Evidence supporting

Depleting the Deer Creek Aquifer

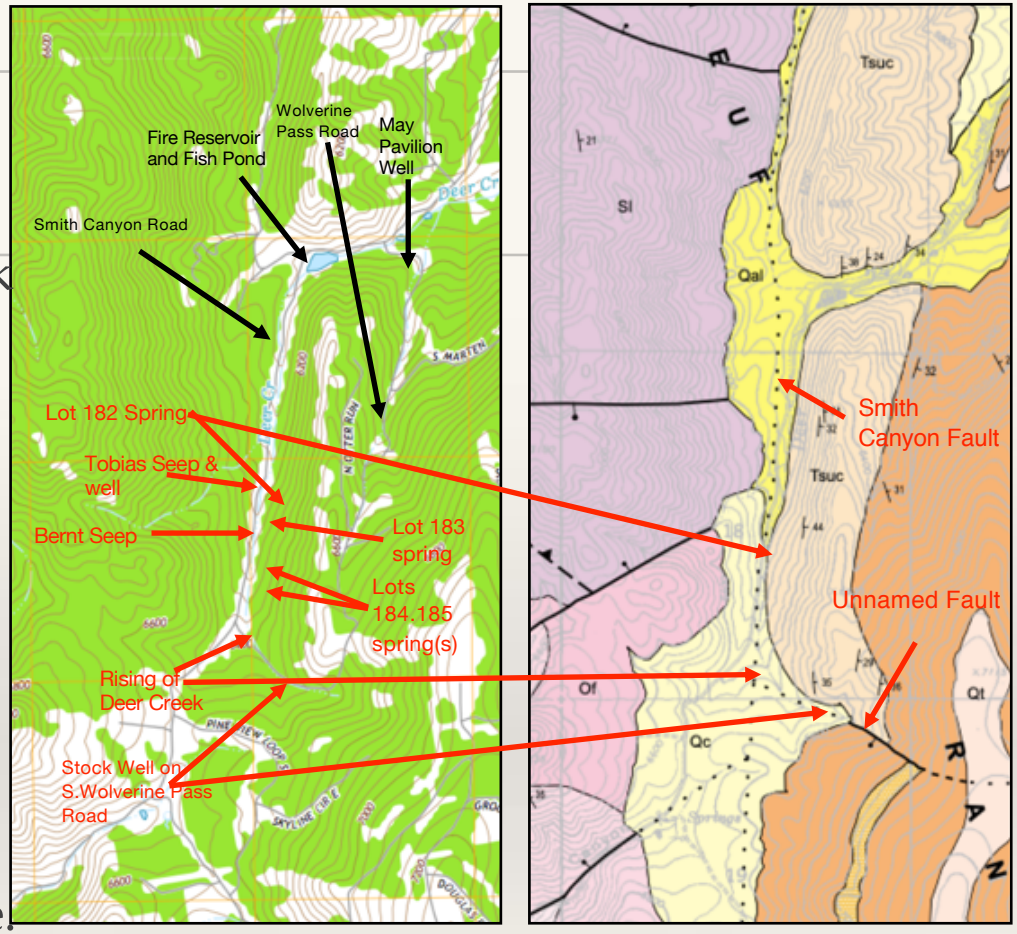
A Rapid Decline

Overview

- The Upper Deer Creek Area (1 slide)
- Declining Aquifer (2 slides)
- Possible Causes of the Aquifer's Decline
  - Possible causes on lot 182 (2 slides)
  - Larger Scope possibilities (3 slides)
- Conclusions (1 slide)

Upper Deer Creek

- Smith Canyon Road follows Deer Creek on west of the Lava Ranch subdivision.
- Prominent faults are:
  - Smith Canyon fault
  - Unnamed fault on S. Wolverine
- Deer Creek rises as springs @ junction of Faults.
- In addition there is a set of springs and seeps in the upper Deer Creek drainage.
- A stock well has recently begun being used as a community well



USGS 2013 "Lava Hot Springs Quadrangle, Idaho-Bannock Co., 7.5 Minute Series "

Link, Crane & Oriel, "Technical report 01-3 Geologic Map of the Lava Hot Springs Quadrangle, Bannock County, Idaho"

Crane 200, "GEOLOGIC MAPPING AND GRAVITY SURVEY OF THE LAVA HOT SPRINGS, IDAHO, 7.5 MIN. QUADRANGLE: EVIDENCE FOR A LATE MIOCENE SUPRADETACHMENT BASIN IN SOUTHEAST IDAHO"

Declining Aquifer – Qualitative

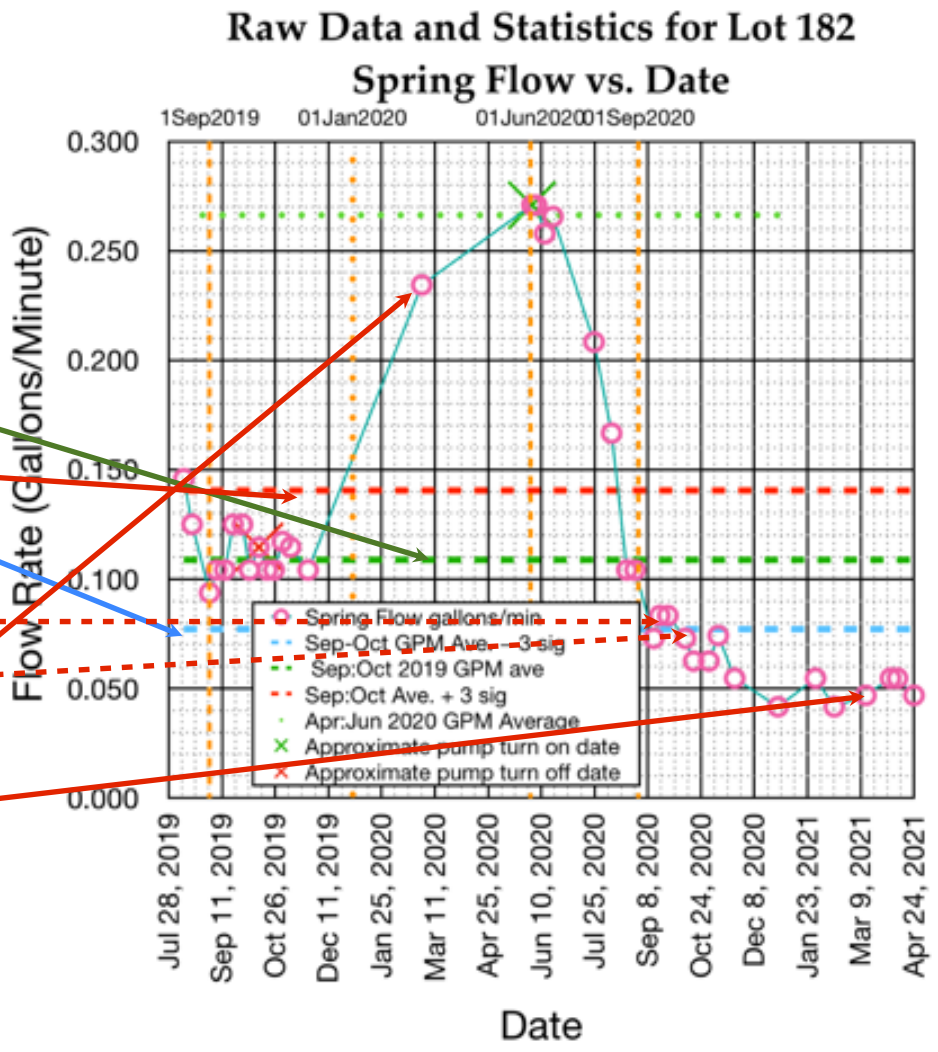
- Lot 182 spring 2000-2006. Lowest flow was 2 quarts/minute.
- Lot 182 spring flow has recently dropped each year.
- 2020 butterflies no longer attracted to Bernt seep.
- Lot 184 spring pool frozen Winter 2021 for first time.
- Tobias seep well flow reported down 2020
- In the Falls of 2019 & 2020 Deer Creek did not flow to pond below Hess lot.
- Bernt's well ran dry in 2000, two tries to find water again
- Not a lot of water. Well logs show dry holes and re-drilling after producing wells fail (Big Bear area too)
- **Conclusion:** Springs, Seeps, wells and Deer Creek show evidence of decline

Lot 182 Cistern Overflow Visual Comparison Max & Min 2016 and 2020

Top Row 2016. Bottom Row 2020
Left column: 1st Week June.
Right column: Last Week October

Declining Aquifer – Quantitative

- In August 2019, began measuring Lot 182 spring flow.
- "Runs Chart" based on 2019 Aug.-Nov. data to compare low flow year to year. Features:
  - A trend when 5 measurements in a row below average.
  - +- 3 std. deviations includes all baseline data
- How did 2020 Aug.-Nov. do?
  - Late Aug. 5 in a row below average!
  - Early October outside of -3 std. deviation limit
  - Has stayed below -3 std. deviation limit since.
  - 2021 NOT seeing recovery like in March 2020!
- **Conclusion:**
  - 95% confidence that 2020 worse than 2019
  - Spring 2021 beginning WORSE than worst of 2020.



Possible Causes on Lot 182

Is Spring Development at Fault?

- Development (more detail in supplemental slides)
  - Designed and constructed with professional engineering input.
  - Passed inspections by county, Dept of Health.
  - Granted water right by Idaho Dept. Of Water Resources (IDWR).
- System worked flawlessly 2006-2016.
- Maintenance & inspection (more detail in supplemental slides)
  - Little that can go wrong, gravity fed.
  - Summer 2019 in-depth inspection — everything as built.
- **Conclusion:** Due diligence for design & implementation. Proper inspection, licensing, maintenance & operation.

Possible Causes on Lot 182

Is the Lot 182 Spring Transient?

- Oral history for spring begins at time of Lava Ranch Subdivision in 1978
  - Realtor (Jay Anthony) sold lot 3 times. "spring was there and active, *including drought years".*
- The spring is in a mound of soil 2-3 feet high. Some soil's accumulation rate is approximately 1mm (1/25") per year
- Inspection of lots and road easement: No new springs to pirate the flow.
- **Conclusion:** Nothing found that indicates the spring is less than ancient.

Arjun M.Heimsath, WilliamE. Dietrich, Kunihiko Nishiizumi, Robert C.Finkel. "Cosmogenic nuclides, topography, and the spatial variation of soil depth", Geomorphology, Volume 27, Issues 1–2, February 1999, Pages 151-172

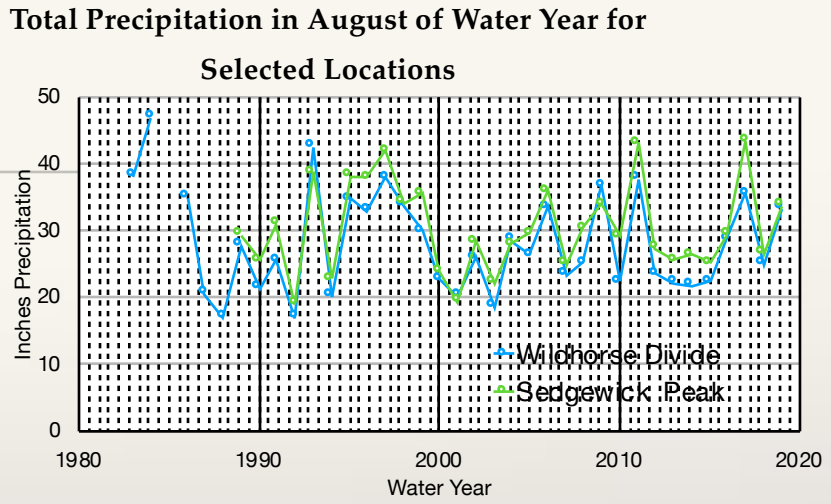
Larger Scope Possibilities

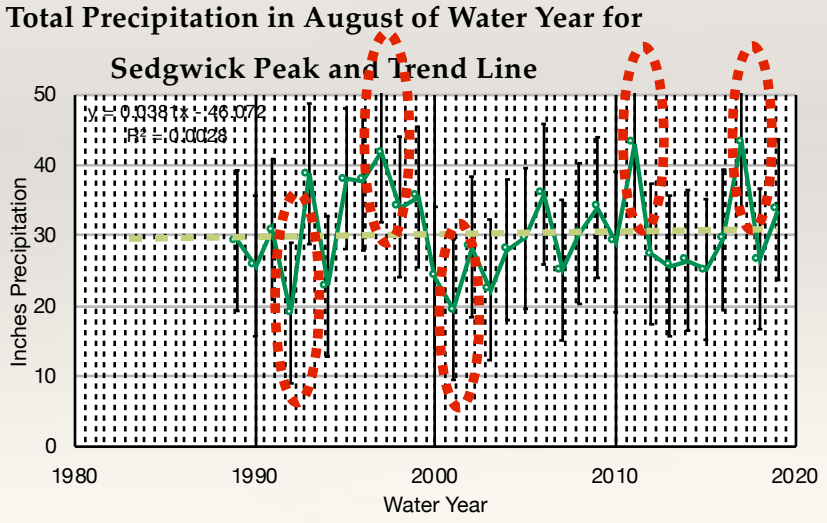
Is There a Drought?

https://wcc.sc.egov.usda.gov/reportGenerator/view/customGroupByMonthReport/monthly/741:ID:SNTL%7Cid=%22%22%7Cname/POR_BEGIN,POR_END/PREC::value

https://wcc.sc.egov.usda.gov/reportGenerator/view/customGroupByMonthReport/monthly/867:ID:SNTL%7Cid=%22%22%7Cname/POR_BEGIN,POR_END/PREC::value

- SNOTEL system measures precipitation. Two nearby stations:
  - Wildhorse divide outside of Pocatello. Elevation 6490'
  - Sedgewick peak, East of Dempsy Creek. Elevation 7850'
- The Sedgewick peak data 1989-2019 was analyzed.
  - The data point error bars show +- 3 std. deviations (+-3**σ**)
  - The only excursions below -3**σ** are 2001 and 1992
  - The only excursions above +3**σ** are 2016, 2011 and 1997
  - For 2010-2019, 2018 was the lowest, 2017 and 2019 were highest, 2001 and 2017 significantly so.
- **Conclusion:** Currently no indication of drought at Lava Ranch.





Larger Scope Possibilities

Nearby Well Activity Changes

- The IDWR requires that well drillers log all wells drilled in the state.
  - A website lets anyone look at activity and results. (May not include older wells)
  - There has only been one new well drilled in the Lava Ranch area for the period 2016-2019. It was drilled in 2018 and is on Big Bear Road, for domestic use.
  - A new well was drilled in 2020 to the NNW of lot 182 outside of Lava Ranch. It produced less than 2 GPM at 40 feet, was drilled to 600+ feet with no further water and backfilled to 40'. The output has declined since.
- Only known change in well activity is repurposing of the LRPOA stock well in 2016
- **Conclusion:** The new wells could not have caused a decline beginning in 2016. Some Deer Creek wells may be seeing declining water production.

https://idwr.idaho.gov/Apps/appsWell/WCInfoSearchExternal/default.aspx

Larger Scope Possibilities

LRPOA Stock Well Use?

- Beginning in 2016, the Lava Ranch Property Association (LRPOA) began using a preexisting stock well near the junction of Smith Canyon and Wolverine Pass Roads as a community water source.
  - This well is on the unnamed fault at the S. end of Wolverine Pass Rd.
  - Water is pumped from the well to two 1700 gallon storage tanks at the N. end of High Country Rd..
- Any of hundreds of Lava Ranch property owners are encouraged to take up to 250 gallons at a time (honor system).
  - At times the demand has exceeded the capacity of the well pump.
  - An unknown yearly or daily amount of water is withdrawn.
- **Conclusion:** This is the only investigated cause that fits the data for both time frame of change in water usage and proximity to lot 182.

"Upgraded Water Supply", June 2016 Lava Ranch newsletter

Conclusions:

- The Deer Creek Aquifer being depleted. There is ***not enough water.*** This is fact, not anyone's fault.
  - The amount of water taken from the aquifer ***must*** be decreased.
  - Uncertain what the aquifer is capable of and how much is being removed.
- Repurposed LRPOA stock well central to the Deer Creek Aquifer depletion.
  - In a geologically influential position.
  - Timing of repurposing coincides with the beginning of decline.
  - High impact, the only well that has hundreds of users.
- The water right for the spring on lot 182 has been infringed.
  - Amount of water has dropped dramatically. Worse year by year.
  - Water availability will soon be ***zero*** minimum (2021).

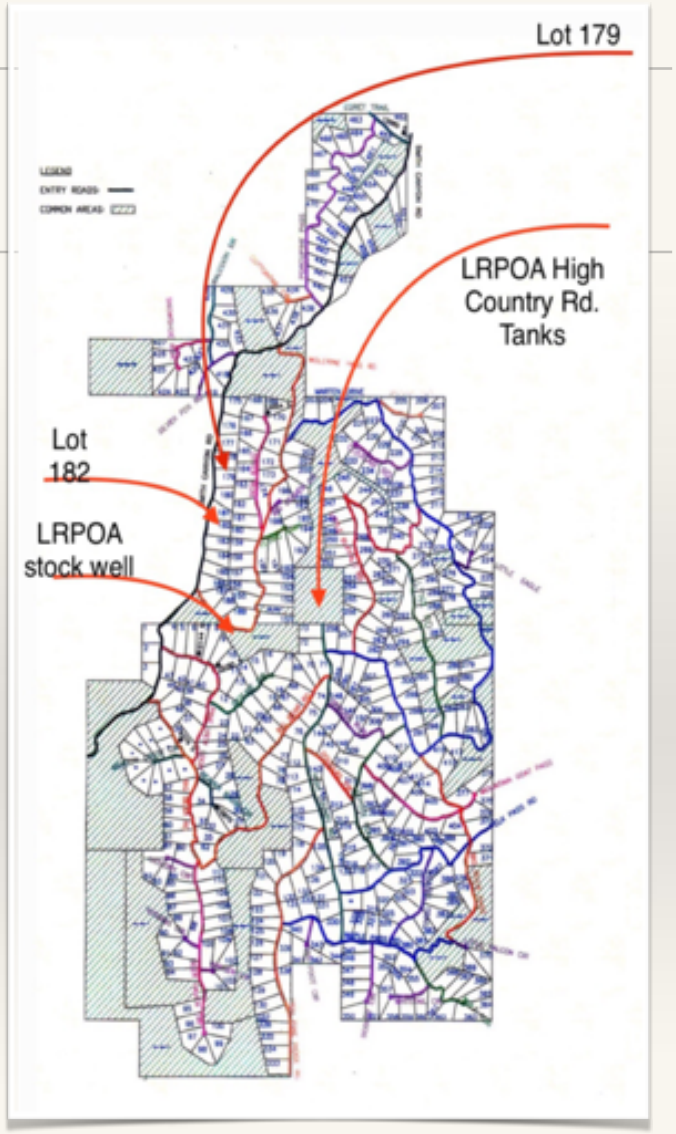
End of Presentation

Supplemental Slides

Supplemental

Lava Ranch Lot Key

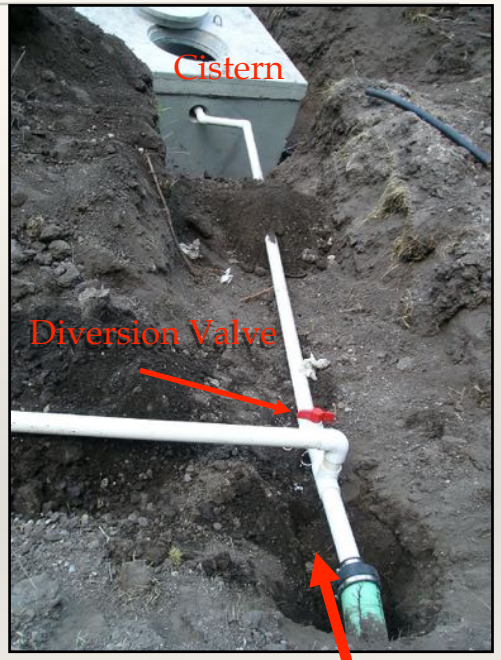
- This shows the location of
  - Lava Ranch Property Owner's Association (LRPROA) stock well
  - High country tanks
  - Lot 179 well logs have been mistaken for LRPOA stock well
  - Red, green and blue lines: LRPOA roads
  - Black lines: Country roads
  - Diagonal shading: common areas



Possible Causes on Lot 182 Supplemental

Was the Lot 182 Spring Improperly Developed?

- Gravity fed from spring pool to cistern. Cistern (used to) overflow to Deer Creek. Pump up to cabin from cistern.
- Diversion of spring flow possible for inspection and measuring
- Development followed advice of John Beer, a licensed Civil Engineer with 50+ years experience in municipal and private water systems.
  - Development done by Gale Allred, DBA Eagle Excavating 2006.
  - Spring plumbing approved by Bannock County Plumbing Inspector Chris Critzer.
  - Spring development inspected and approved by S.E.I. Health Department.
  - The Idaho Department of Water Resources (IDWR) inspected the developed spring and **issued a water right**.
  - Since 2005 the Lot 182 spring has operated 24/7, 52 weeks a year. Met domestic needs until after 2016.
- **Conclusion:** Due diligence for design & implementation. Proper inspections/licensing performed.



Possible Causes on Lot 182 Supplemental

Is the Lot 182 Water System Properly Maintained?

- Summer 2019 the system was partially excavated for inspection:
  - Spring pool and perforated pipes inspected, no obstructions, spring pool at expected elevation. O.K.
  - Cistern drained and inspected. No leaks, Pump connected. OK.
  - Overflow system excavated and inspected. O.K.
- **Conclusion:** System still functioning as designed.

Supplemental

Flow Rate Unit Comparison

Converting One Flow Rate to Other Flow Rate Units

	Gallons/ day	Gallons/ hour	Gallons/ min	Gallons/ sec	Cubic ft/ sec	Cups/min
Well per day	2500	104.17	1.74	0.03	0.00	27.78
LRPOA DECREE	250	10.42	0.17	0.00	0.00	2.78
Lot 182 water right	25853	1077.19	17.95	0.30	0.04	4.79
Pre 2016 lot 182 summer min	720	30.00	0.50	0.00833	0.00111	8
1 quart/min Flow Rate	360	15.00	0.25	0.00417	0.00056	4

Supplemental

Cistern Filling Times as a Function of Flow Rate and Use

- Left hand column — fill rate cups/min. 2nd column in Gallons/day
- Third column is days to fill an empty cistern
- 250 gallons per day is what LRPOA recommends for lot owners with no spring
- 360 gallons per day is near peak of what we have now
- 720 gallons per day was the minimum when spring developed

Spring Flow Rate vs. Cistern Filling Characteristics

Use rate (gallons/day)			250.0	360.0	720.0
Fill rate (cups/min)	Gallons/day	Days to Fill Empty 1500 Gallon Cistern	Days to deplete @ 250.0 gallons/day use	Days to deplete @ 360.0 gallons/day use	Days to deplete @ 720.0 gallons/day use
0.000	0.00	never	6.0	4.2	2.1
0.250	22.50	66.67	6.6	4.4	2.2
0.500	45.00	33.33	7.3	4.8	2.2
0.750	67.50	22.22	8.2	5.1	2.3
1.000	90.00	16.67	9.4	5.6	2.4
1.250	112.50	13.33	10.9	6.1	2.5
1.500	135.00	11.11	13.0	6.7	2.6
1.750	157.50	9.52	16.2	7.4	2.7
2.000	180.00	8.33	21.4	8.3	2.8
2.250	202.50	7.41	31.6	9.5	2.9
2.500	225.00	6.67	60.0	11.1	3.0
2.750	247.50	6.06	600.0	13.3	3.2
3.000	270.00	5.56	always full	16.7	3.3
3.250	292.50	5.13	always full	22.2	3.5
3.500	315.00	4.76	always full	33.3	3.7
3.750	337.50	4.44	always full	66.7	3.9
4.000	360.00	4.17	always full	always full	4.2

Spring Flow Rate vs. Cistern Filling Characteristics (continued

Use rate (gallons/day)			250.0	360.0	720.0
Fill rate (cups/min)	Gallons/day	Days to Fill Empty 1500 Gallon Cistern	Days to deplete @ 250.0 gallons/day use	Days to deplete @ 360.0 gallons/day use	Days to deplete @ 720.0 gallons/day use
4.250	382.50	3.92	always full	always full	4.4
4.500	405.00	3.70	always full	always full	4.8
4.750	427.50	3.51	always full	always full	5.1
5.000	450.00	3.33	always full	always full	5.6
5.250	472.50	3.17	always full	always full	6.1
5.500	495.00	3.03	always full	always full	6.7
5.750	517.50	2.90	always full	always full	7.4
6.000	540.00	2.78	always full	always full	8.3
6.250	562.50	2.67	always full	always full	9.5
6.500	585.00	2.56	always full	always full	11.1
6.750	607.50	2.47	always full	always full	13.3
7.000	630.00	2.38	always full	always full	16.7
7.250	652.50	2.30	always full	always full	22.2
7.500	675.00	2.22	always full	always full	33.3
7.750	697.50	2.15	always full	always full	66.7
8.000	720.00	2.08	always full	always full	always full

Key

Never fills
Not full by next weekend
Full by next weekend
Always full

Supplemental
Faults Near Lava Ranch

- Smith Canyon follows the Smith Canyon Fault, a local basin and range fault
- Less prominent unnamed fault helps form the side canyon that the southern end of Wolverine Pass road comes down
- The intersection of these two faults is coincident with the rising of Deer Creek
- Faults crush and weaken rock helping to define erosion features and drainage

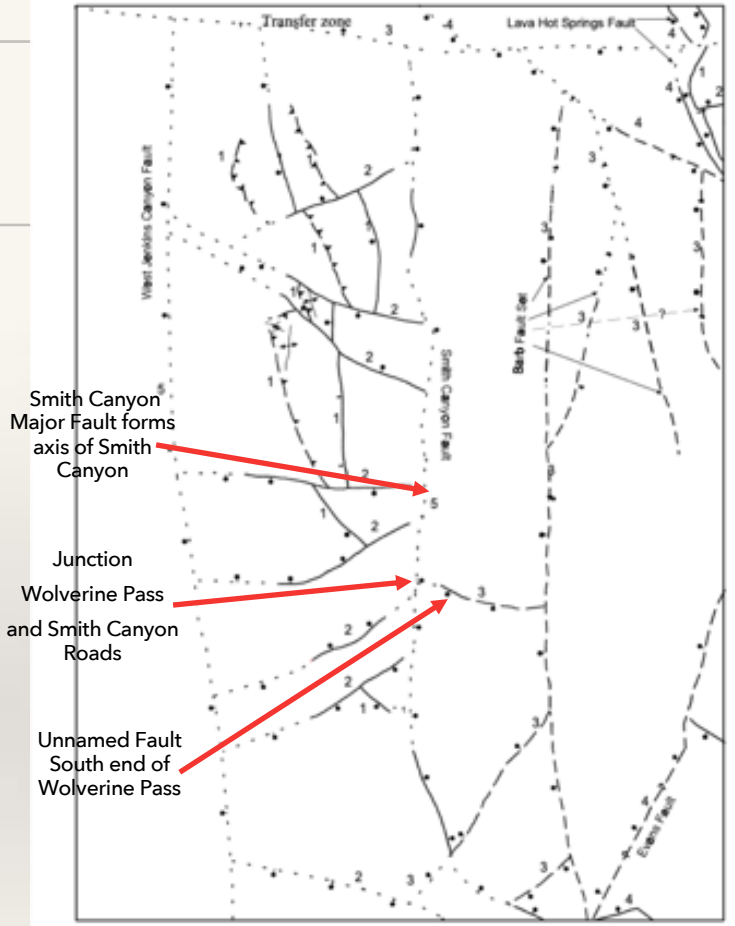


Figure 38. Fault pattern in the study area. Numbers are as follows: 1)Thrusting, folding, and thrust parallel normal faulting of Paleozoic Rocks, 2) East-west faulting of Paleozoic rocks, 3) Syndepositonal normal faulting and folding of the Salt Lake Formation and activation of the transfer zone, 4) Post depositional normal faulting of the Salt Lake Formation, 5) Widely spaced tilt-block normal faulting.

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