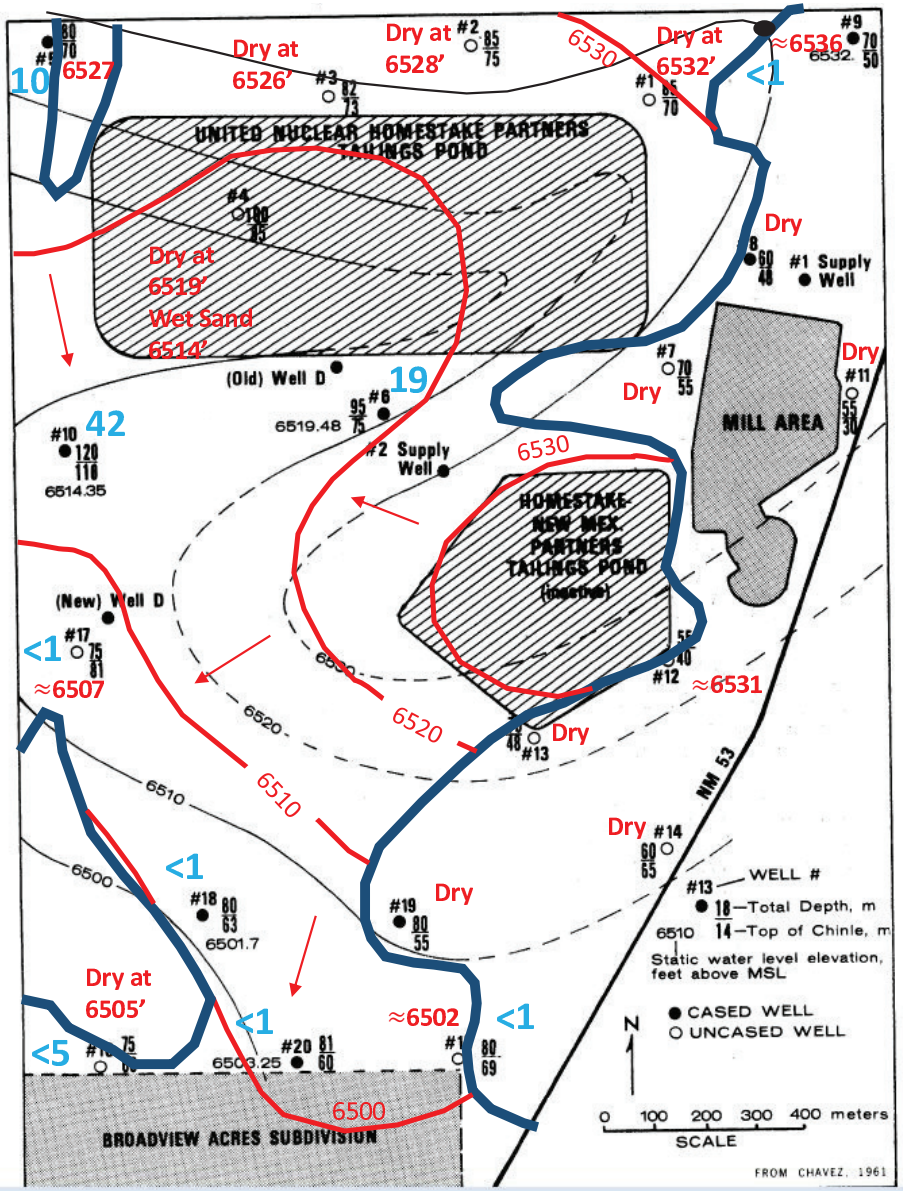
BASE FLOW ALLUVIAL AQUIFER

From HMC Background Report



3.1	µµC/L Radium 226
11	Well Number
42'	Saturation Thickness
6508	Water Elevation
	Water Level Contour
	Aquifer Boundary

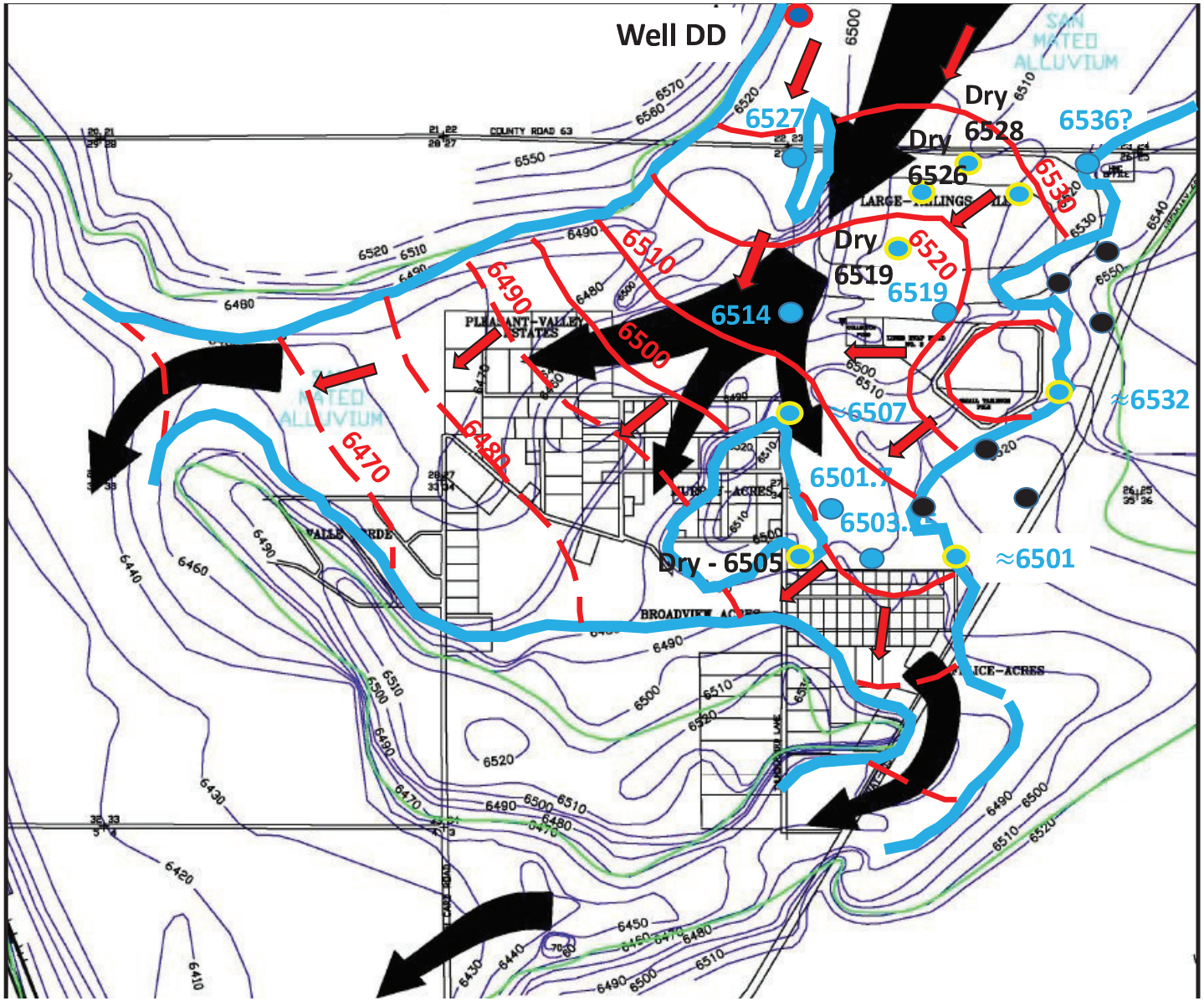
Base of Alluvium Structure Contour and Ground Water Flow Map



ALLUVIUM WATER ELEVATION MAP

MODIFIED FROM 1960 GROUND WATER INVESTIGATION

Chavez, 1961
EPA, 1975



Dry Boring

Potential Water

Water

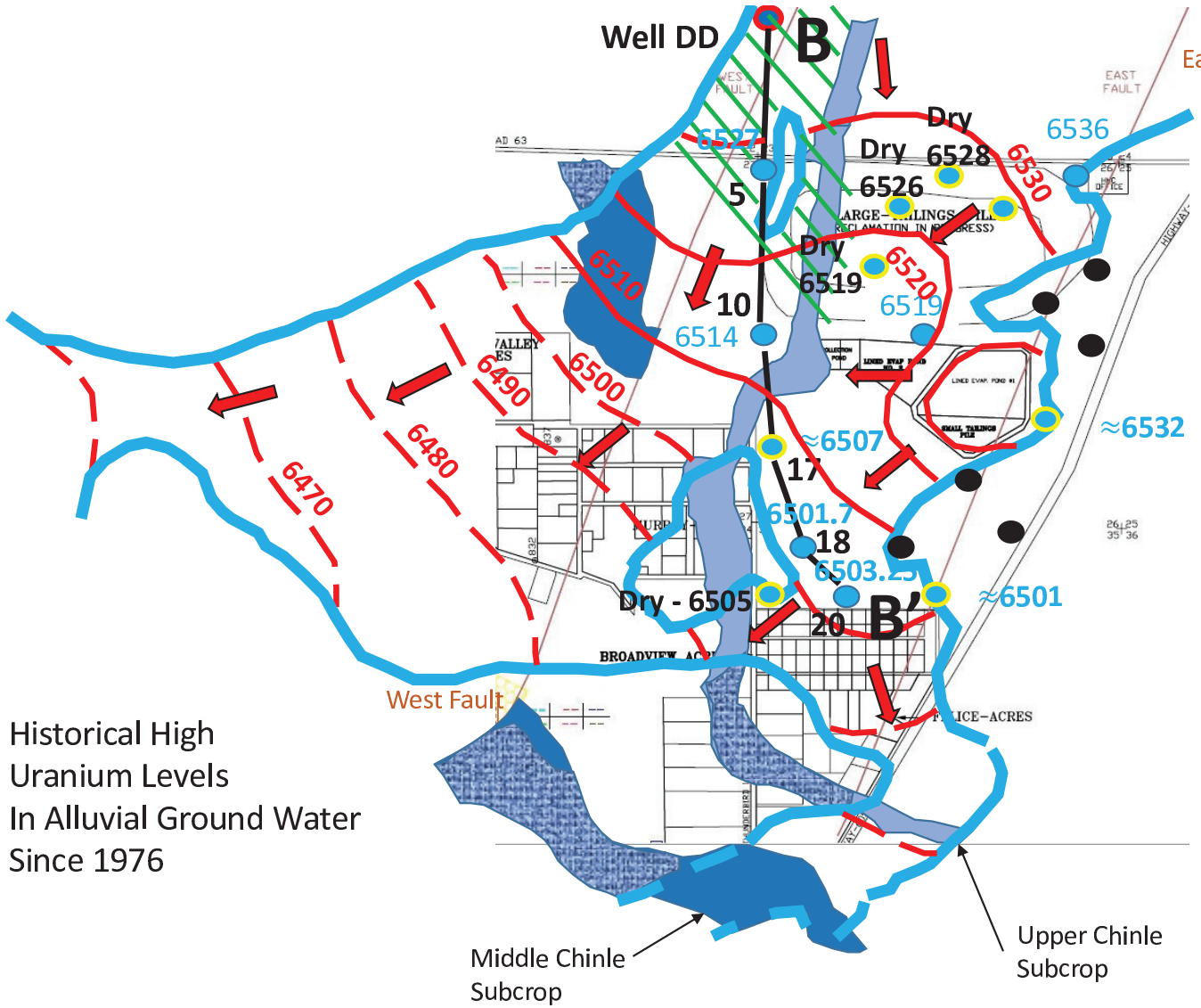
Aquifer Boundary

Water Level Contour

BASE FLOW ALLUVIAL AQUIFER

Based on 1960 Chavez Report

Modified From HMC Background Report



Dry Boring

Potential Water

Water

Aquifer Boundary

Water Level Contour

Historical High Uranium Levels In Alluvial Ground Water Since 1976

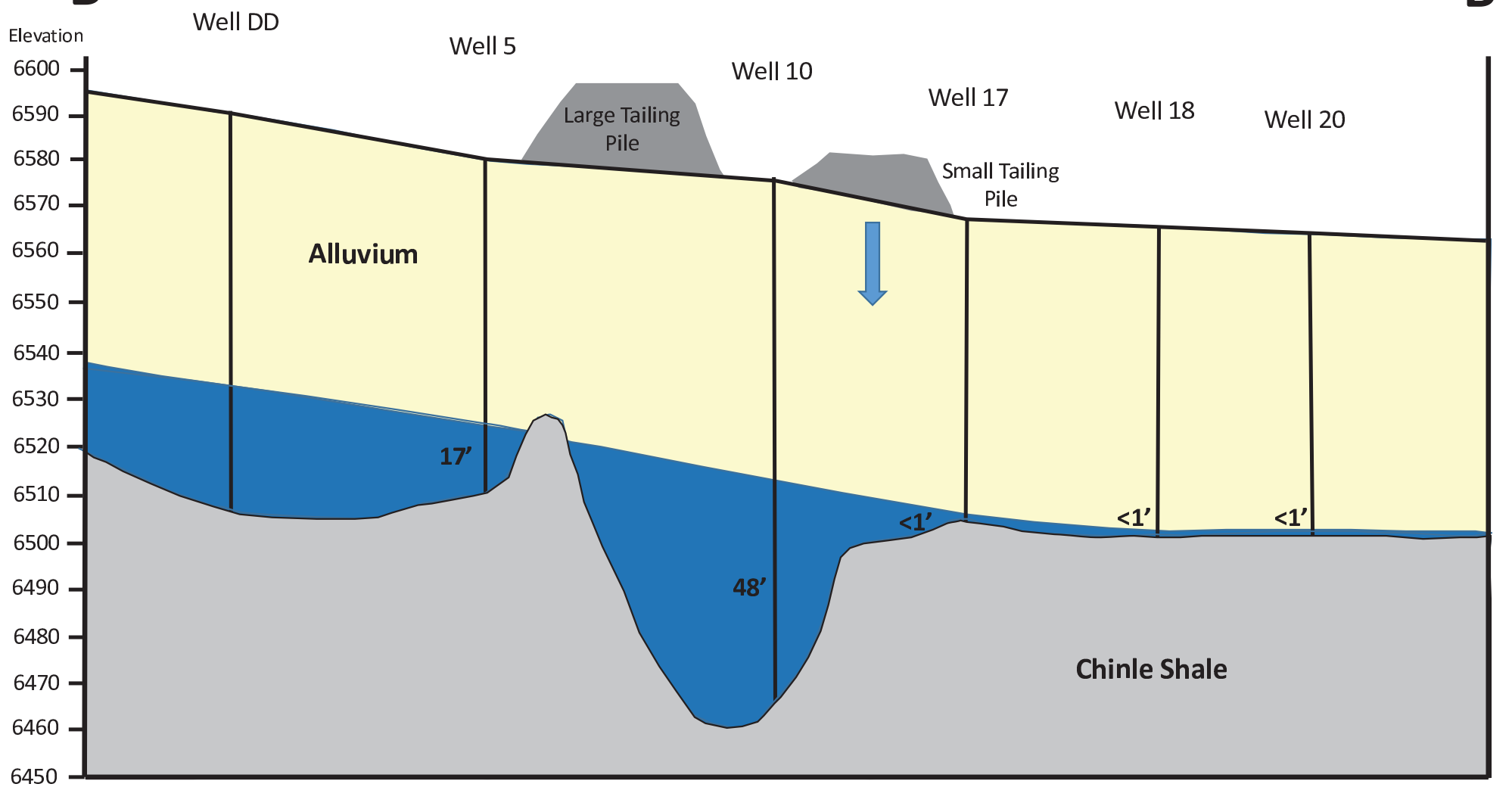
1960 BASE FLOW ALLUVIAL AQUIFER

Based on 1960 Chavez Report

Modified From HMC Background Report

Draft – For Discussion Purposes Only

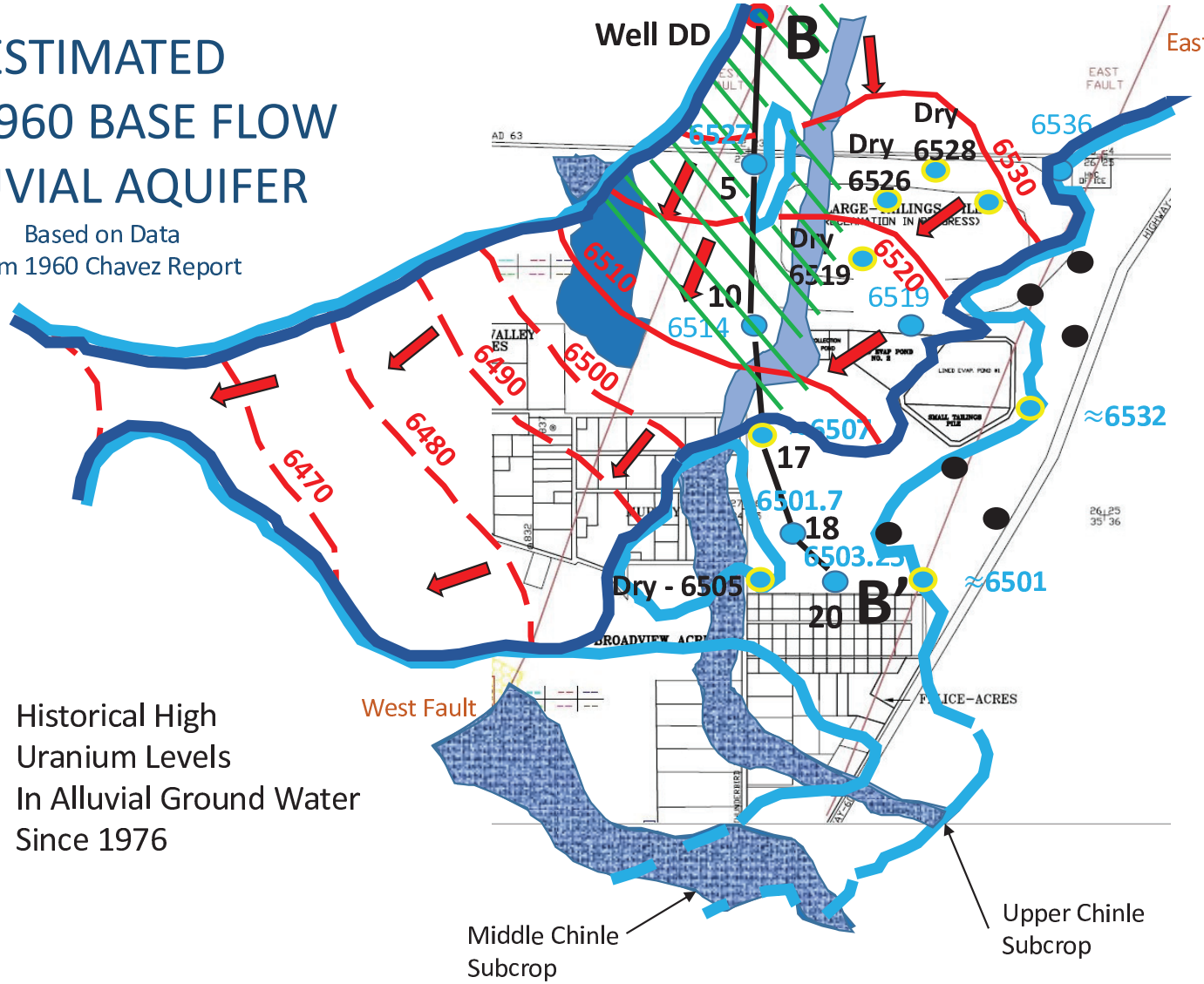
Cross Section B-B’



Draft – For Discussion Purposes Only

ESTIMATED PRE-1960 BASE FLOW ALLUVIAL AQUIFER

Based on Data
From 1960 Chavez Report



Dry Boring

Potential Water

Water

Pre-1960 Aquifer Boundary

1960 Aquifer Boundary

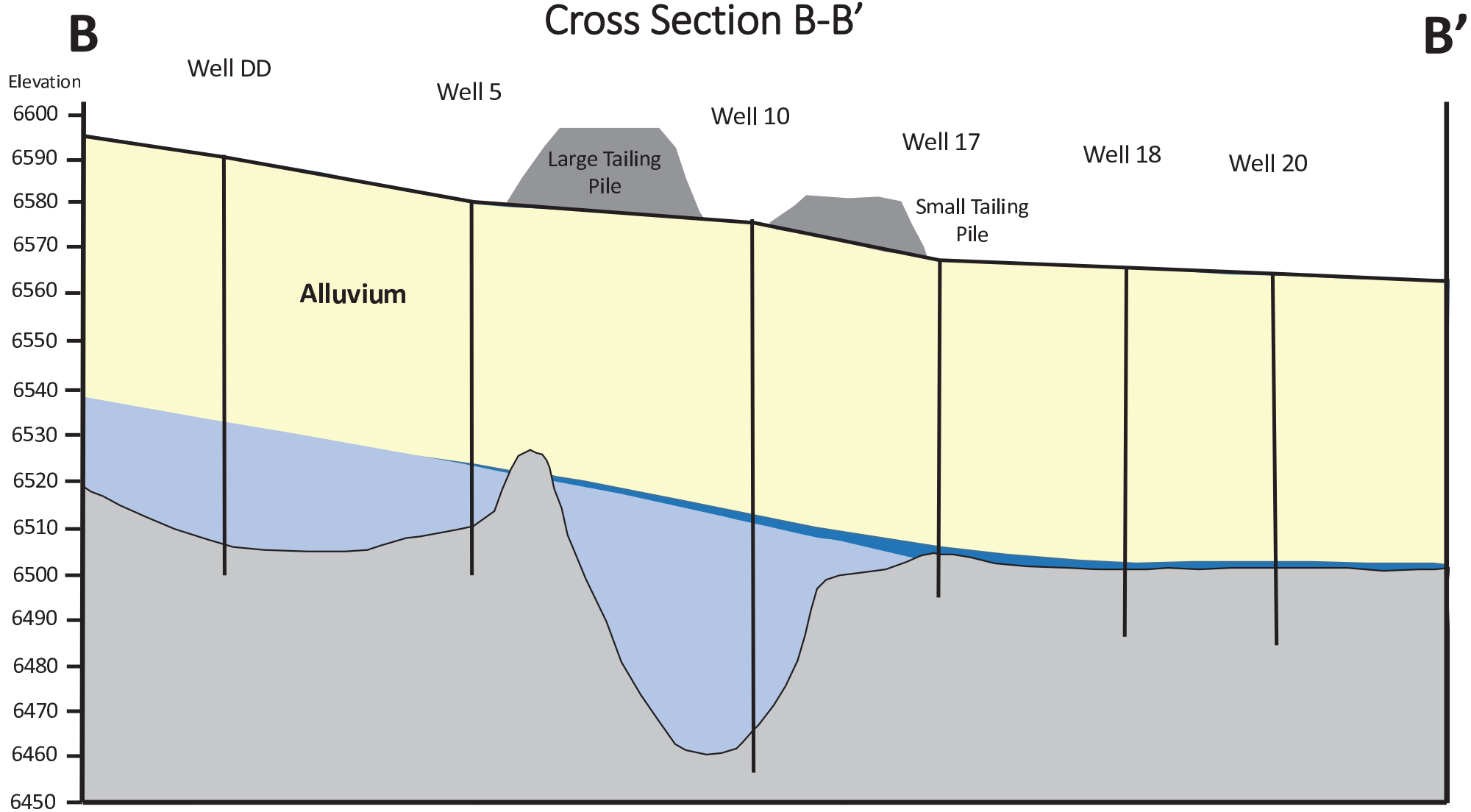
Water Level Contour

Unsaturated Alluvium over Chinle Subcrop

Historical High Uranium Levels In Alluvial Ground Water Since 1976

Draft – For Discussion Purposes Only

Cross Section B-B'



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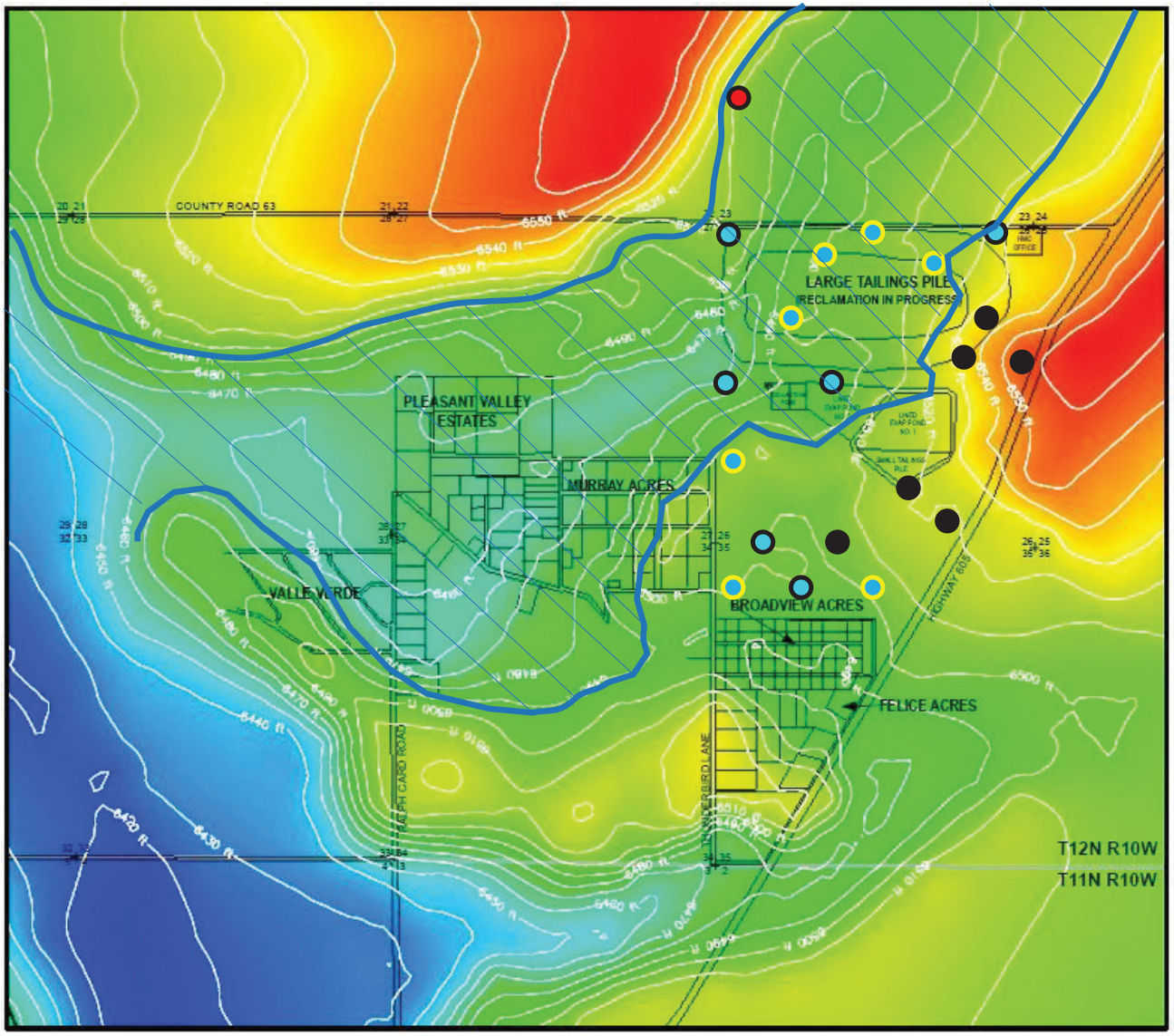
ESTIMATED SATURATED ALLUVIUM BEFORE 1960 AND MILLING



- Water in Borehole
- Dry Borehole
- Potential Water in Borehole

6,570
6,550
6,530
6,510
6,490
6,470
6,450
6,430
6,410

BASE OF ALLUVIUM ELEVATION (FT-AMSL)

Modified From Homestake CAP

Draft – For Discussion Purposes Only

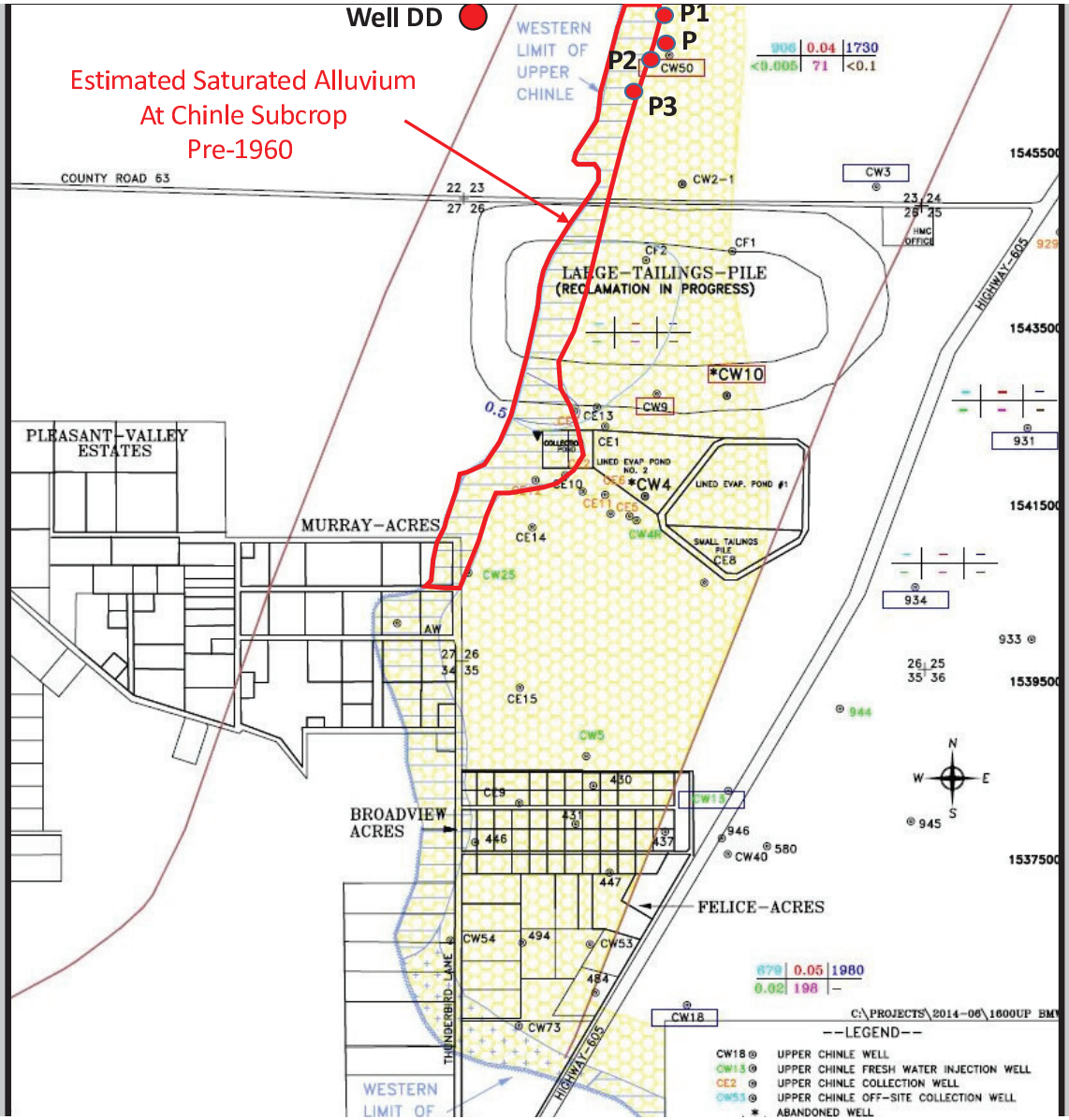
UPPER CHINLE

Mixing Zone wells

- CW-50 and CW-52 are in good locations
- CW-9 and CW-10 not in best locations but water appears to be of better quality

Non-Mixing Zone Wells

- 931 and 934 are in good locations
- Why are Uranium levels in CW-3, CW-13 and CW-18 so high?



Map from Homestake 2013 Annual Report

UPPER CHINLE

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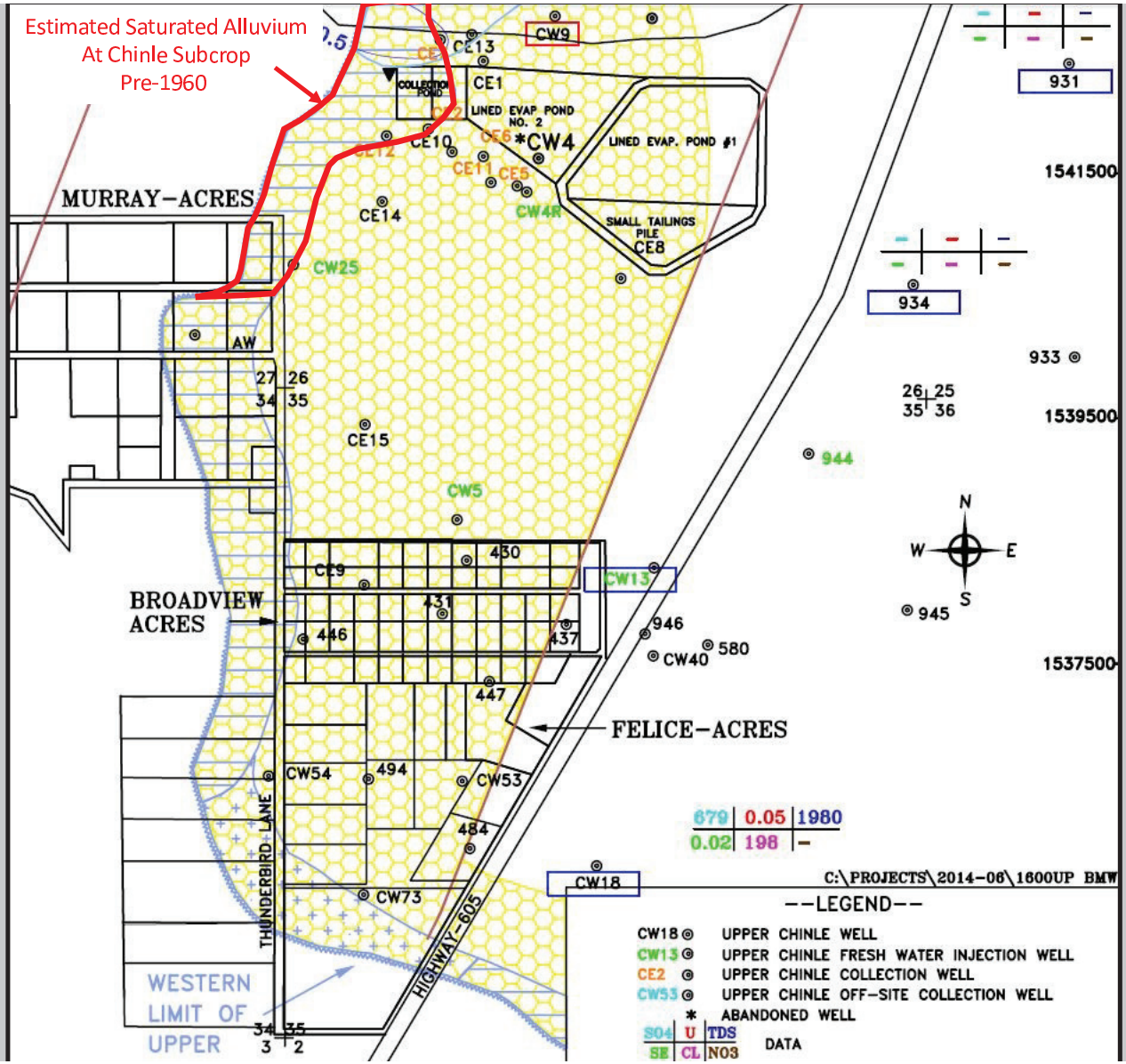
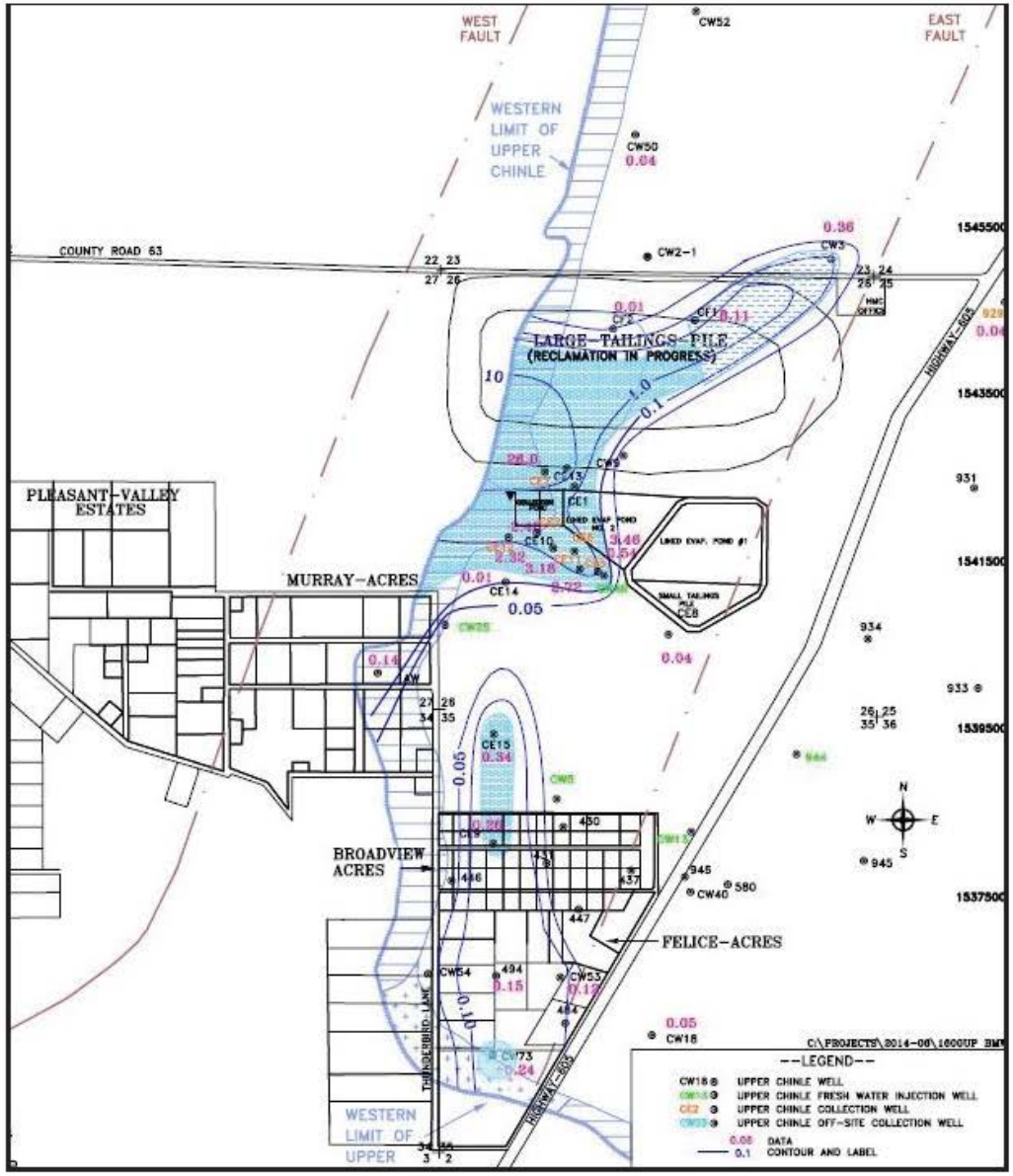


URANIUM ISOCONCENTRATION CONTOUR MAP

Upper Chinle

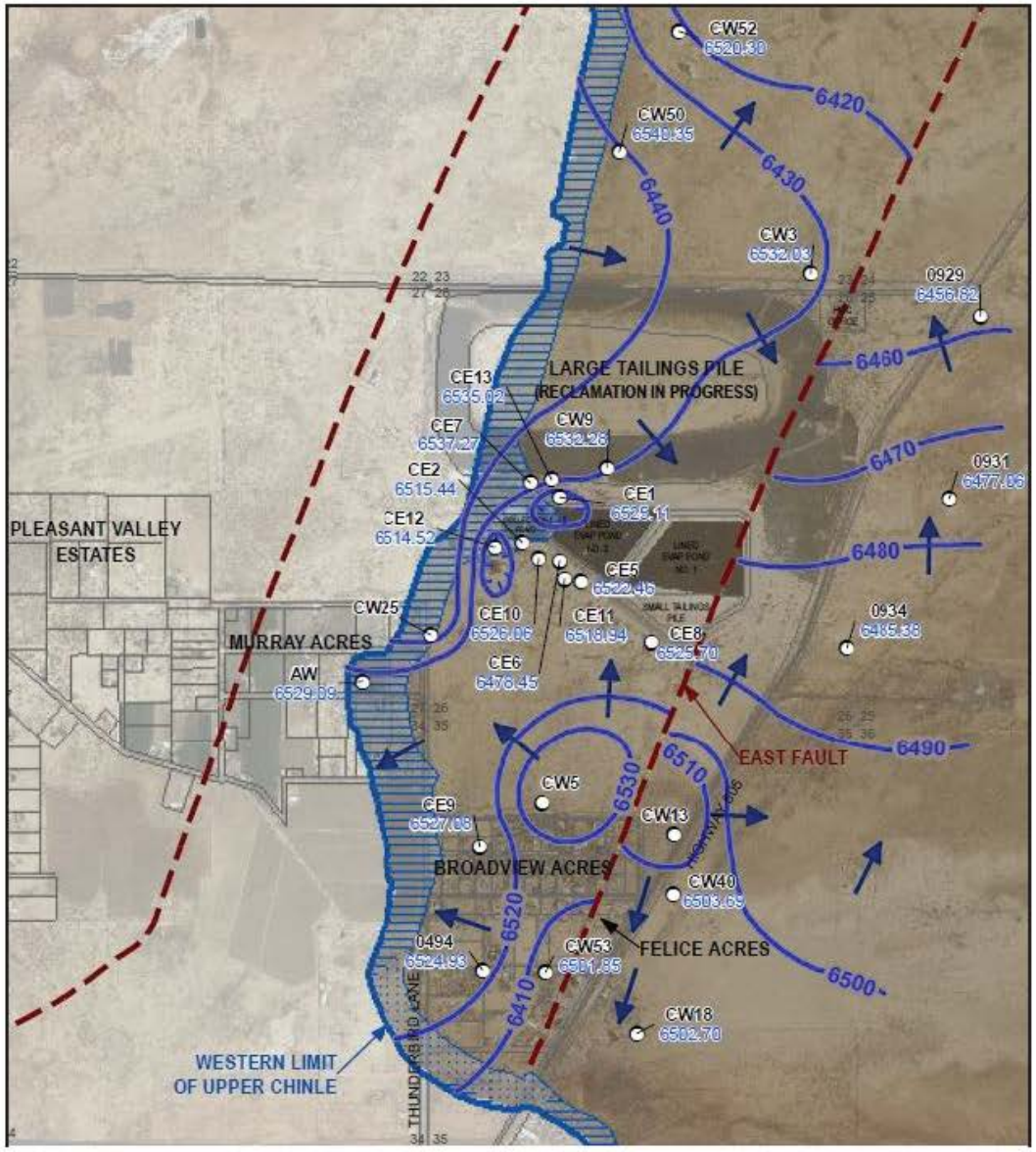
Homestake 2013 Annual Report



GROUND WATER FLOW DIRECTION

Upper Chinle

Homestake CAP



UPPER CHINLE BACKGROUND WELL DATA

	Well	Uranium (ppb)	Selenium (ppb)	Molybdenum (ppb)	Sulfate (ppm)	TDS (ppm)
Cleanup Standards (MZ)		180	140	100	1750	3140
Mixing Zone	CW-50*	41-42	<5-7	<30		
	CW-52*	9-41	17-28	<30		
	CW-9	<8.5-55	<10-25	<30-110		
	CW-10	12-50	<1-7	<10-20		
Cleanup Standards (NMZ)		90	60	100	914	2010
Non-Mixing Zone	CW-3	02-76	05-68	10-50	566-1,050	920-2,130
	CW-13	45-96	36-244	<30		
	CW-18	16-148	<10-129	<30-50		
	931	04-50 (144?)	05-30	10-110 (420)	608-779	1,290-2,160
	934	08-93 (361)	05-63	10-230	620-821	1,549-1,930

*Data from only two sampling events available

Data from Homestake 2003 Statistical Evaluation Report

MIDDLE CHINLE

Mixing Zone Wells

- CW-15, CW-17, CW-24, CW-35, WR25 - Reasonable

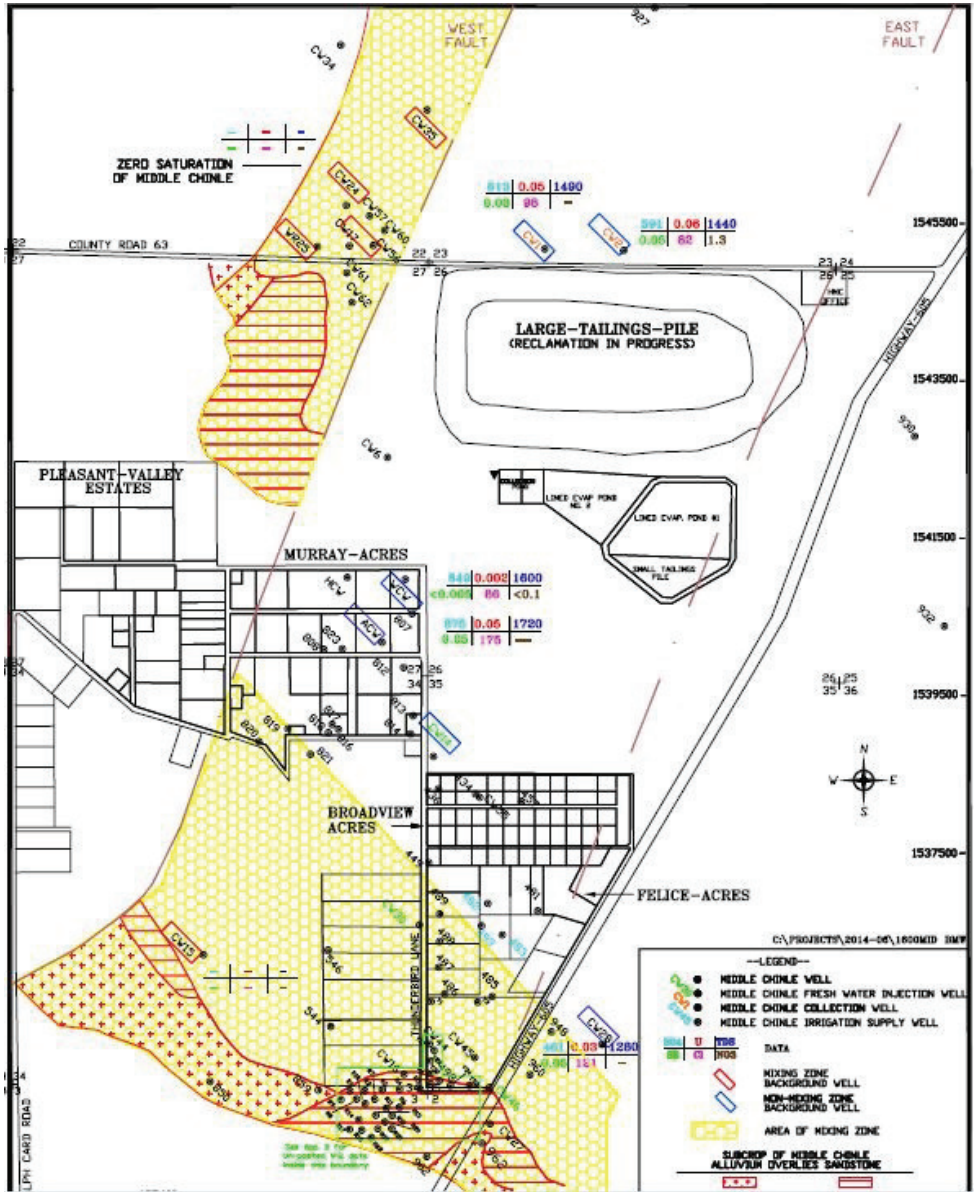
Non- Mixing Zone Wells

- CW1, CW2 CW-28, ACW, WCW - Reasonable
- CW-14 appears impacted by Se

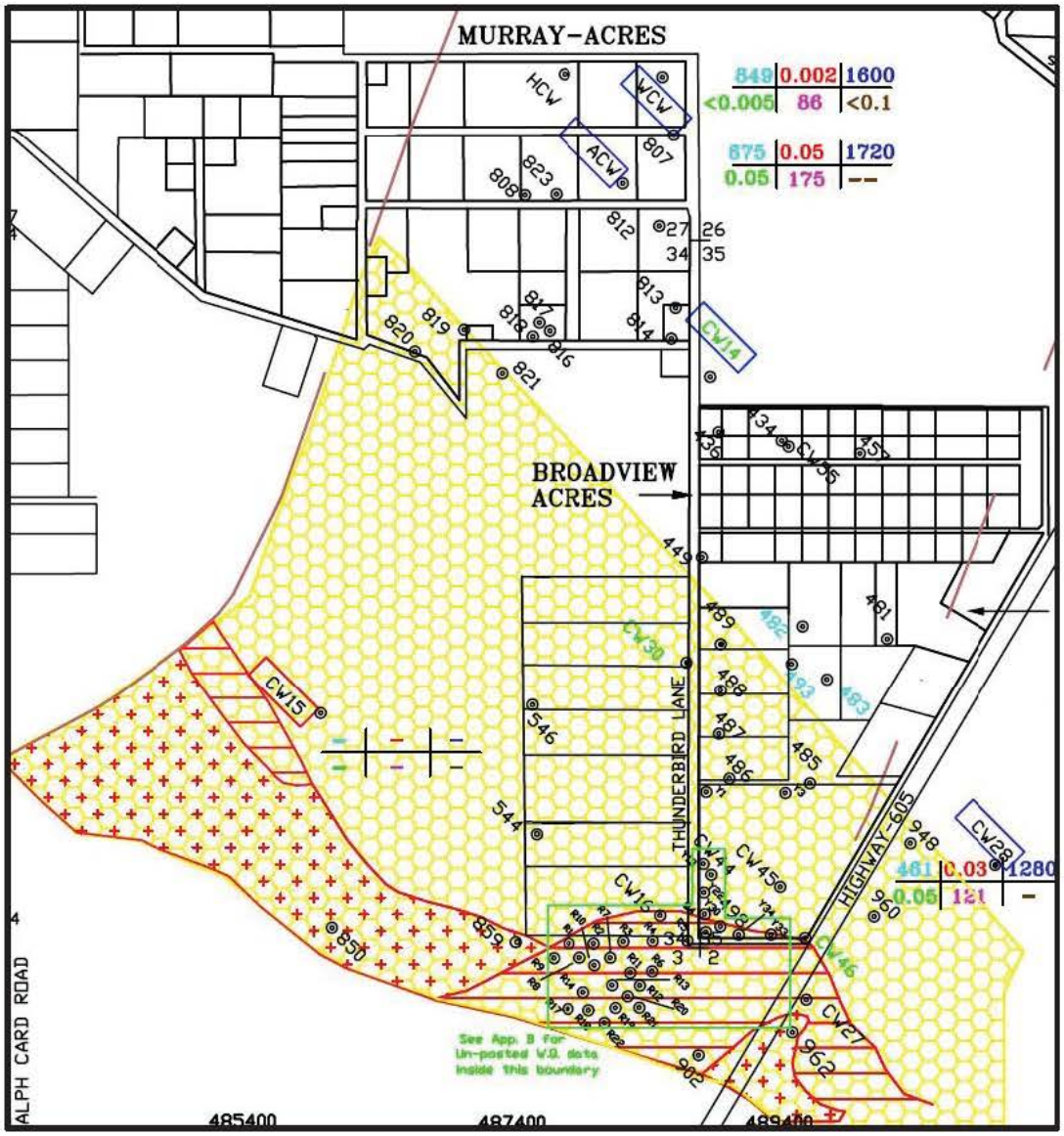
- Why not use 930 or 932 for background?

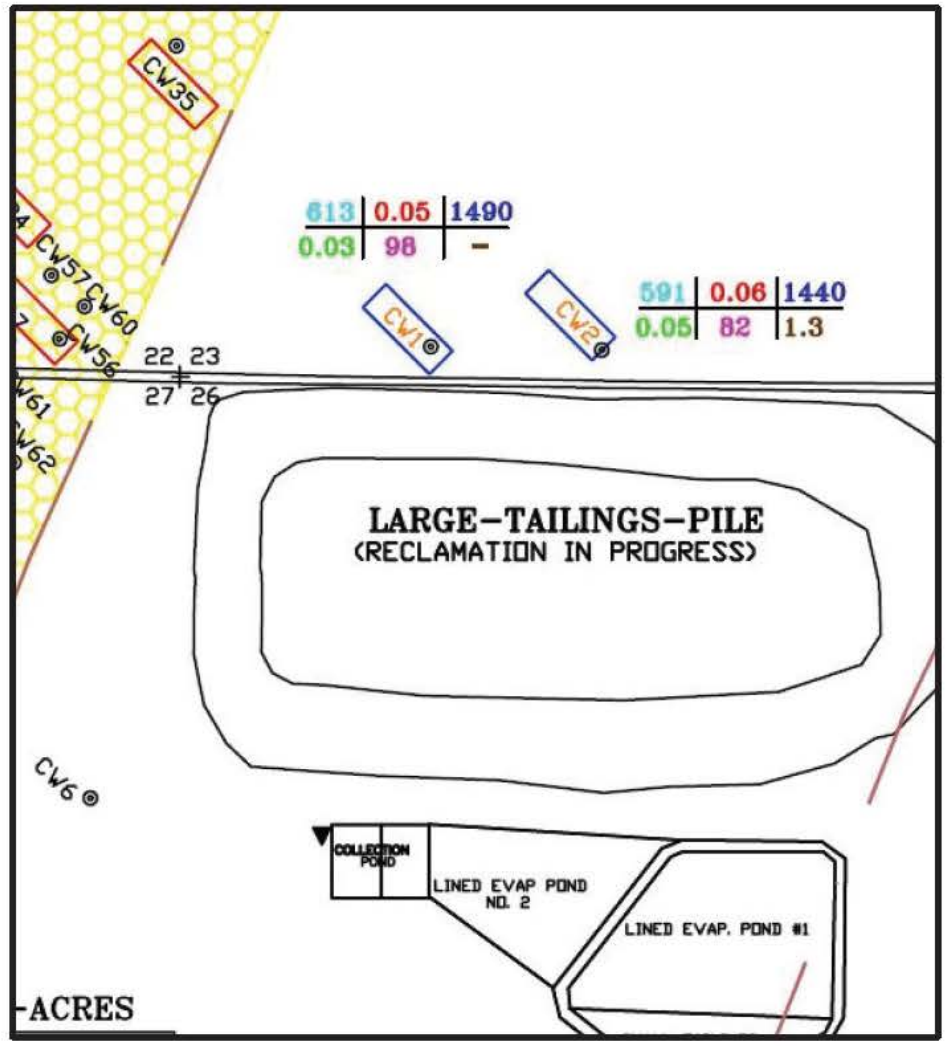
Data Availability

- CW-1 and CW-2 – 1982-2003
- CW-14- 3 samples from 1995
- CW-28 – 1995-2003
- WCW- 1980-2000



Map from Homestake 2013 Annual Report



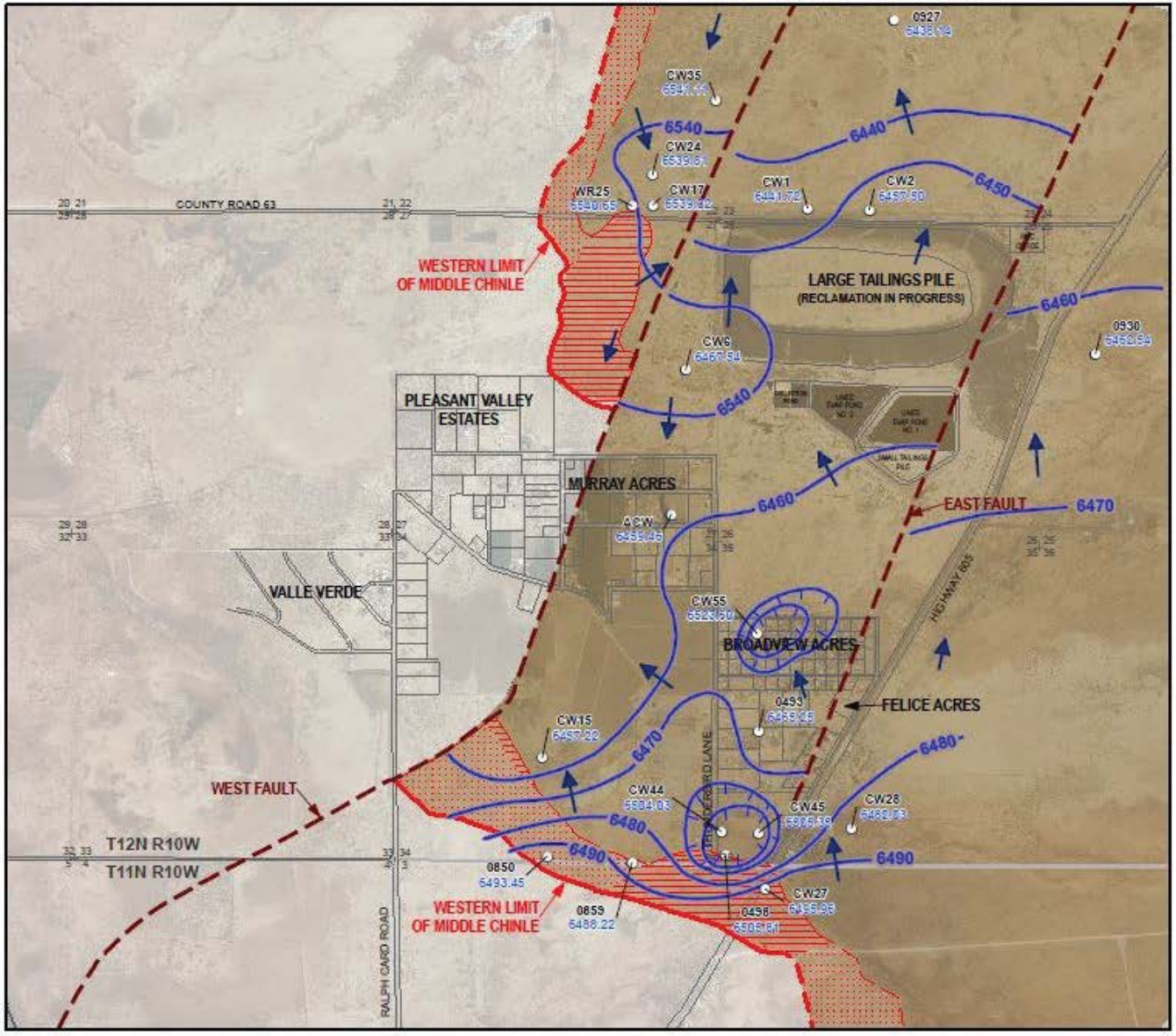


MIDDLE CHINLE

MIDDLE CHINLE BACKGROUND WELL DATA

Data from Homestake 2013 Statistical Evaluation Report

	Well	Uranium	Selenium	Molybdenum	Sulfate	TDS	
Cleanup Standards (MZ)		180	140	100	1750	3140	
Mixing Zone	CW-15	15-50	11-42	<30		1446-1710	C/E Block
	CW-17	69-175	69-116	<30-70		1620-3250	Western Block
	CW-24	101-154	34-79	<30-40		3020-3160	
	CW-35	141-231	12-520	<30		1830-2370	
	WR-25						
Cleanup Standards (NMZ)		70	70	100	857	1560	
Non-Mixing Zone	CW-1	<8.5-62	11-90	<30-40		2020-2514	Central and Eastern Block
	CW-2	<8.5-69	<10-30	<10-50		860-2280	
	CW-28	11-61	16-83	<30-30		944-1410	
	ACW	<8.5-25	<10-10	<10-30		1172-1470	
	WCW	<8.5-33	<10-20	<10-30		1170-1980	
	CW-14	10-19	83-222	<30		1306-1486	



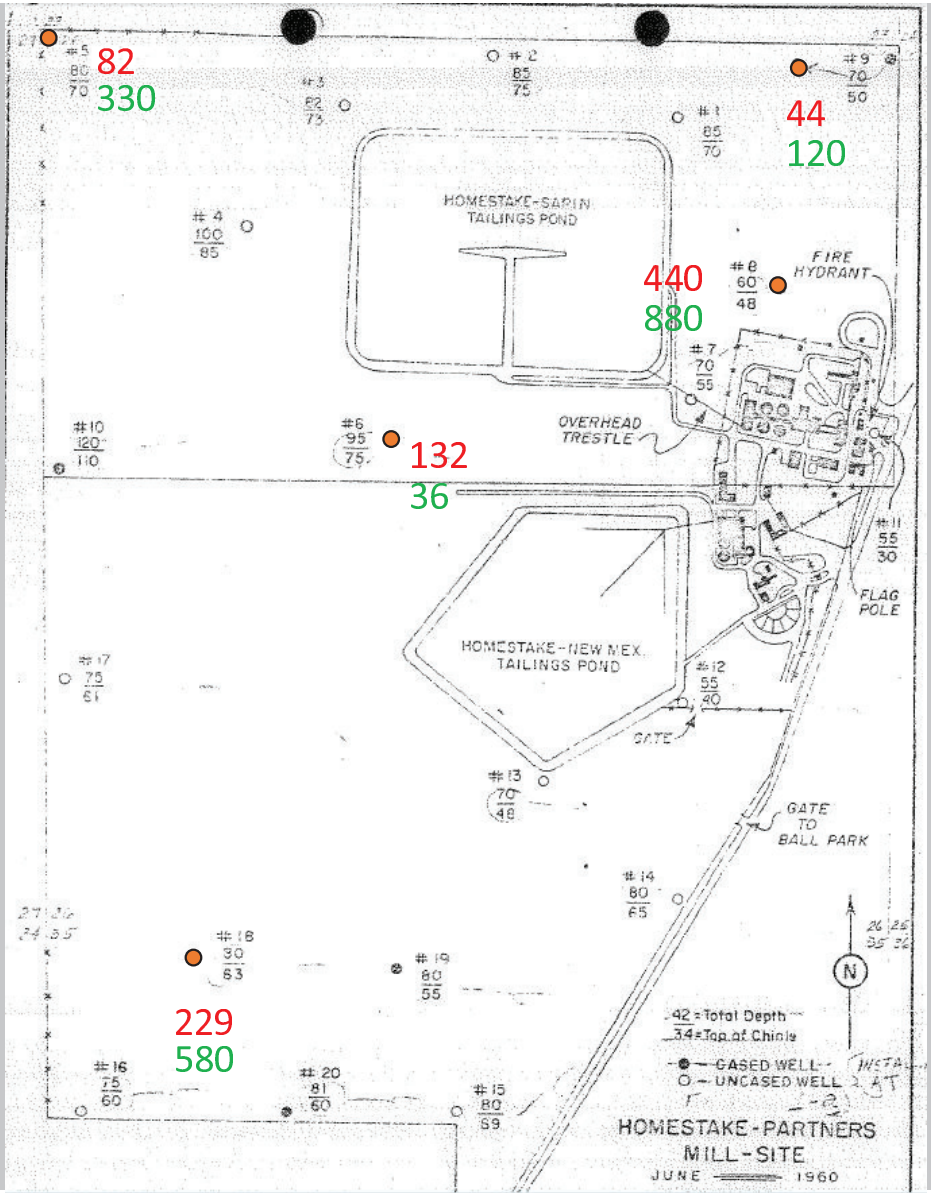
GROUND WATER FLOW MAP

Middle Chinle

Homestake CAP

Aquifer In West Fault Block Separated From Central And East Block

EXTRA SLIDES


82
330
44
120
440
880
132
36
229
580
HOMESTAKE-SARIN TAILINGS POND
HOMESTAKE-NEW MEX. TAILINGS POND
FIRE HYDRANT
OVERHEAD TRESTLE
FLAG POLE
GATE
GATE TO BALL PARK
42 = Total Depth
34 = Top of Chinle
GASED WELL
UNCASED WELL
HOMESTAKE-PARTNERS MILL-SITE
JUNE 1960

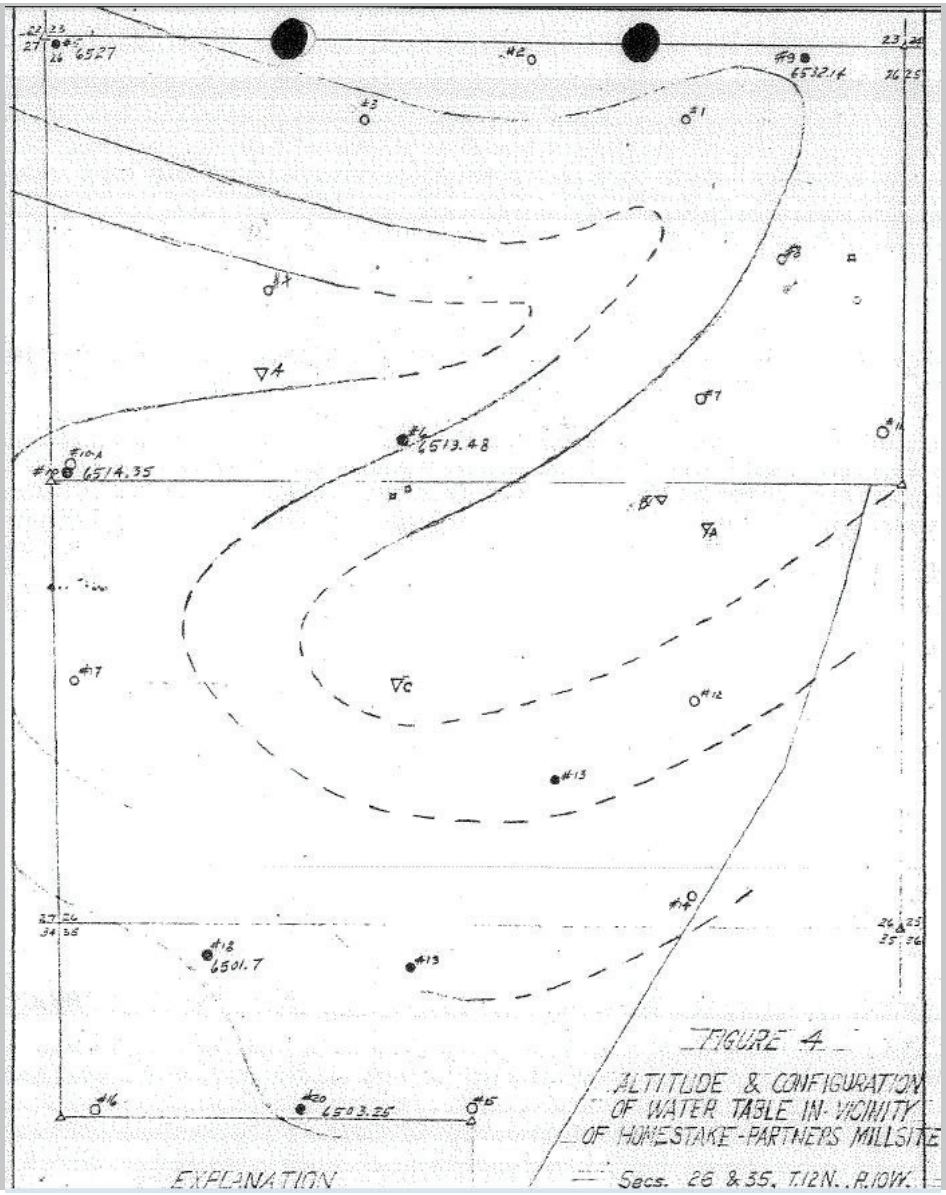


FIGURE 4
ALTITUDE & CONFIGURATION OF WATER TABLE IN VICINITY OF HOMESTAKE-PARTNERS MILLSITE
Secs. 26 & 35, T12N., R10W.
EXPLANATION

Water likely, Cavings Prevented Probing Bottom of Borehole

Water

Dry

10 Bore Hole No.

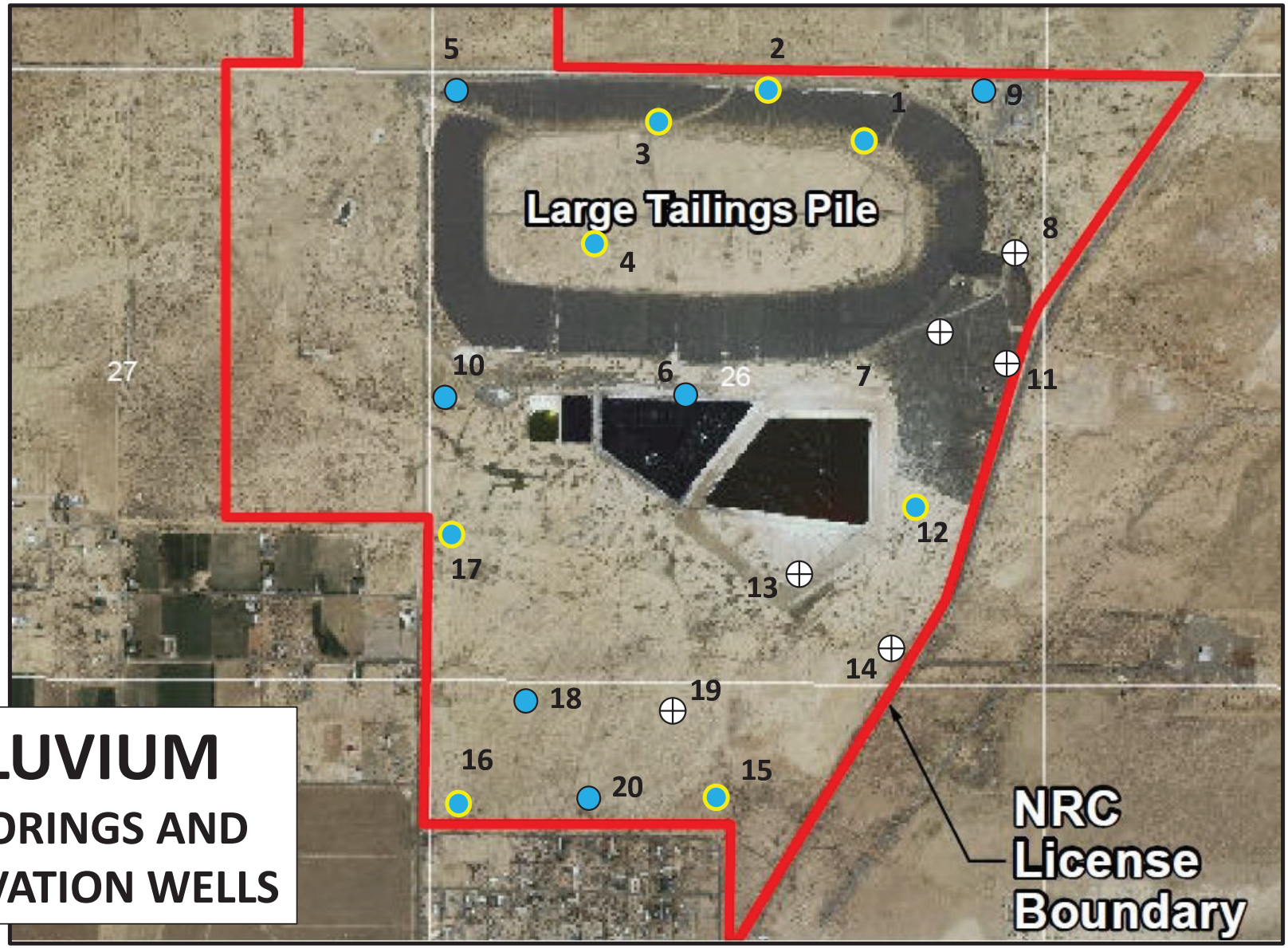


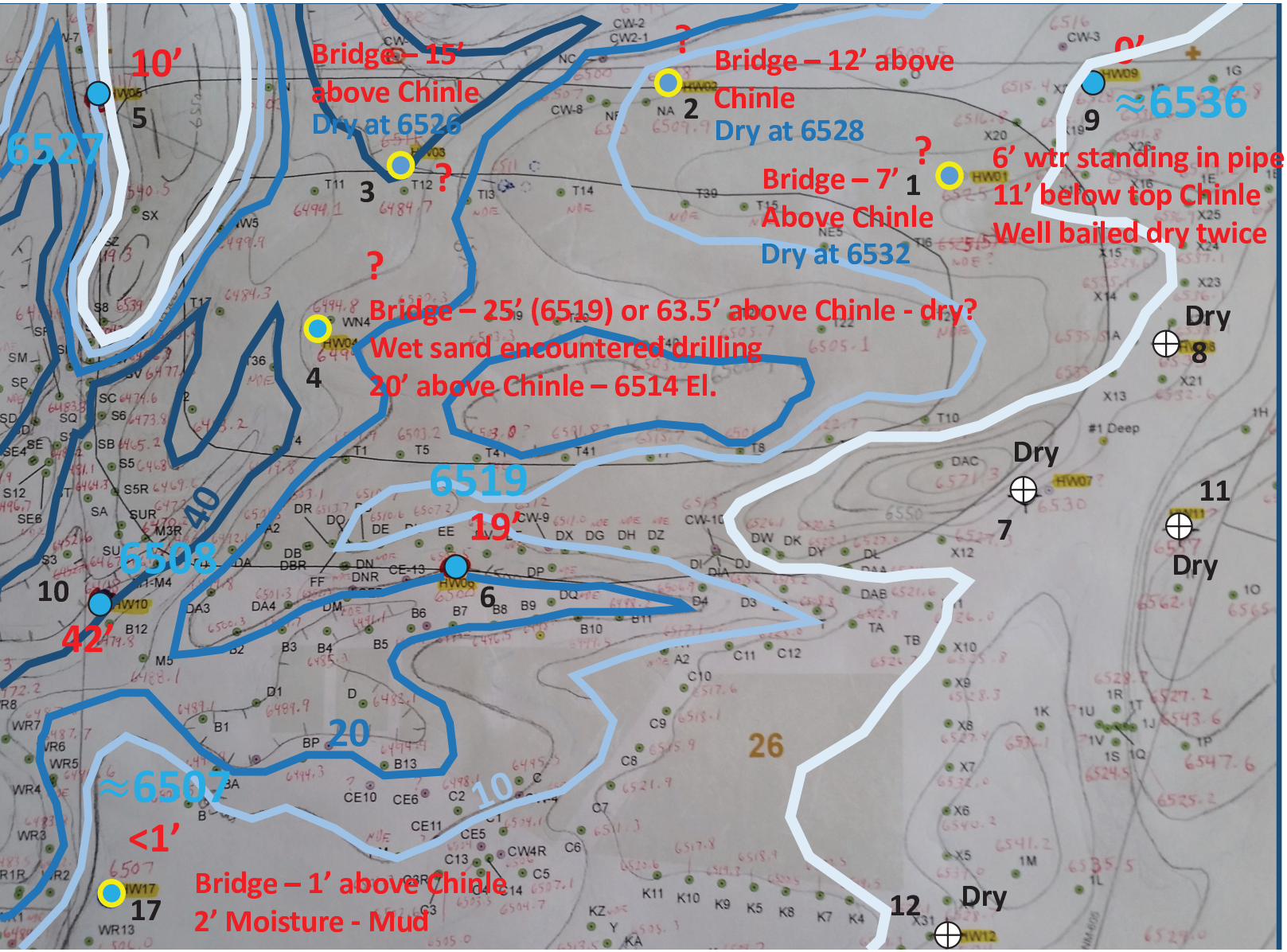
Figure Modified from Homestake CAP

ALLUVIUM
1960 BORINGS AND OBSERVATION WELLS

Estimated Potential Saturation Prior to Mill Tailing Disposal Operations

11	Well Number
42'	Saturation Thickness
6508	Water Elevation
	Water Level Contour
	Aquifer Boundary

Base of Alluvium Structure Contour and Ground Water Flow Map



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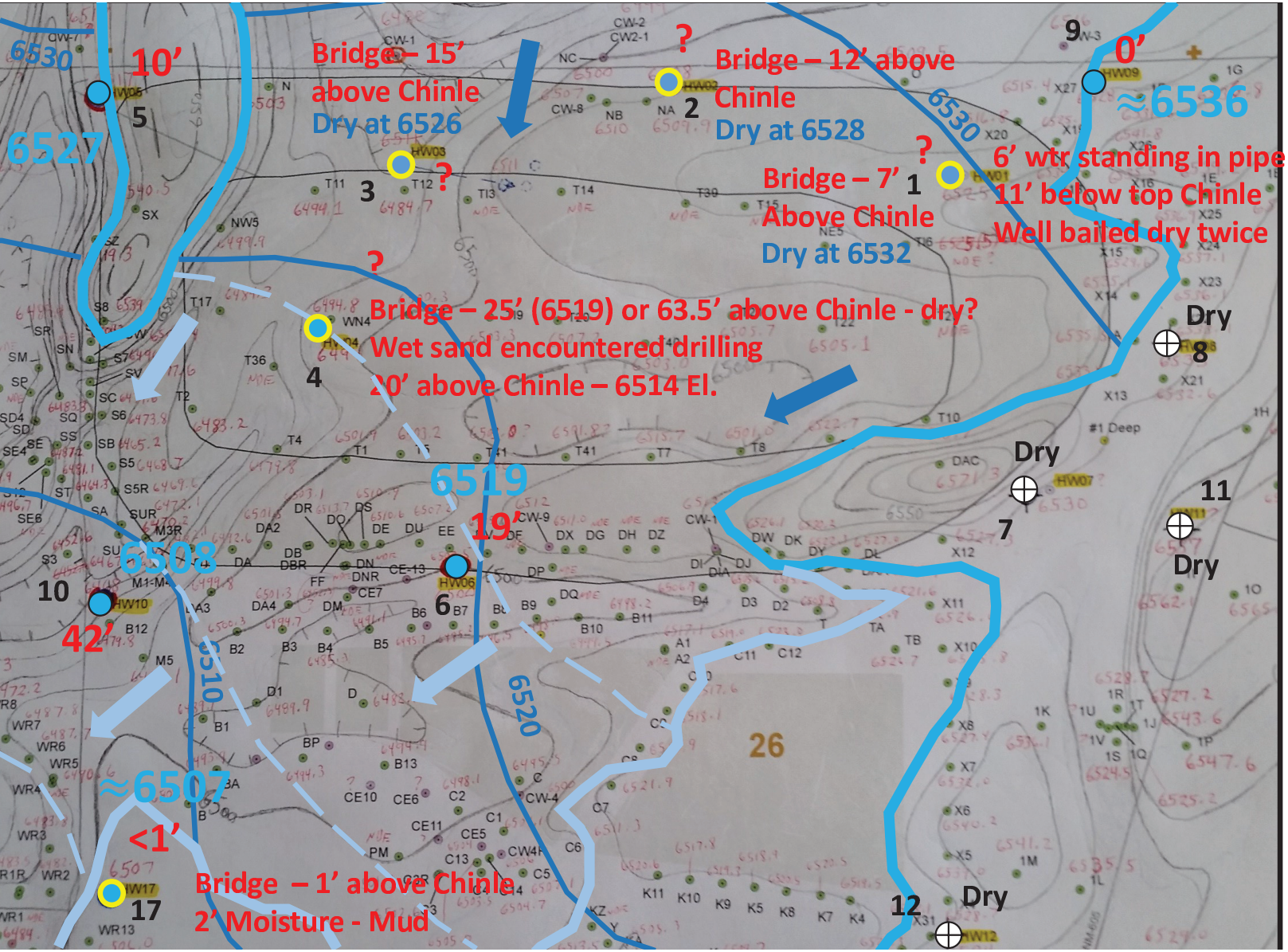
Base of Alluvium Structure Contour Map



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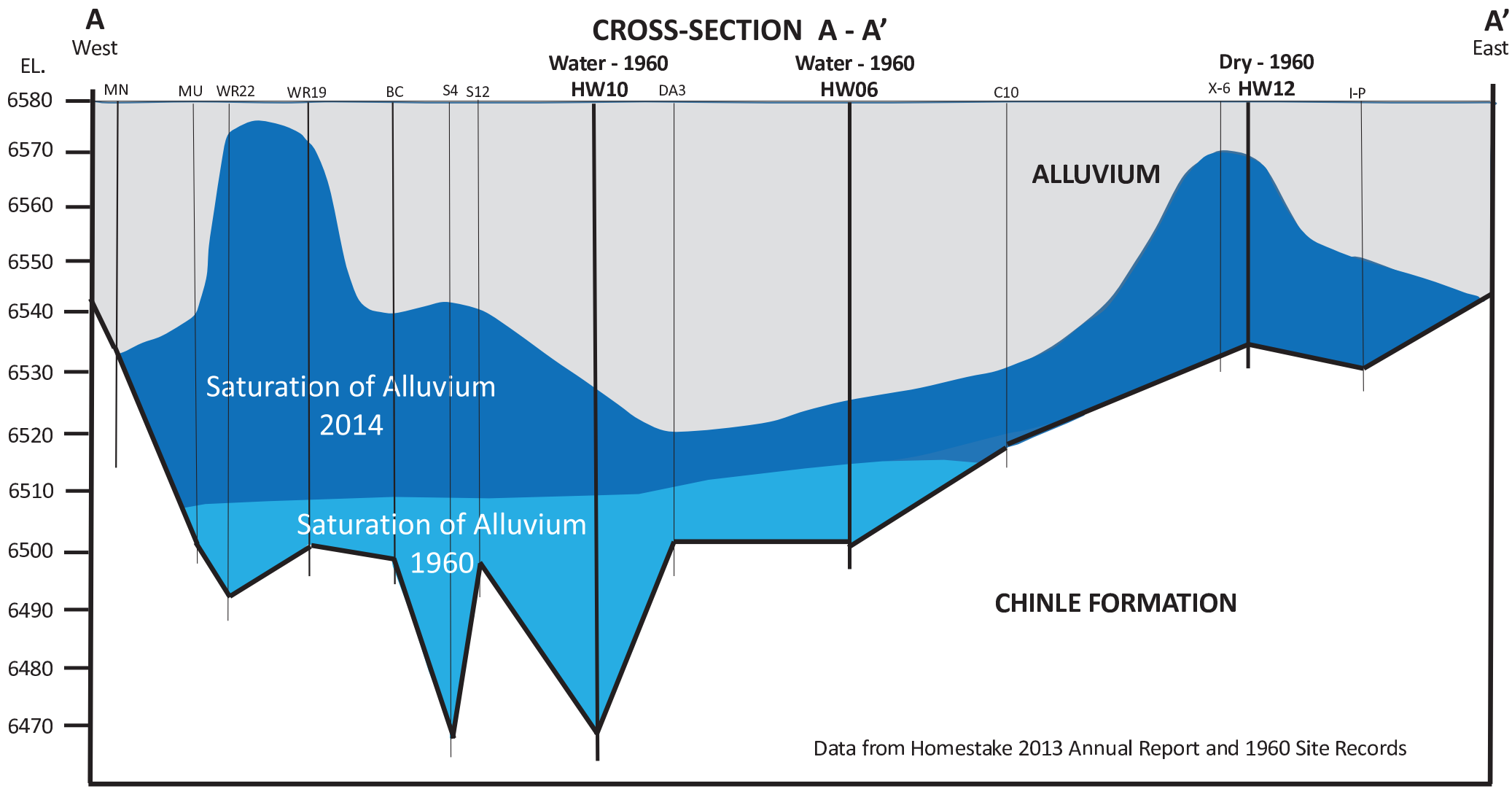
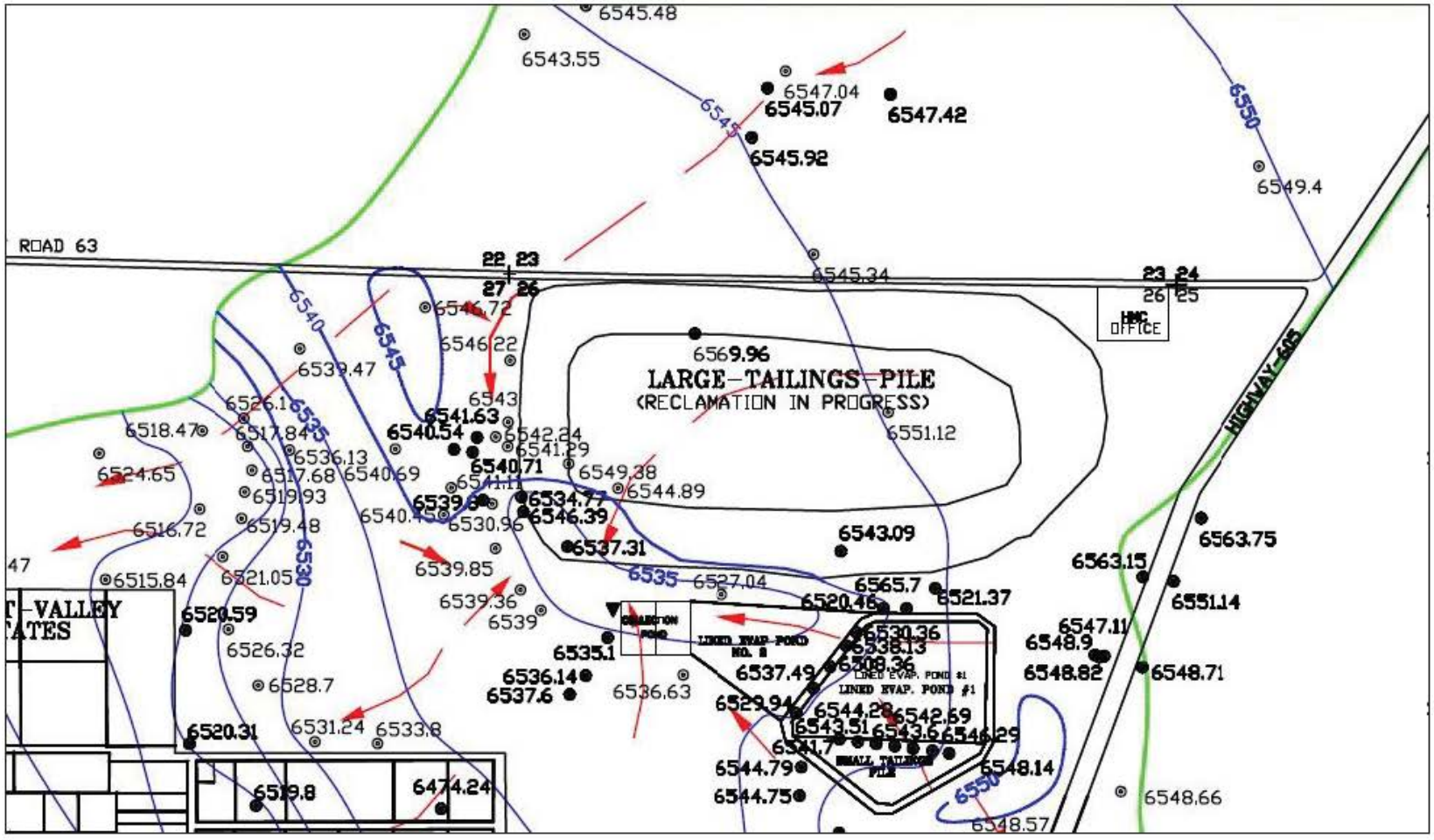


HOMESTAKE MINING COMPANY NPL SITE

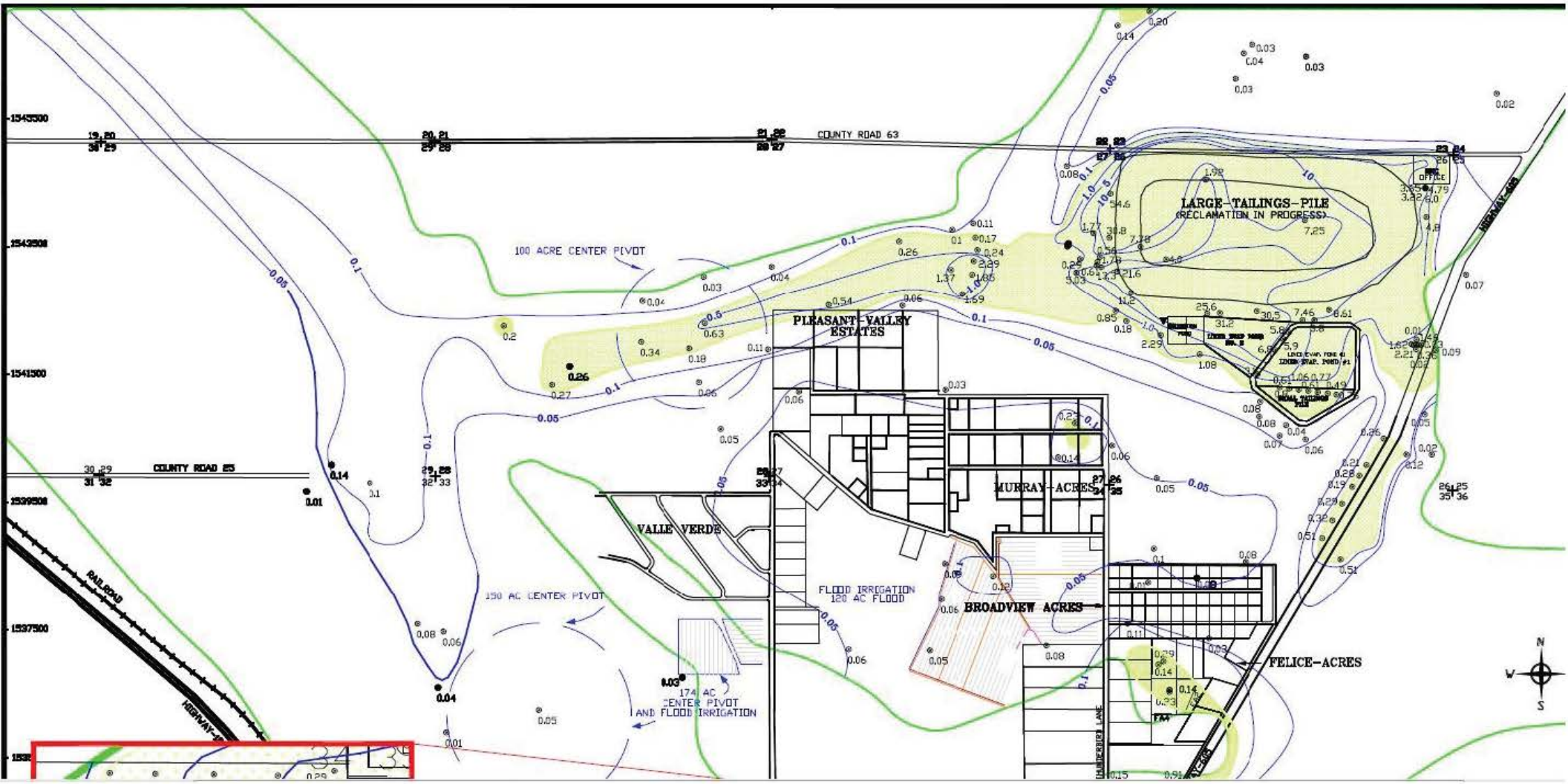
ALLUVIUM POTENTIOMETRIC SURFACE MAP

Homestake 2013 Annual Report



URANIUM CONCENTRATIONS – ALLUVIAL AQUIFER

Homestake 2013 Annual Report



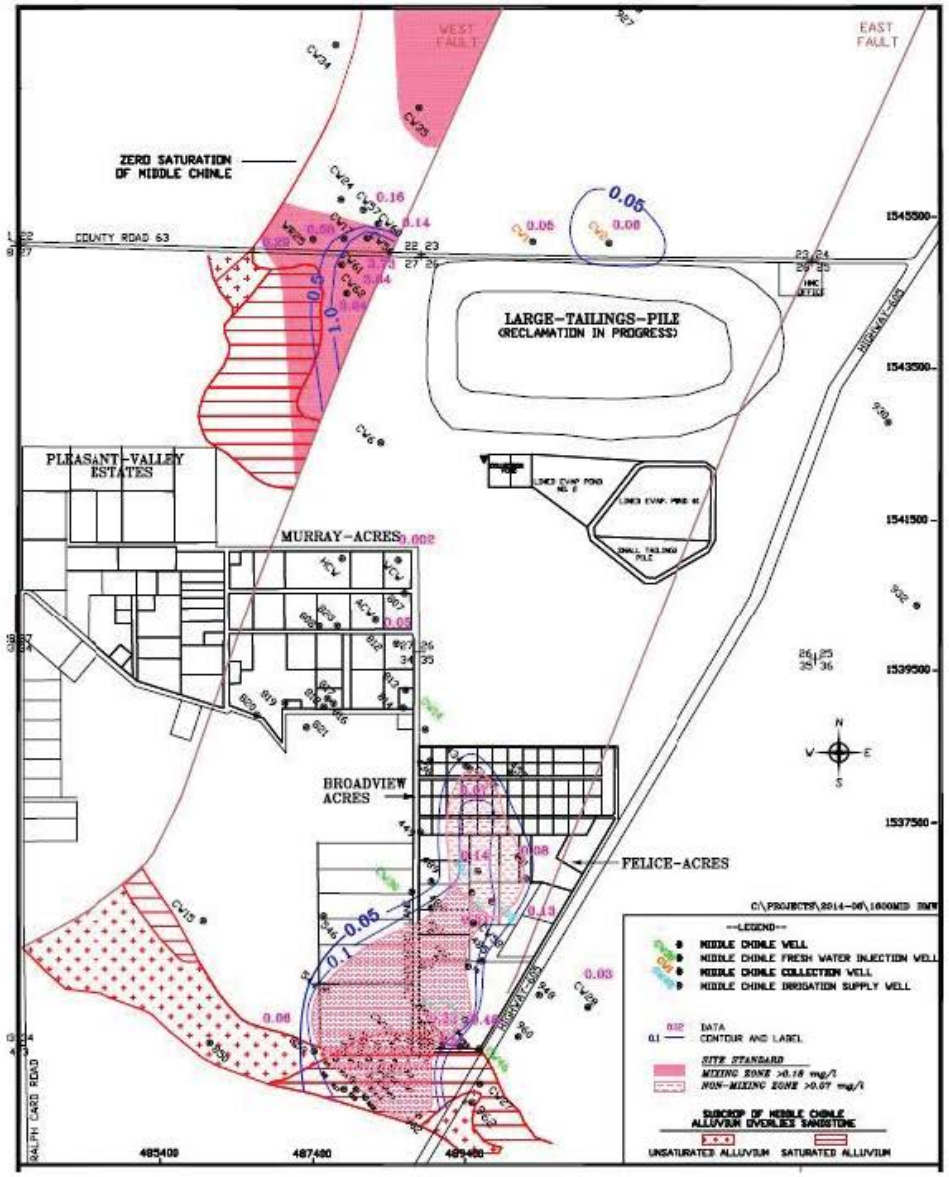
CHINLE AQUIFERS

BACKGROUND WATER QUALITY ASSESSMENT

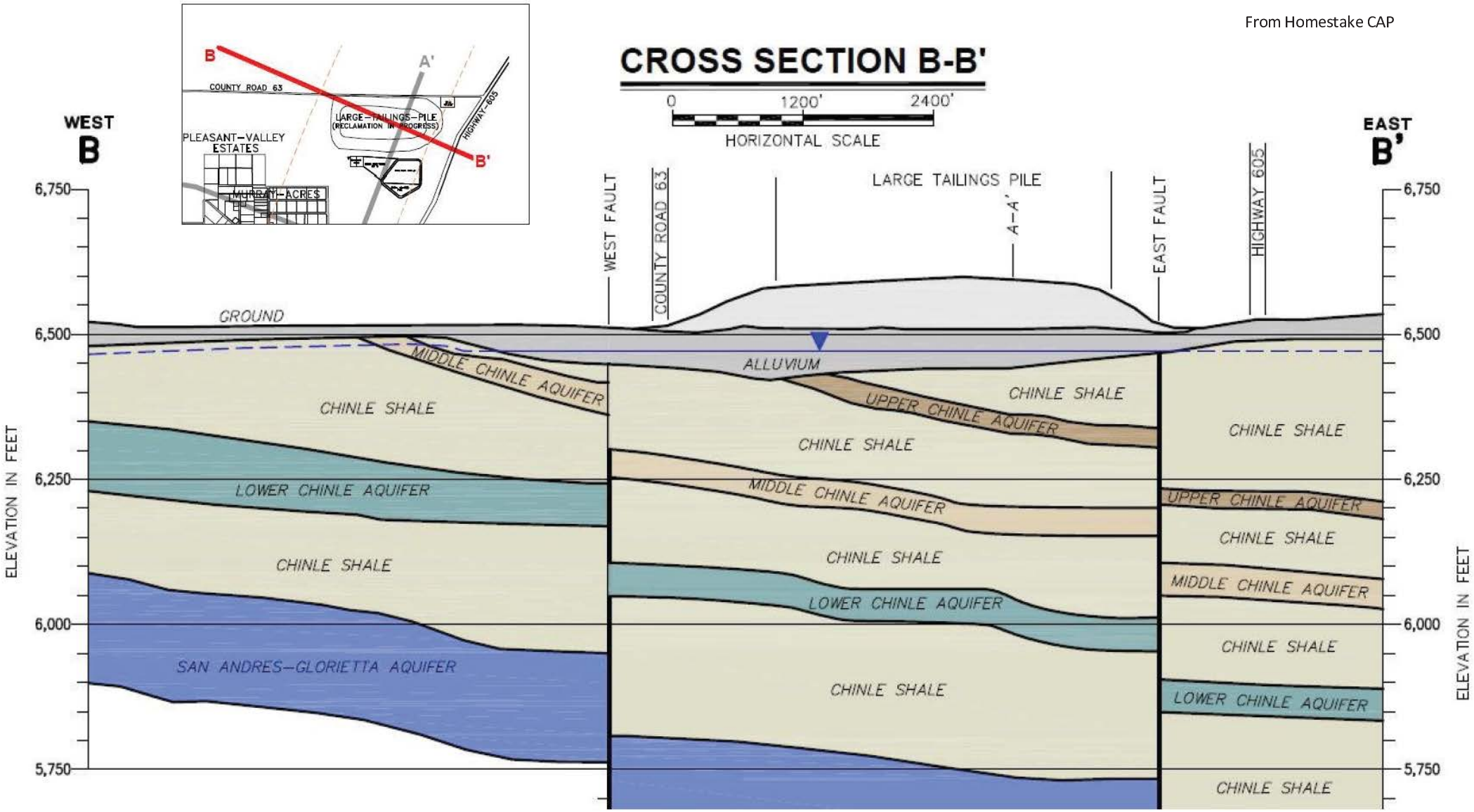
URANIUM CONCENTRATION MAP

Middle Chinle

Homestake 2013 Annual Report



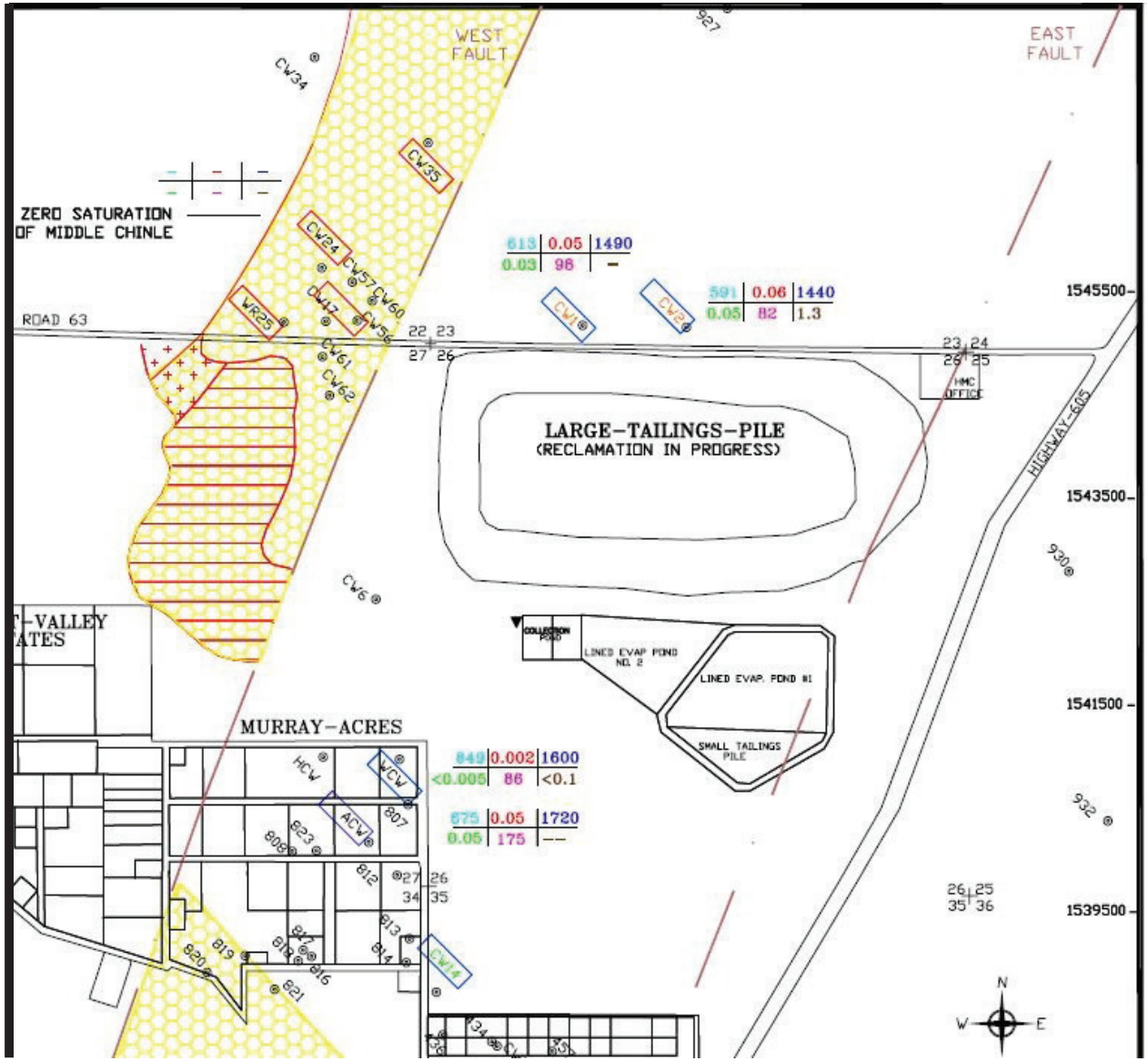
From Homestake CAP



MIDDLE CHINLE

Other Issues for Mixing Zone

- No Non-Mixing Zone water quality west of West Fault?
- Downgradient Extent of Mixing Zone west of West Fault not delineated?



Map from Homestake 2013 Annual Report

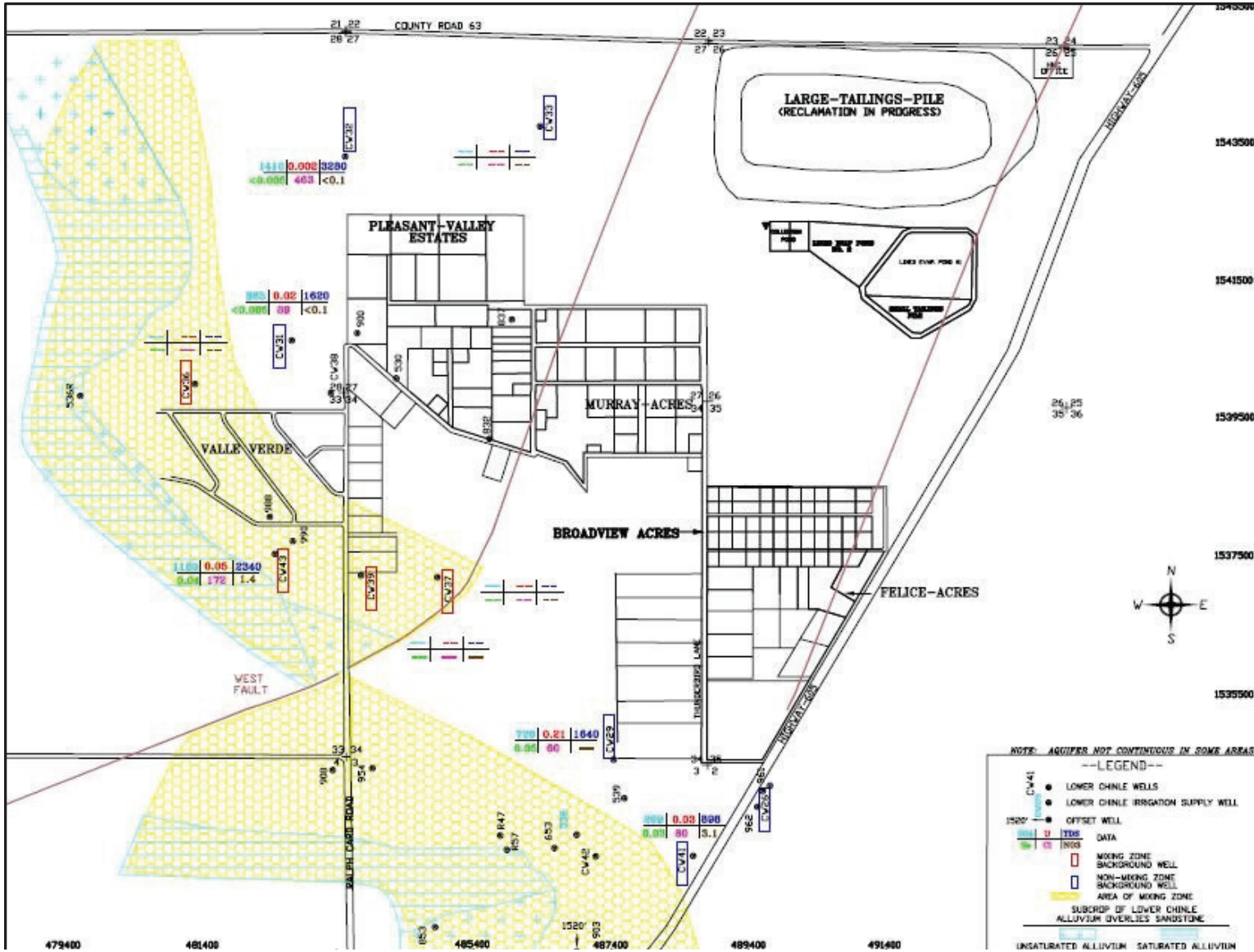
LOWER CHINLE

Mixing Zone Wells
- CW-26, CW-29, CW-31, CW-32, CW-33, CW-41
- Background levels seem high

Non-Mixing Zone Wells
- Selenium in C/E Blocks seems high for Non-Mixing Zone

- Water quality is better in private wells than in background monitor wells

Data Availability
- All Wells – 1995-2002 except CW-41
- CW-41-1996-1998



Map from Homestake 2013 Annual Report

LOWER CHINLE BACKGROUND WELL DATA

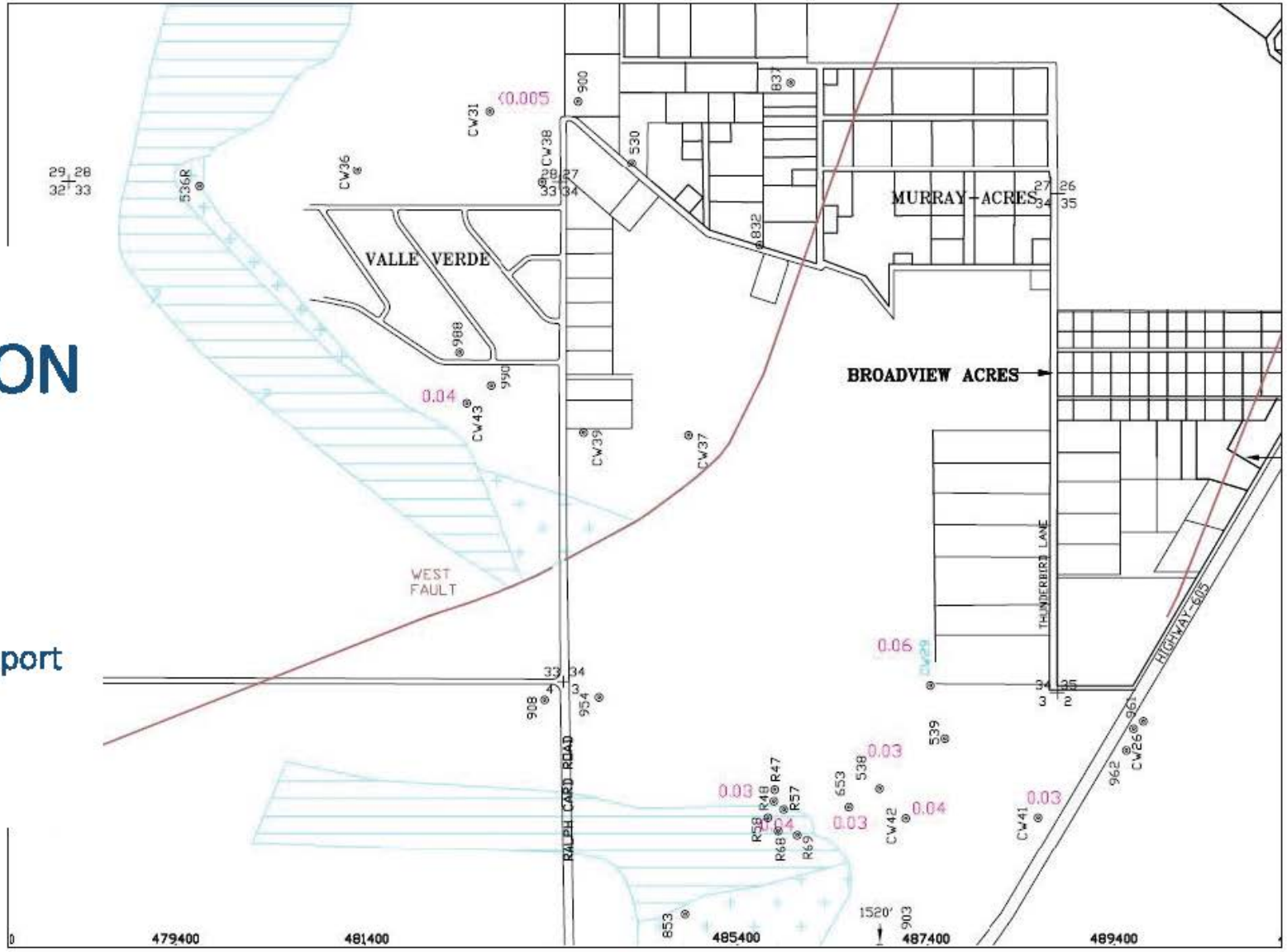
	Well	Uranium	Selenium	Molybdenum	Sulfate	TDS
Cleanup Standards (MZ)		180	140	100	1750	3140
Mixing Zone	CW-36	2-13	<5-35	<30		
	CW-37	24-32	75-96	<30		
	CW-39	17-45	31-85	<30		
	CW-43	21-33	9-25	<30		
Cleanup Standards (NMZ)		30	320	100	2000	4140
Non-Mixing Zone	CW-26	16-24	192-364	<30-120		
	CW-29	9-53	<14-155	<30		
	CW-31	6-16	<5	<30		
	CW-32	6-10	<10-2570	<30		
	CW-33	<10-26	<10-14	<30		
	CW-41	13-48	8-24	<30		

Data from Homestake 2003 Statistical Evaluation Report

SELENIUM CONCENTRATION MAP

Lower Chinle

Homestake 2013 Annual Report



LOWER CHINLE - PRIVATE WELL DATA

(select wells southeast of Felice Acres)

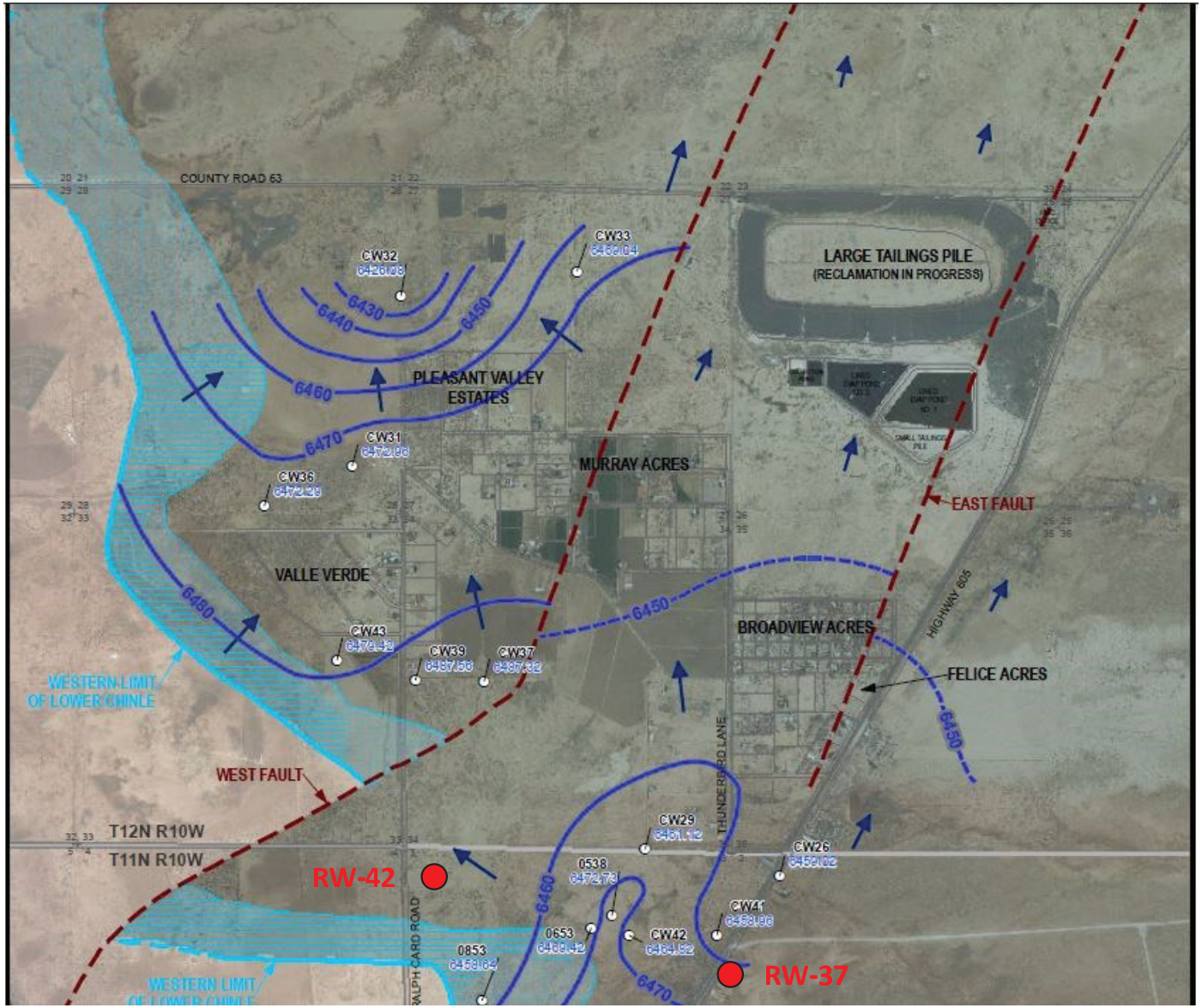
Well	Uranium (ppb)	Selenium (ppb)	TDS (ppm)
RW-37 (963)	15	12	700
RW-38 (572)	11	8	598
RW-42 (954)	6	2	934
RW-44 (574)	17	9	606
RW-47 (964)	16	11	658

Data from NMED Summary Report on 2005-2007 Residential Sampling

GROUND WATER FLOW MAP

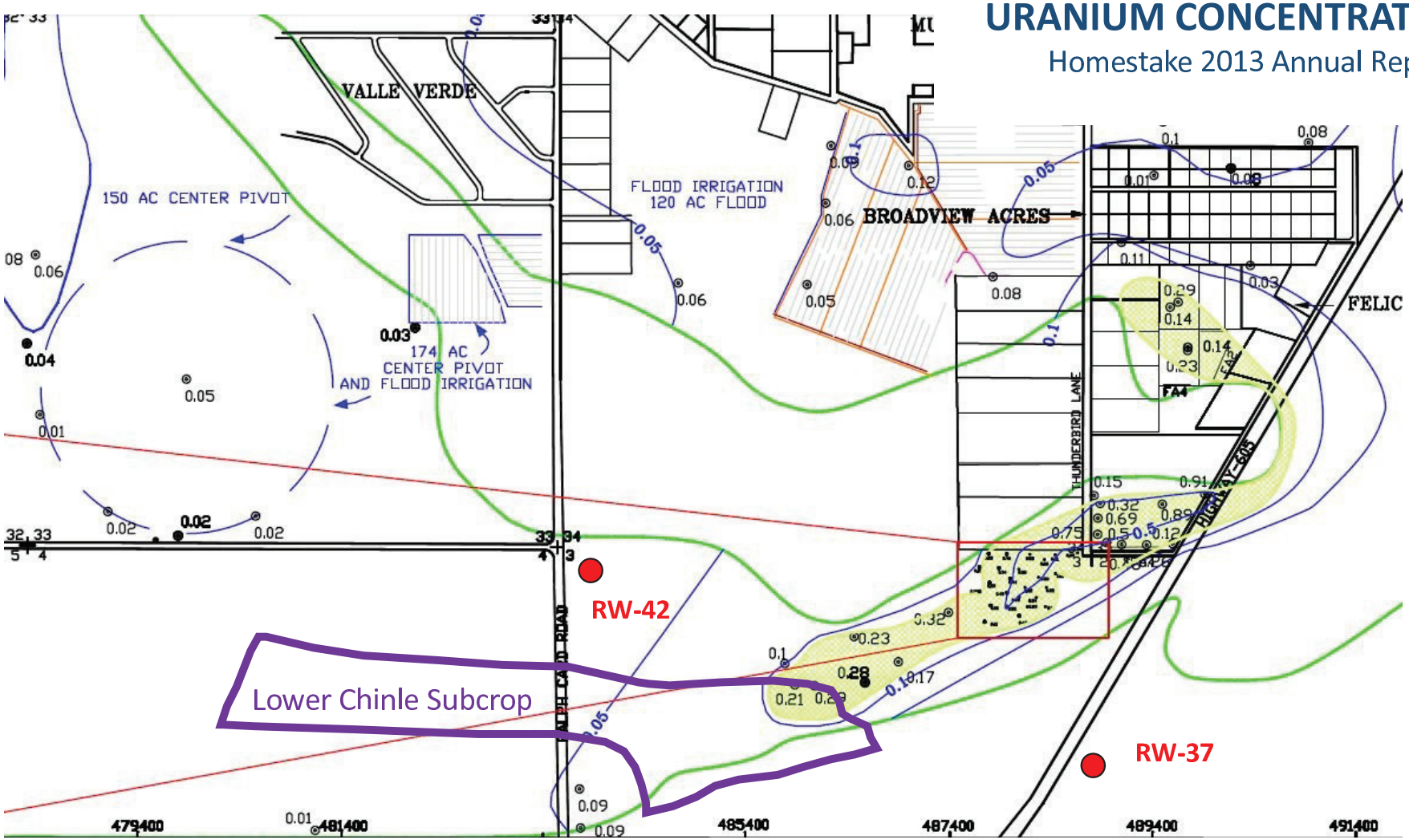
Lower Chinle

Homestake CAP



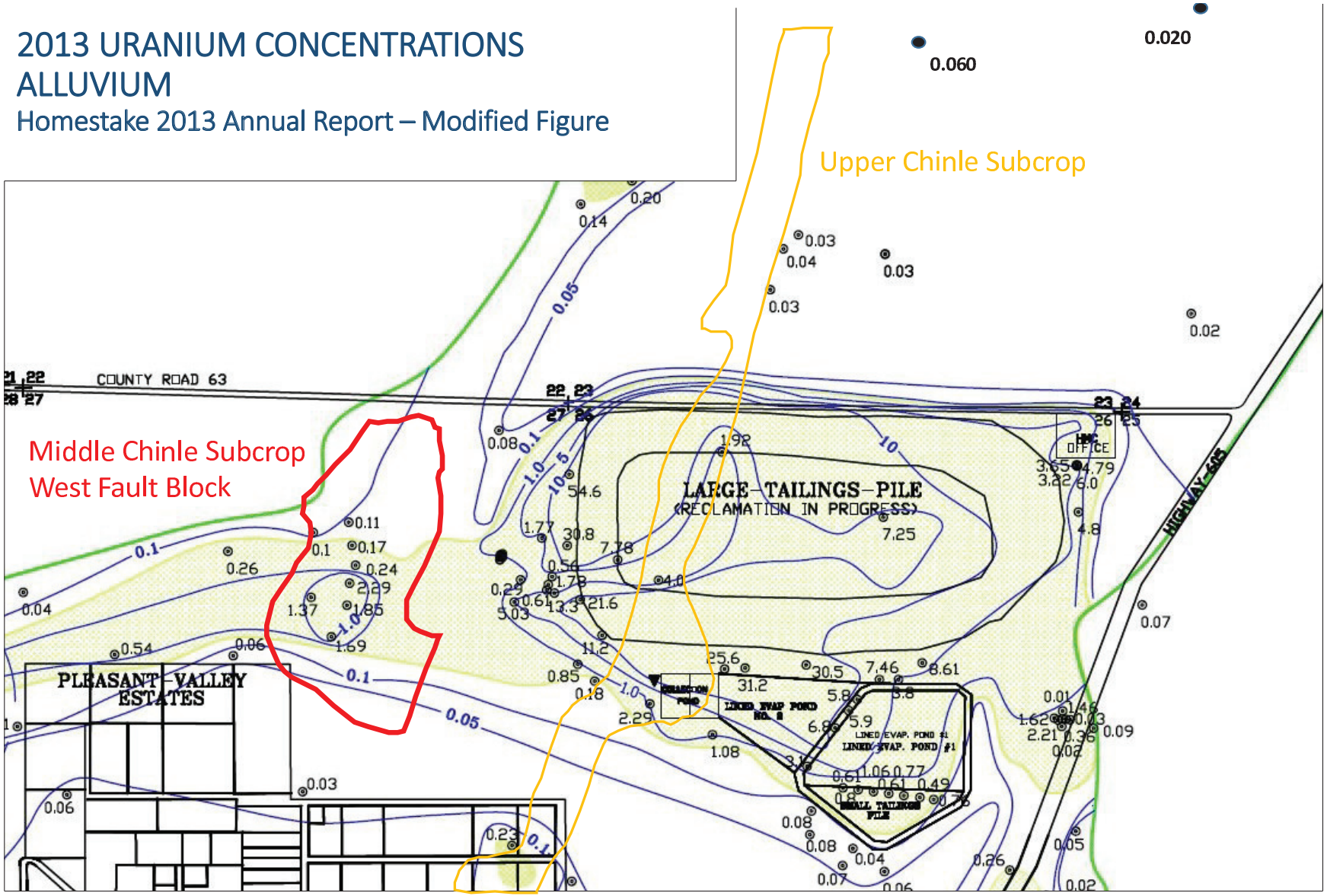
URANIUM CONCENTRATION MAP

Homestake 2013 Annual Report



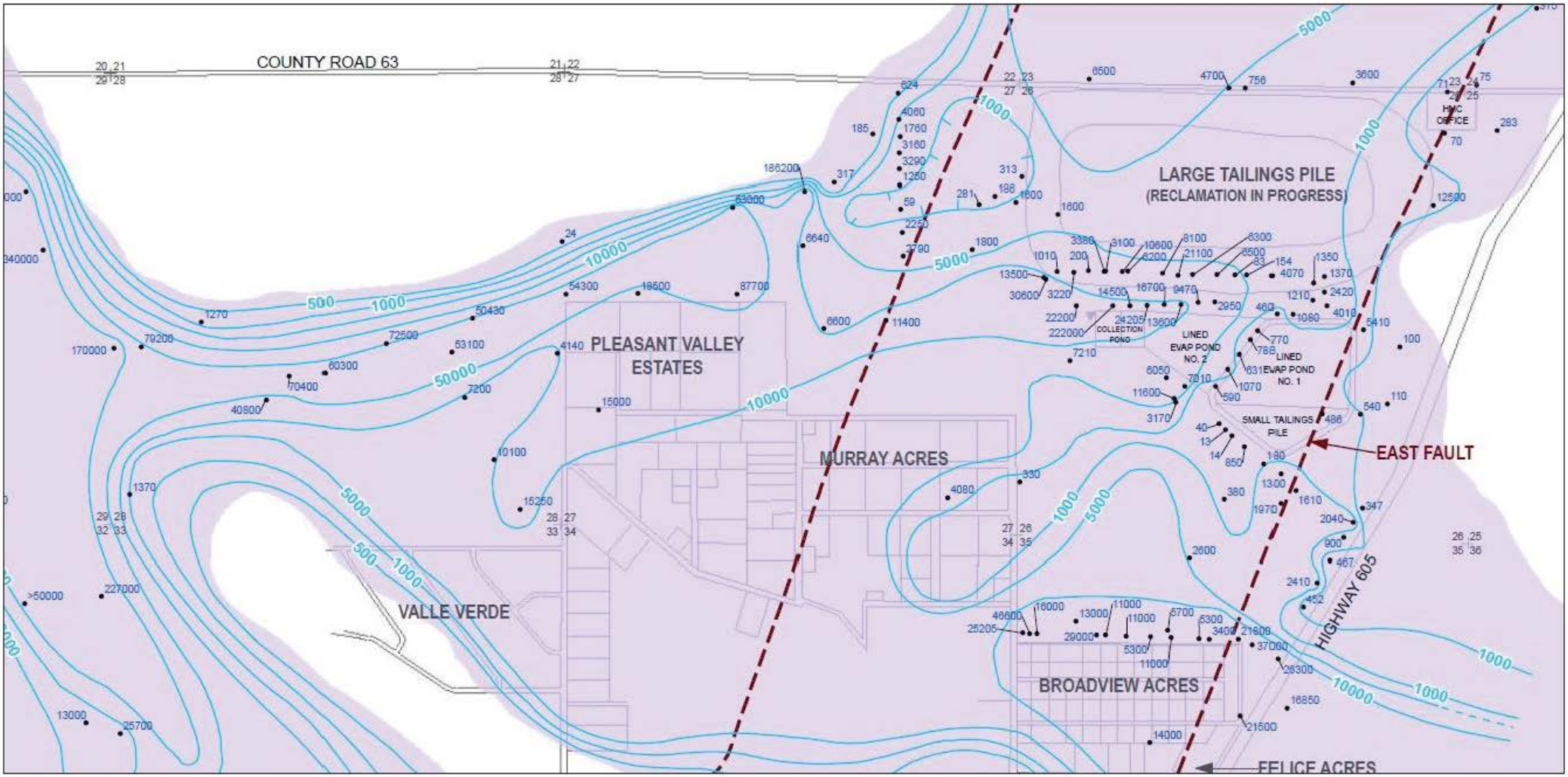
2013 URANIUM CONCENTRATIONS ALLUVIUM

Homestake 2013 Annual Report – Modified Figure



TRANSMISSIVITY – ALLUVIAL AQUIFER

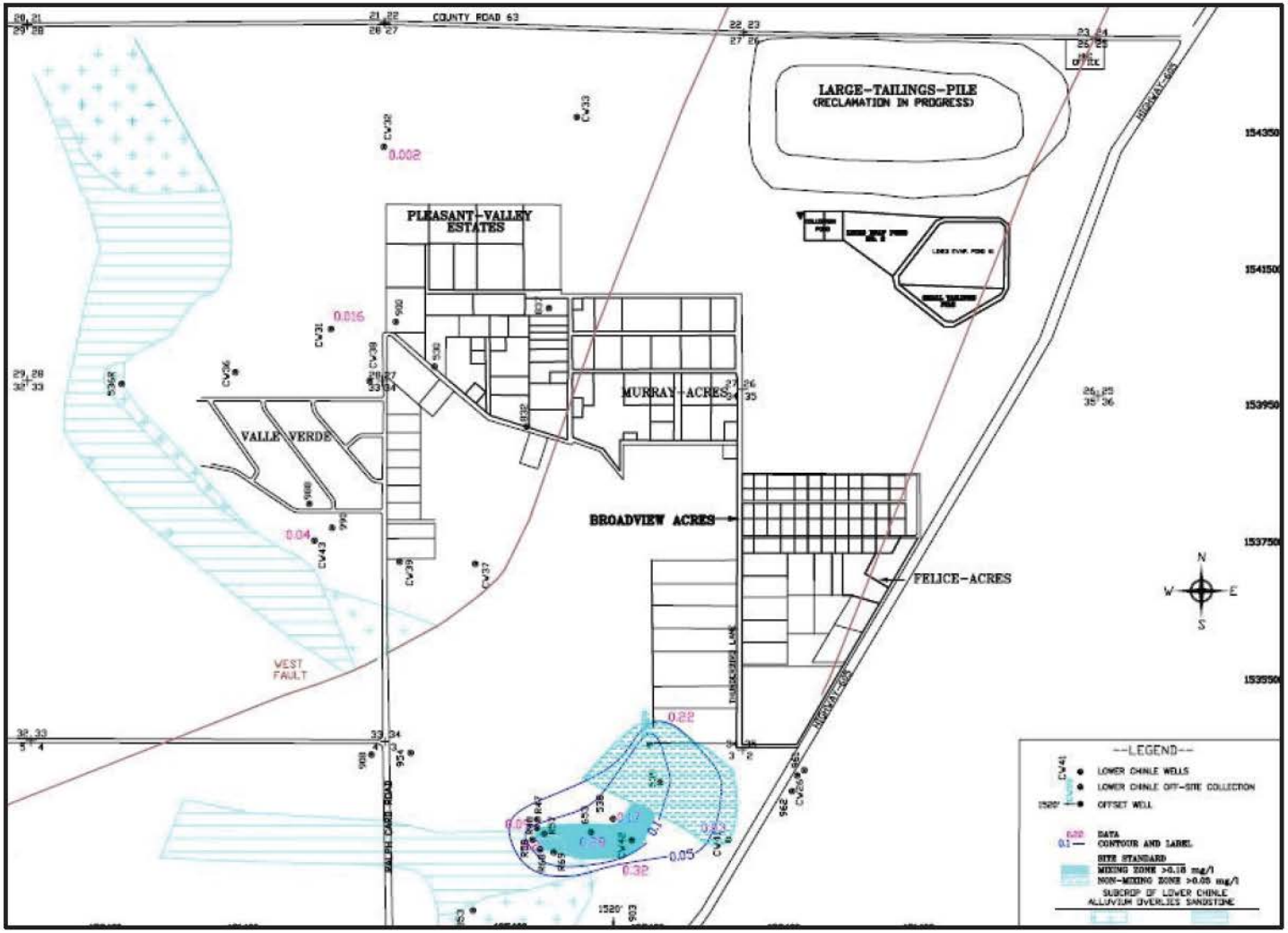
Homestake CAP



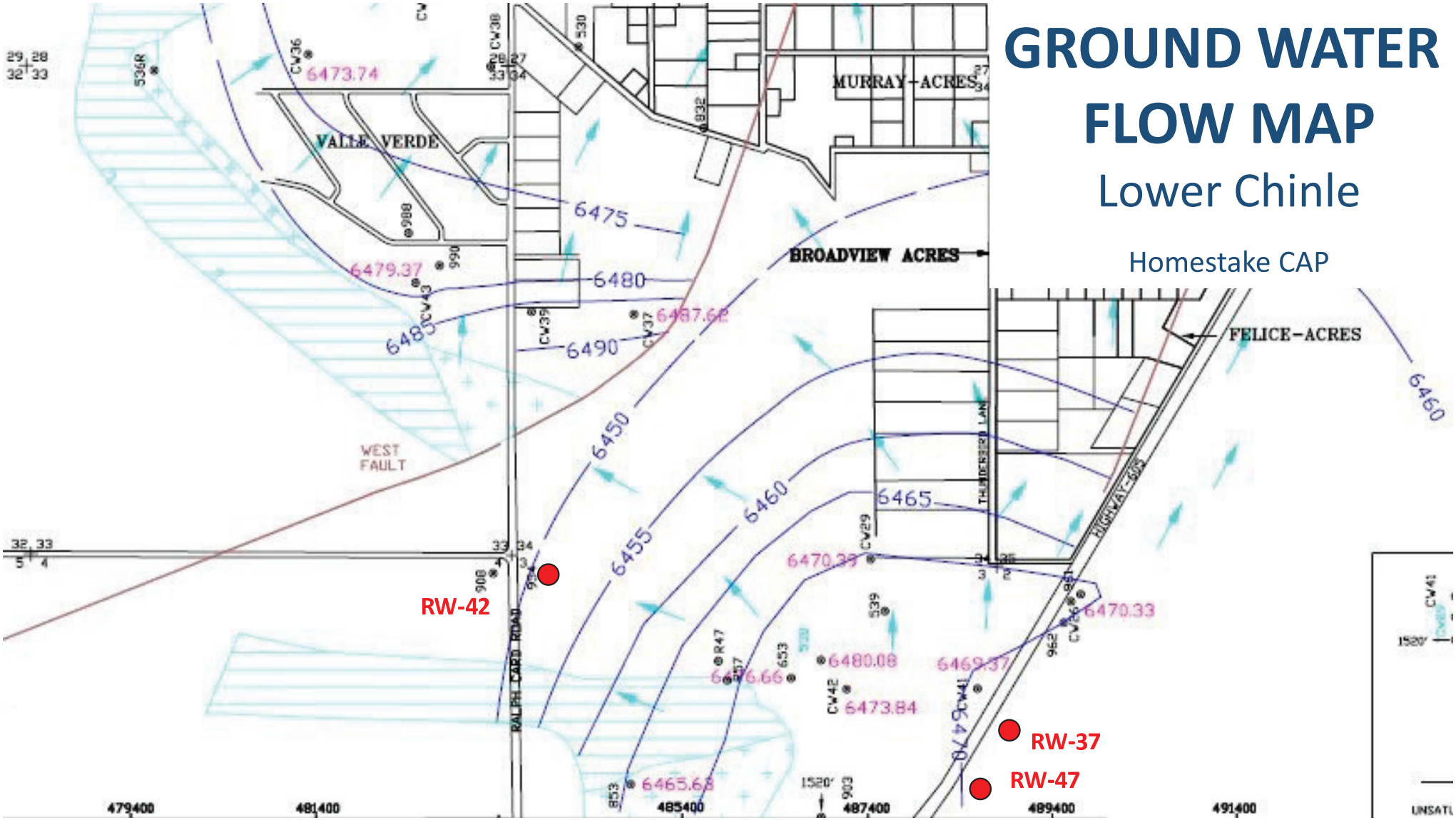
URANIUM CONCENTRATION MAP

Lower Chinle

Homestake 2013 Annual Report



GROUND WATER FLOW MAP

Lower Chinle

Homestake CAP