# Surface Water and Spring Flow Measurements for Upper Deer Creek in Smith Canyon, Bannock County ID

A report prepared by Mike and Lori Beer in response to the June 28, 2021 request by James Cefalo of the IDWR



## Summary


This report is in response to the request contained in the letter "RE: Request for Additional Information" from James Cefalo of the IDWR dated June 28th, 2021. The letter requested data concerning flows of the spring at 13714 S. Smith Canyon Bannock County Spring (AKA Lava Ranch Subdivision, Lot 182 Spring) and flows of Deer Creek in Smith Canyon at the same address. The report covers just over 20 years of observations of the Lot 182 spring and surrounding area.

**Lot 182 Spring Flow:**

There are three different types of spring flow data available for the lot 128 spring:

1. **Initial Measurements:** This was during planning the planning phase of the lot 182 cabin and spring development 2000-2005. This shows that the undeveloped spring flowed at a peak rate of 2/3 gallons/minute to minimum rate of 1/4 gallons/minute. This interval spanned a significant local and regional drought.
2. **Photographs:** Photographs were taken to reference changes of the overflow of the cistern that captures the Lot 182 spring output. This data was taken from the spring of 2016 to the summer of 2021. It visually demonstrates as the overflow diminishes from a significant stream to nothing. This interval begins at a time where the region is NOT in a drought, and ends in a drought period. The decline begins prior to the drought. There is an appendix that contains additional photographic data.
3. **Recent Measurements:** A set of measurements with the intention to quantify the spring's decline. This began in the late Summer of 2019 and continues to the present. The results are that the peak flow in 2021 (7/8 cups/minute; 0.055 gallons/minute) is now significantly lower than the minimum flow in 2019 (1 1/2 cups/minute; 0.094 gallons/minute).

**Deer Creek Flow Measurements:**

These began in November of 2020 and continue to the present. This measurement includes flows of all the springs above the lot 182 property, except a minor contribution from the lot 183 spring, as well as flows from snow melt and rain. Excluding melt and precipitation, the Deer Creek Winter flow was 11 to 13 gallons per minute. The early summer 2021 flow has declined to 5 to 6 gallons per minute.

**Overview of Report:**

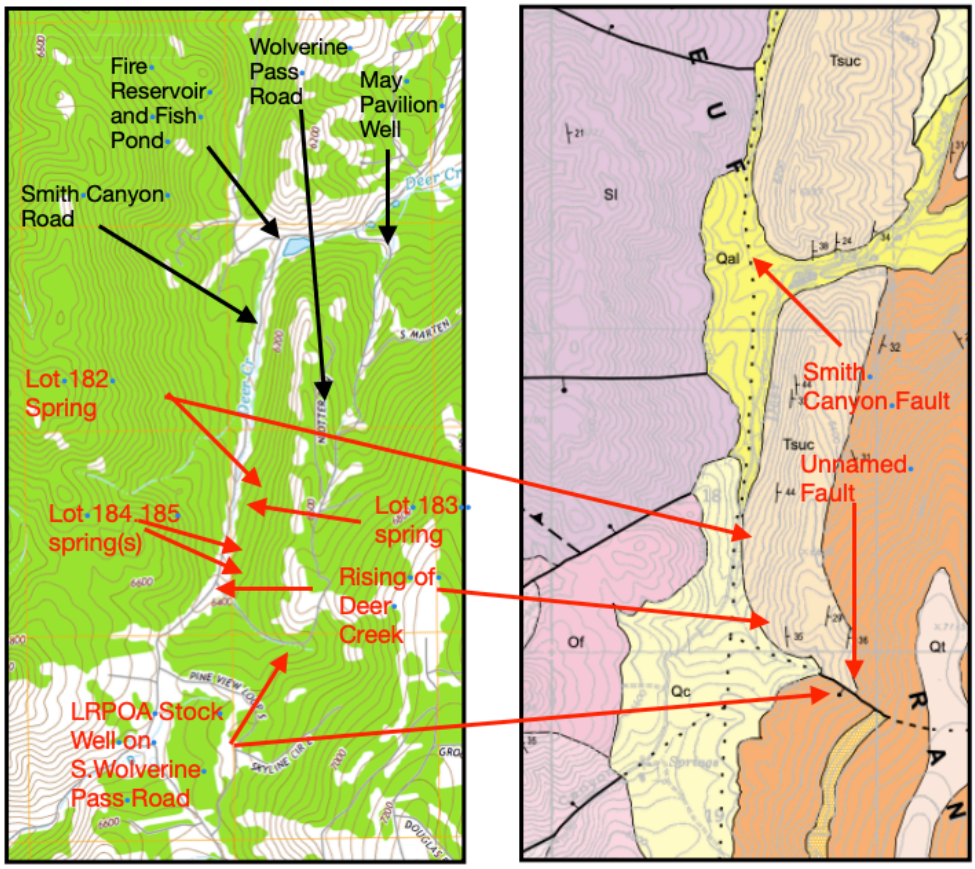
This report has sections that provide a physical context for the features of the Deer Creek Drainage. After this introduction measurement methodology is discussed, measurement results provided, and concluding comments made for each of the three data types for the Lot 182 Spring. A similar treatment is given for for the Deer Creek data. The report finishes with concluding remarks.

There are three appendices to the report. The first shows the complete photographic data set. The second supports the claim that the decline of the Lot 182 Spring does not correlate well with drought. The last is a map of the Lava Ranch Subdivision including lot numbers

# Upper Deer Creek Drainage Context

There are several springs and wells in the Upper Deer Creek Drainage. The underlying geology exerts an influence on the location of the springs and the interaction of the springs and wells. The following figure is composed information taken from the USGS 7.5 minute Lava Hot

Springs Quadrangle[1], the Geologic map for the Lava Hot Springs Quadrangle[2] and information for the geologic interpretation is from a master's theses by Crane[3]. Annotations have been added to provide context for springs and wells discussed in this report




Relationship of surface features in the Upper Deer Creek drainage to underlying geology. The maps have north up and are centered on section 18 of Township 10 South Range 38 East. Section 19 is to the south and section 7 to the north. Section 19 drains both into Deer Creek and Marsh Creek Valley. South of section 19, the topography drops into Marsh Creek Valley. Scale is provided by the intersection of the section lines at mile intervals.

The rising of Deer Creek appears to be influenced by the intersection of the Smith Canyon Fault and an unnamed fault intercepting the Deer Creek fault at right angles from the east. The

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

[2] Link, Crane & Oriel 2000, "Technical report 01-3 Geologic Map of the Lava Hot Springs Quadrangle, Bannock County, Idaho"

[3] Crane 2000, "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"

Smith Canyon Fault is of relatively recent origin and is an east-dipping normal fault [4]. The unnamed fault is older than the Smith Canyon Fault and dips to the south [5]. This older fault is then truncated by the newer Smith Canyon Fault. This fault junction allowed erosion to remove material easily. The floor of Deer Creek Valley raises quite abruptly on the south edge of the unnamed fault. This is apparent by the steepness of the south side of the basin Deer Creek rises in as well as a steep hill on the county road to the SE of the the Bernt Cabin. The intersection of these two faults helps to force water to the surface, causing the rising of Deer Creek. The springs at the rising of Deer Creek are closely clustered. The next spring from this set of springs on Deer Creek is downstream (north) and over a mile away.

The LRPOA stock well is near the two faults' intersection. Removing water with this well lowers the aquifer's head, influencing flow in the springs at the rising of Deer Creek.

Further evidence of faults controlling water in the drainage is discernible from well logs [6]. Successful wells in the area occur only in zones containing broken rock or occasionally gravel above an impervious rock or clay layer. Unsuccessful wells may be in close proximity to springs or successful wells. The primary difference between wells seems to be related to the position east and west of the Smith Canyon fault. Deer Creek roughly follows the fault and thus serves as a marker for the fault.

Wells on the west side of the fault tend to produce at lower actual static elevations and be much deeper[7] and also problematic[8]. This is consistent with the idea that the aquifer is fault controlled and the fact that the Smith Canyon Fault dips to the east. A well drilled to the west of the fault cannot intersect the east dipping fault containing the aquifer.

Wells along Deer Creek are more successful as they appear to be in the shattered rock of the

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[4] Crane, 2000 p 108.

[5] Crane, 2000 p 105.

[6] IDW Well Construction web Page Well Construction section, Well Finder. , https://idwr.idaho.gov/Apps/appsWell/WCInfoSearchExternal/default.aspx .

[7] IDWR well logs for Bernt, T10S R38E section 18, D0033117, D0035111 and also an unlisted well. There is also a letter from Gary and Linda (Bernt) Haskett, trustees of the Bernt cabin, submitted as testimony to the Beer water call. The Bernt cabin is to the south west of Lot 182, and across Smith Canyon Road. The well logs here represent geology found on the west side of Smith Canyon Fault.

[8] IDWR well logs for Burgess, T10S R38E section 18, D0004784, D000699 and also an untagged well. These wells are to the west of Lot 182, and across Smith canyon Road. The well logs represent geology found on the west side of Smith Canyon Fault.

main fault or gravel deposits associated with Deer Creek[9] [10] [11].

Wells have been drilled East of the fault [12], these wells are up on the ridge to the East of Deer Creek, at higher elevation. They appear to have static heads at elevations at least as high as the LRPOA stock well casing head. As the LRPOA stock well is not an artesian well, this implies at best a non-hydrostatic connection.

Other than the LRPOA stock well, there do not appear to be other wells drilled along the unnamed fault associated with the rising of Deer Creek. No well log is available on-line for the LRPOA stock well.

From both the well log and geologic mapping evidence, the upper Deer Creek Aquifer is fault controlled. There is a part of the aquifer associated with Deer Creek, but other portions may not be unified, may be perched, or may be weakly connected.

# Lot 182 Spring Flow Measurements

There are three types of data available documenting the Lot 182 Spring's flow: Initial, photographic and recent. The data is distinguished by time frame and methods of measurement.

## Lot 182 Spring Initial Measurements

Initial measurements were taken 2000-2005 during the planning and construction of the Lot 182 cabin. This verified the feasibility of using the spring and also demonstrated that the completed water system was operating as expected.

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**Lot 182 Spring Initial Measurement Methodology:**

Prior to development, the Lot 182 artesian spring was surrounded by a low mound of vegetation and drained over the surface towards Deer Creek. A shallow trench was dug

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[9] IDWR well log for Tobias, T10S R38E section 18 D0075479. There is also a letter from Justin Tobias that was submitted as testimony to the Beer water call. This well is to the north west of lot 182, diagonally across Smith Canyon Road. The log represents geology on the west side of the Smith Canyon Fault. It was successful only because the well intercepted a shallow alluvial deposit that connects to Deer Creek.

[10] IDWR well log for Johnson drilling permit 29-93-E-089-000 this is on lot 179, 3 lots north (~1200') of lot 182. This well is alongside Deer Creek and not to be confused with a different Johnson unrelated property Lot 8, adjacent to an LRPOA common area that is the location the LRPOA stock well.

[11] IDWR well logs for Hess T10S R38E section 18 D0081205. No well log document available on-line. This is further north along Deer Creek than the lot 179 Johnson well.

[12] IDRW well log for Gests T10S R38E section 18. D0045778. This is SE of lot 182, but up on the ridge to the east of the Deer Creek Drainage, the static head on this well appears to be very near the elevation of the LRPOA stock well head.

through the edge of the mound and a piece of PVC pipe buried in the trench. The outlet of the pipe permitted flow measurement with a graduated gallon container over a timed period (Volumetric running start and stop method[13] [14]). Measurements were timed over a 1 minute interval using a stopwatch. Accuracy of the measurements was estimated at +-1/4 cup (0.03125 gallon) and within 1/4 second of time.

During the 2000-2005 interval, S.E. Idaho and the Lava Ranch subdivision experienced a significant drought. The initial measurements spanned this drought period. This demonstrates that high levels of spring flow were previously sustained during a drought.

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## Lot 182 Water System Construction

A water system was designed that uses a 1500 gallon cistern to capture the spring's output. Water capture is entirely gravity fed with spring water dropping into the capture cistern. A pump is used to lift water from the cistern to the cabin. The flow from the spring was verified to not have been changed by development.

There are two points that may be used to measure the water flowing in the system:

1) Diversion Outlet: Is activated using a valve that diverts the spring's flow prior to its entering the cistern. In the diversion mode, no water enters the capture cistern and the entire spring flow is observable. The diversion valve and outlet are at a lower level than the spring pool so their operation does not alter the spring's flow.
2) Cistern Overflow Outlet: This sets the maximum level of water in the cistern. The outlet is at the top of the cistern opposite the point that the spring flow normally enters the cistern. When there is sufficient flow from the spring the cistern overflows and this outlet drains to Deer Creek.

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## Lot 182 Spring Initial Measurement Values:

Over the interval of 2000-2005 and prior to the development of the spring ***no measurements were seen below 1/4 gallons/minute, nor above 2/3 gallons/minute.*** Measurement intervals were not regular. Each season of each year was measured every year.

When the water system was first constructed, the time to fill the cistern was checked twice. Filling times were just over 2 days. During these tests it was not possible to remain on site longer then 48 hours, at which time the cistern was not quite full. Returning within 72 hours

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[13] Lief O. Olsen, "Introduction to Liquid Flow Metering and Calibration of Liquid Flowmeters" U.S. Department of Commerce, National Bureau of Standards Technical Note, Volume 831 P33, June, 1974. https://nvlpubs.nist.gov/nistpubs/Legacy/TN/nbstechnicalnote831.pdf

[14] John D. Wright, NIST *Flow Measurement: Practical Guides for Measurement and Control*, 2nd edition, D. W. Spitzer editor, The Instrumentation, Systems, and Automation Society, Research Triangle Park, North Carolina, pp. 731- 760. 2001.

after starting showed an overflowing cistern. A filling rate of 1500 gallons within 48 hours corresponds to a spring flow rate of approximately 0.52 gallons per minute. Filling the cistern in 72 hours corresponds to a flow rate of 0.35 gallons/minute. Both of these values are well within the observed flow rates prior to spring development.

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### Lot 182 Spring Initial Measurement Conclusions:

The initial measurements showed a flow rate of *1/4 to 2/3 gallon per minute*, even in drought conditions and after spring development.

## Lot 182 Spring Photographic Measurements:

When the LRPOA Board announced that they were going to be pumping from the repurposed stock well on South Wolverine Road, this raised a concern as to whether this might impact the Lot 182 Spring. So as not to rely on memory or impressions, the cistern overflow was regularly photographed and videoed.

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### Lot 182 Spring Photographic Measurement Methodology:

Photographs and videos were taken with a handheld cell phone, and the files archived. The pump that is used to lift water from the cistern into the cabin is turned off at the end of a cabin visit, and the photographs were taken at the start of the next visit, prior to turning the cistern pump back on. Cistern overflow at this time indicates the cistern has been able to refill since the last visit.

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### Lot 182 Spring Photographic measurement values

A more complete set of photographs covering late spring and mid fall seasons is presented in Appendix I. Appendix II shows that the decline has occurred in both dry and wet years, independent of drought conditions. The following photographs span the interval 2016-2020.


Upper row: flow in 2016. Lower row: flow in 2020. Left column: flow in early June. Right Column: flow in late October.

From these photographs, it is possible to tell that there has been a decrease year on year for a given season. The photographs in Appendix I show that the change has not been concentrated in any one year, but that it has been continually decreasing from 2016 to the present. In the mid winter and spring of 2021 there was no cistern overflow. This is unprecedented.

Not shown in these photographs is the effects on the area surrounding the cistern overflow. The area between the overflow outlet and Deer Creek used to be quite marshy and soggy. It is now hard and dry.

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## Lot 182 Spring Photographic Measurement Conclusions

The output of the Lot 182 Spring has been in decline since 2016. This decline began directly after the LRPOA stock well was repurposed and began to be used. The decline happened even in wet years so is not related to just drought conditions. For most of 2021 there has been no cistern overflow.

## Lot 182 Spring Recent Measurements

During the summer of 2019 the cistern overflow was often dry at the start of a cabin visit. This caused concern, and a set of measurements were begun at the water system's diversion point upstream of the cistern. This was done for two reasons:

1) At times there was no water to observe at the cistern overflow.
2) Measurements made at the diversion point are independent of what happens in the rest of the water system.

At the same time these measurements were begun, a complete inspection of the Lot 182 water system and surrounding area was performed without finding any problems.

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### Lot 182 Spring Recent Measurements Methodology:

The measurements span from the summer of 2019 to the present time. They are made at the diversion point above the cistern. The diversion valve is turned and the flow at the output of the diversion pipe is allowed to stabilize. A graduated 1 quart glass container is rapidly inserted under the diversion outlet and left there for 60 seconds. At the end of this time the measuring container is abruptly pulled from under the output and the volume recorded (volumetric running start and stop method). Times are repeatable to within 1/4 second. Volumes can be read to under +-1/4 oz.. Sequential measurements immediately after each other produce the same result.

Measurements have been made as frequently as once per week, but sometimes there are longer intervals between measurements. During late 2019 and the first half of 2020 it was not possible to measure every week.

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### Lot 182 Spring Recent Measurements Results:

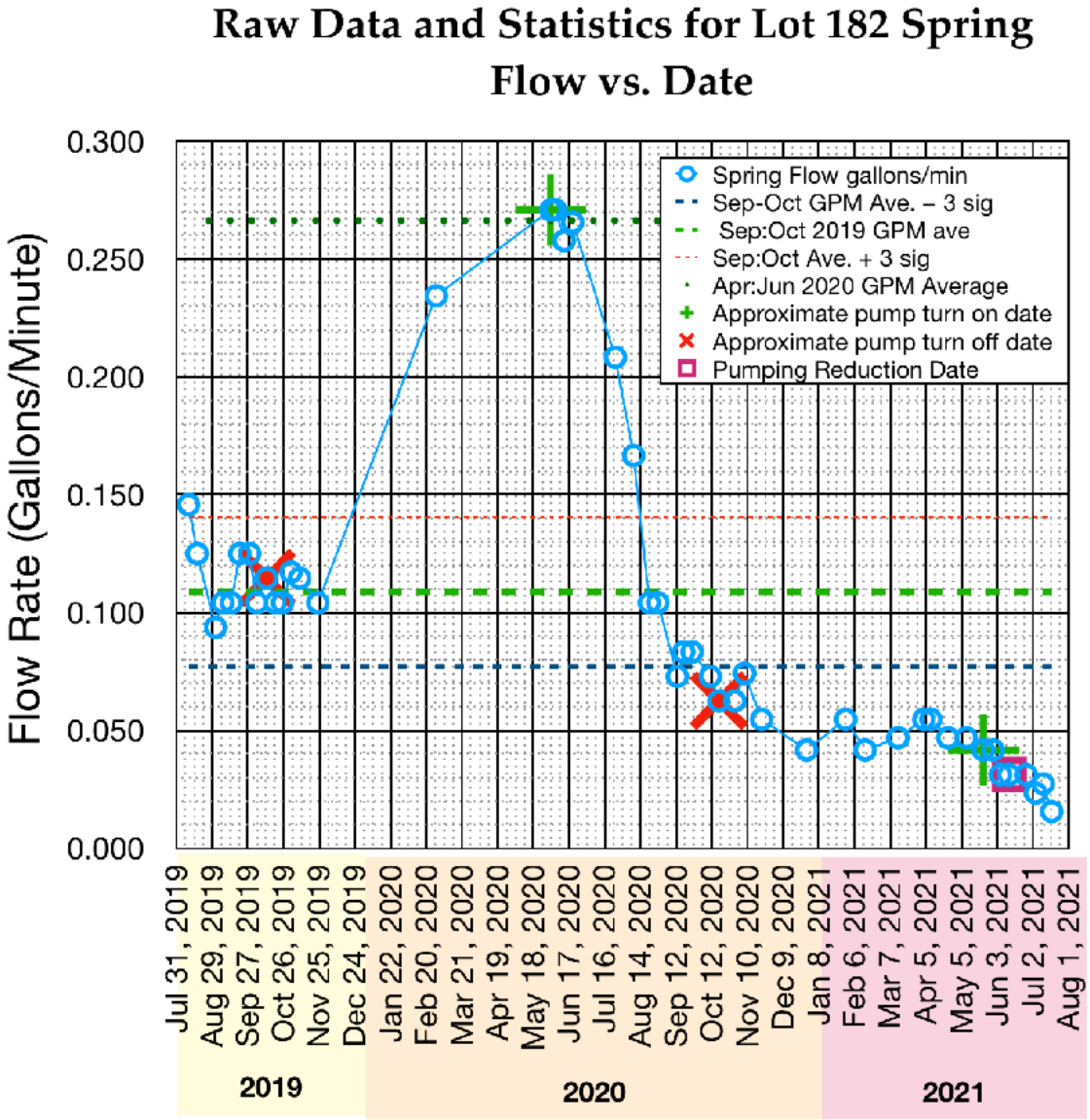
The following graph plots the flow rate with time, and displays statistical values based on the flow rate in September to October of 2019. The September to October time is a period of relatively consistent flow due to low usage and moderate temperatures.

There is a file attached to this report that contains the raw data in .csv format.

The September to October 2019 measurements were allowed a calculation of reliable statistics. References were determined and added to the chart for: average flow (green horizontal dashed line), average plus three standard deviation flow (dashed red horizontal line) and average minus three standard deviation flow (horizontal dark blue dashed line). During the fall of 2020 and all of 2021 the spring flow has been less than 3 standard deviations below the average for the late summer and fall of 2019. Note that during the winter 2019 to spring 2020 interval the Lot 182 Spring flow increased. This did not occur during the winter 2020 to spring 2021 interval.

Dates are annotated on the graph when the LRPOA stock well pump is turned on (dark green

plus signs) and when the pump is turned off (red Xs). During June of 2021 the LRPOA was obligated to reduce the pumping rate to half the peak daily rate that had been previously possible. This date is indicated with a hollow magenta box.




In the fall of 2019 there was a period of relative flow stability after the LRPOA pump was turned off. The flow increased in the spring of 2020. There was a sharp decline in flow when pumping was resumed. This decline ended in September when the number of people visiting Lava Ranch declined. This pattern of decline and increase is also seen in the pictorial data for most years, with the exception of 2020-2021. In the spring of 2021 there was not an increase of flow, but a decline began when pumping resumed. Something in 2021 has reduced the rate of flow decline as the 2021 rate is lower than the 2020 rate, particularly after the maximum

LRPOA stock well pumping rate was reduced in June 2021.

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### Lot 182 Spring Recent Measurements Conclusions

Data taken on the interval of August 2019 through mid July 2021 indicates that the minimum and maximum spring flow for each year have decreased in a statistically significant fashion. The 2021 spring melt did not generate an increase in Lot 182 spring flow similar to what was seen during the spring melt during 2020.

Late summer 2019 flows for the Lot 182 Spring averaged 0.1 GPM. Spring 2020 peak flows were over 0.25GPM. Fall 2020 flows were in the 0.08 to 0.06 GMP range. Peak 2021 flows were in the 0.06GPM range and have since declined to 0.0156 GPM on July 18th 2021.

# Deer Creek Flow Measurements

In November of 2020 a weir was placed on Deer Creek near the upstream boundary of Lot 182. This weir has operated since that time and continues to produce measurements. Placement of this weir accounts for spring flow from lots 184, 185 and 186, but does not account for spring activity on Lot 183. Only one measurement of the lot 183 spring contribution to Deer Creek flow is available. On July 18th, 2021 it was 0.14 GPM. When flow information for the springs on Lots 182 and 183 is added to the flow at the weir, the entire spring flow for the rising of Deer Creek is accounted for. This weir also measures snow melt and precipitation events for the upper Deer Creek drainage.

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### Deer Creek Flow Measurement Methodology:

The Deer Creek weir is a 17.5 degree "V" notch weir. It is sited, operated and constructed following recommendations in the Bureau of Reclamation's "Water Measurement Manual" [15]. Weir water head measurements are converted to flow values using the Kindsvater-Shen[16] equation. Values for constants to calibrate the 17.5 degree notch weir are based on curve fits of standard charts from the American Society for Testing and Materials (ASTM)[17] and the International Organization of Standards (ISO)[18]. The curve fits were developed by LMNO

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[15] Water Resources Research Laboratory, Department of the Interior, Bureau of Reclamation. US Government Printing Office, Washington DC 20402, "Water Measurement Manual, A Water Resources Technical Publication", Third Revised Edition, 2001. https://www.usbr.gov/tsc/techreferences/mands/wmm/WMM_3rd_2001.pdf

[16] ibid. Chapter 7, . https://www.usbr.gov/tsc/techreferences/mands/wmm/chap07_07.html

[17] ASTM. (1993). American Society for Testing and Materials. ASTM D5242. "Standard method for open-channel flow measurement of water with thin-plate weirs". 1993.

[18] ISO. (1980). International Organization of Standards. ISO 1438/1-1980(E). "Water flow measurement in open channels using weirs and venturi flumes - Part 1: Thin plate weirs". 1980.

Engineering, Research and Software Ltd.[19]. V angles less than 25 degrees are an extrapolation but was used for the lower flows in Deer Creek as a 25 degree notch does not provide sufficient head. As low flows are of major concern and may be checked by the volumetric method, this has been compensated for.

**Measurements:** These consist of first verifying that the pool upstream of the weir is of proper length and depth for the width of flow passing through the "V" notch as specified in the "Water Measurement Manual". The head above the point of the "V" notch is measured. This head is converted to a flow measurement using a spreadsheet containing the Kindsvater-Shen equation. The measurement date, head and derived flow information for each measurement is then recorded. When the flow is low enough, weir measurements are augmented with volumetric measurements.

Measurements are hoped to be taken weekly, but sometimes this interval is longer. In winter, snow and ice accumulations may prevent as rigorous of inspection for the upstream pool conditions as is possible in other seasons.

**Accuracy:** The accuracy of the low flow conditions has been checked with volumetric running start and stop method measurements. This comparison shows that the flows based on head measurements at the weir plate are a little lower than the volumetric measurements. The cause is probably related to the extrapolation for the 17.5 degree notch.

It is difficult to get head measurements to better than 1/4" accuracy even in a still pool above the weir plate. The Kindsvater-Shen equation is known not to be appropriate for heads lower than 2.4" and for notch angles less than 25 degrees. These three constraints set the low flow accuracy of the Deer Creek Weir.

In cases where the weir is operating at low flow conditions, the weir head measurements are augmented with volumetric measurements.

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### Deer Creek Flow Measurements

The weir on Deer Creek was constructed in November 2020 and has been in operation and monitored since. Measurement intervals of one week are hoped for, but not always possible. Note that as of July 18th, there is insufficient head for weir measurements. On and after this date only volumetric measurements exist.

Winter conditions were for the most part steady. Flow measurements peaked mid March during the spring melt. Significant precipitation occurred in May and June. All these show up as increased flow in Deer Creek.

The graph contains a vertical red dashed line indicating the date at which the LRPOA stock well pump was observed to have been turned on in 2021. A vertical dashed blue line indicates the data (June 15th) that the amount of pumping was reduced to bring the peak water use into

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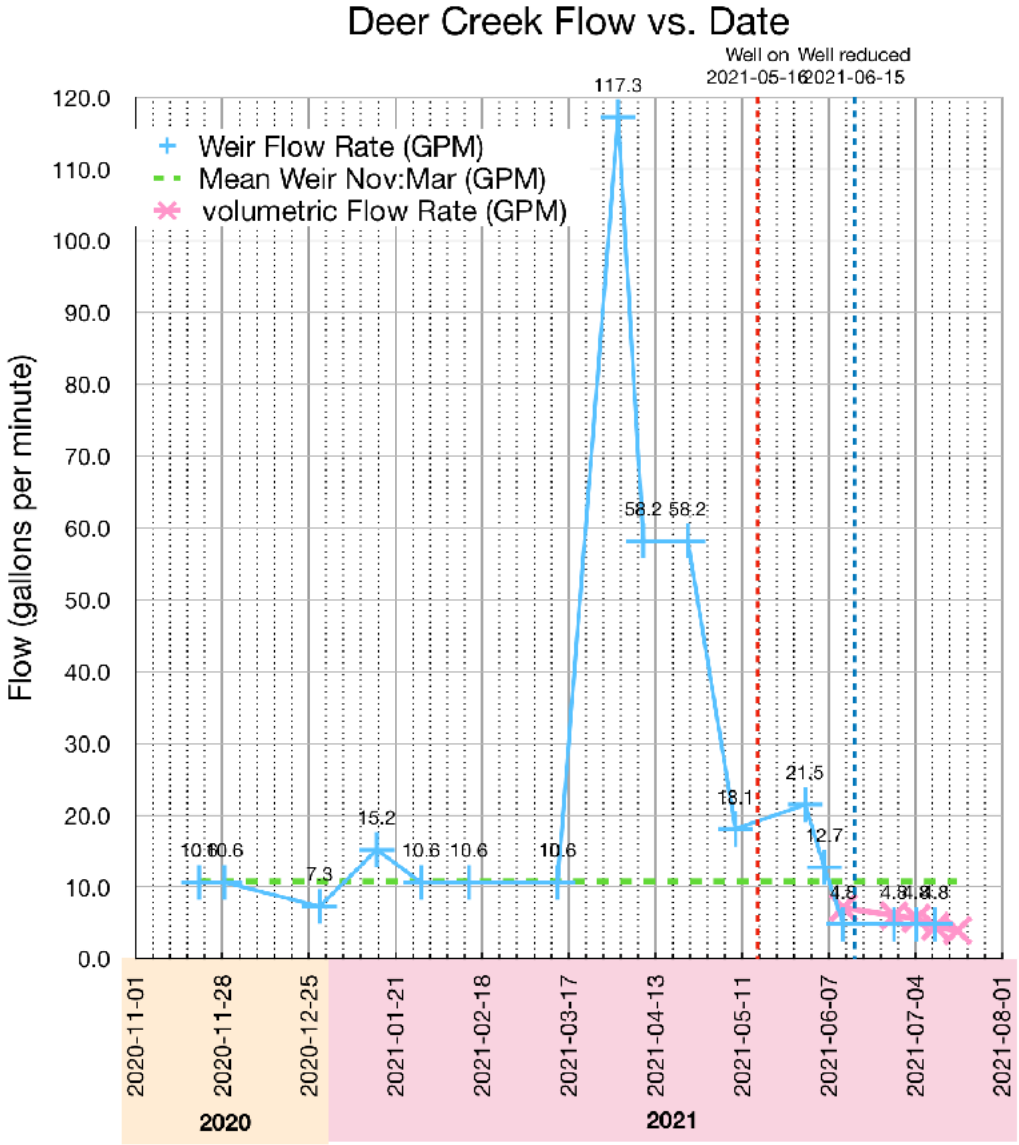
[19] "V-notch (Triangular Weir Calculator" LMNO Engineering, Research and Software Ltd., 7860 Angel Ridge Rd., Athens, Ohio 4570 USA. https://www.lmnoeng.com/Weirs/vweir.php

compliance with state law and regulations. It is interesting that the rate of flow decline in Deer Creek levels off at this time.

There is a file attached to this report that contains the raw data in .csv format.




## Deer Creek Flow Measurement Conclusions

Summer 2021 flows past the spring season flow peak are so far lower than winter 2021 flows. It is interesting that the Deer Creek flow rate decrease leveled off when reduced pumping on the LRPOA well was instituted.

# Report Conclusions

Flow measurements have shown that the Lot 182 Spring and Deer Creek flows are declining. Since 2016 this reduction is a new behavior for the Lot 182 Spring. Prior to this the Lot 182 Spring had been consistently producing water, even in drought years. There is every indication that this decline began when the LRPOA began pumping on their repurposed stock well in 2016. Seasonal declines seem to also be related to pumping activity on this same well. The Lot 182 Spring normally experiences at least partial recovery of flow rate in the spring relative to the previous year's flow. This recovery did NOT occur in the spring of 2021.

# Appendix I: Additional Photographic Data for the Lot 182 Spring

The following set of photographs shows the Cistern overflow for the years 2016 to 2020. The left hand column of photogram indicates the flow before or shortly after the LRPOA stock well pump is turned on in the Spring. The right hand column of photographs indicates the flow after the pump has been turned off in the Fall.

There is a seasonal decline across rows, and a general decline year to year down columns for a particular season.

May 30, 2016

November 6, 2016

May 20, 2017

November 23, 2017

May 17, 2018

No photo available

June 6, 2019

October 19,2019

June 1, 2020

November 07, 2020

May 31, 2021

July 18, 2021

# Appendix II: Regional Drought Conditions Referenced to Lot 182 Spring Measurement Spans

At several times in this report drought has been mentioned. Over the 21 year span of the measurements drought has come, gone, and returned. The graphic that follows helps to line up the measurement times mentioned in the report.

The graphic is based on a graphic in a western drought article that appeared in the New York Times[20]. That article used data from the drought monitor website maintained by University of Nebraska-Lincoln[21]. The graphic presented above has two added sets of annotation. The first is a small star placed in the SE Idaho part of each map. This helps to orient the U.S. western graphic to SE Idaho. There are also three polygonal outlines. The first has a green dashed border. This represents the timespan of the initial measurements. The pink dashed border represents the timespan of the photographic measurements. The red dashed border represents the timespan of the recent measurements. The upper left two maps show the timespan of the Deer Creek Weir measurements

From this, it is should be clear that the initial measurements represent a time period where SE Idaho experienced severe to exception drought, yet the Lot 182 Spring had no problems producing 1/4 GPM or better flow rate.

The photographic measurements show a spring decline beginning in 2017, a non-drought year. 2018 was an abnormally dry year, but 2019 was not. 2019 is the time the Lot 182 Spring decline became increasingly apparent, but was not a drought year.

The recent measurements began in 2019, a very wet year. This was the first year that there were periods of NO cistern overflow, a situation that had not occurred previously.

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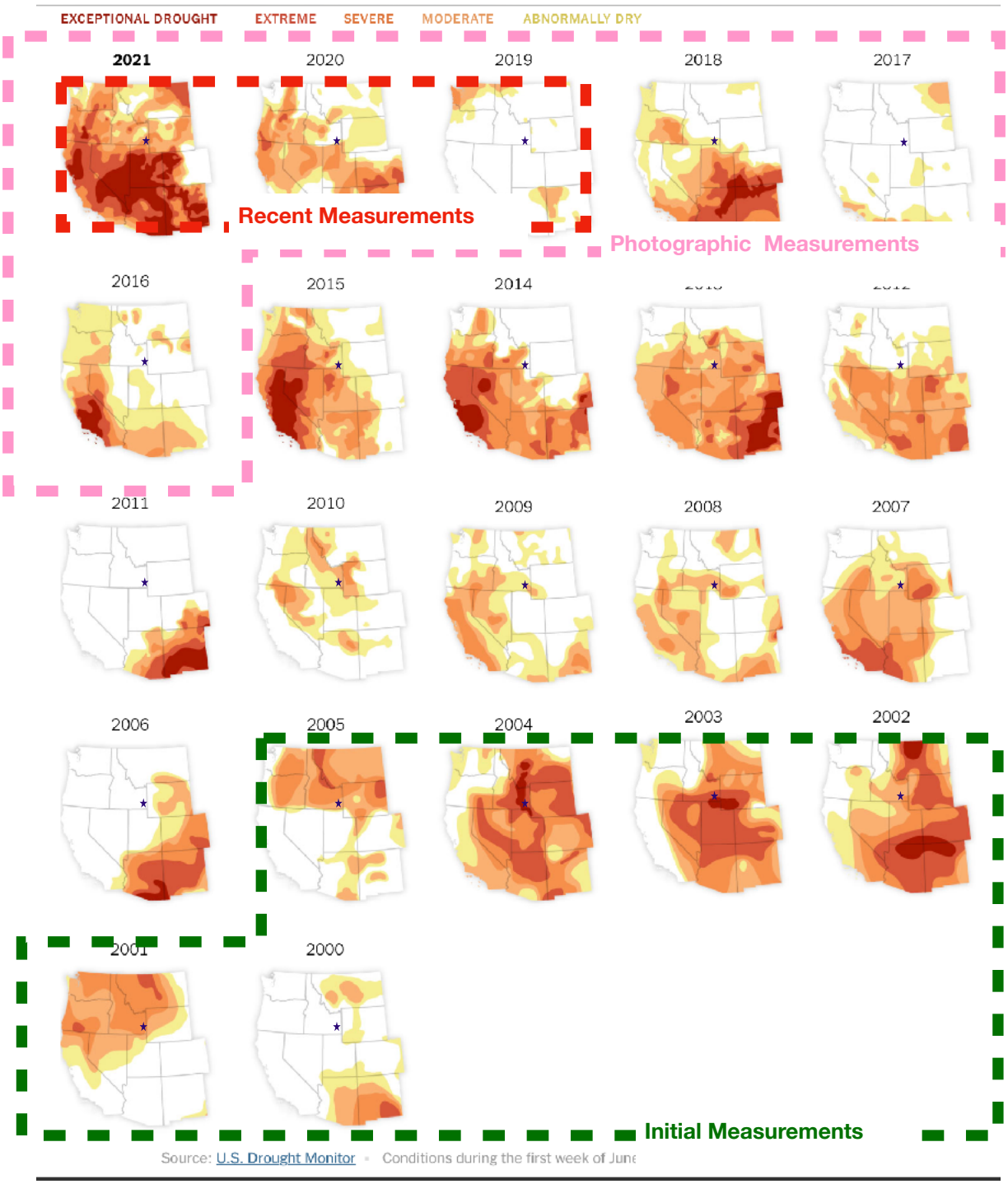
[20] N.Y. Times “How Severe Is the Western Drought? See For Yourself.” By Nadja Popovich June 11, 2021 https://www.nytimes.com/interactive/2021/06/11/climate/california-western-drought-map.html?campaign_id=190&emc=edit_ufn_20210611&instance_id=32797&nl=updates-from-the-newsroom&regi_id=100935008&segment_id=60500&te=1&user_id=c1f8c0d764f02e25c6a353ee62191be7

[21] US Drought Monitor https://droughtmonitor.unl.edu




Measurements intervals correlated with Regional drought. The small stars on each map show the location of SE Idaho. Initial Measurements interval outlined with dashed green outlined polygon. Photographic measurement interval outlined with dashed pink outlined polygon. Recent measurement interval outlined with a dashed red outlined polygon

The above evidence and reasoning is the basis for the claim that the Lot 182 Spring decline is NOT related to drought.

# Appendix III: Map of Lava Ranch Subdivision With Lot Numbers