



2018 Helena Valley Flooding

Inputs and Outputs

A Presentation to the Helena Valley Flood Committee

Jan 24th , 2019

Peter Schade
Lewis & Clark County
Water Quality Protection District



Contents



- Revisit spring conditions of 2018
- Hydrologic setting of Tenmile Creek and Helena Valley
- Climate data comparisons
- Hydrologic data comparisons

2018 March 7



Fox Ridge looking South

2018 March 15



Applegate Rd & Norris Rd Looking West

18 March 15



Crestwood Lane looking SW



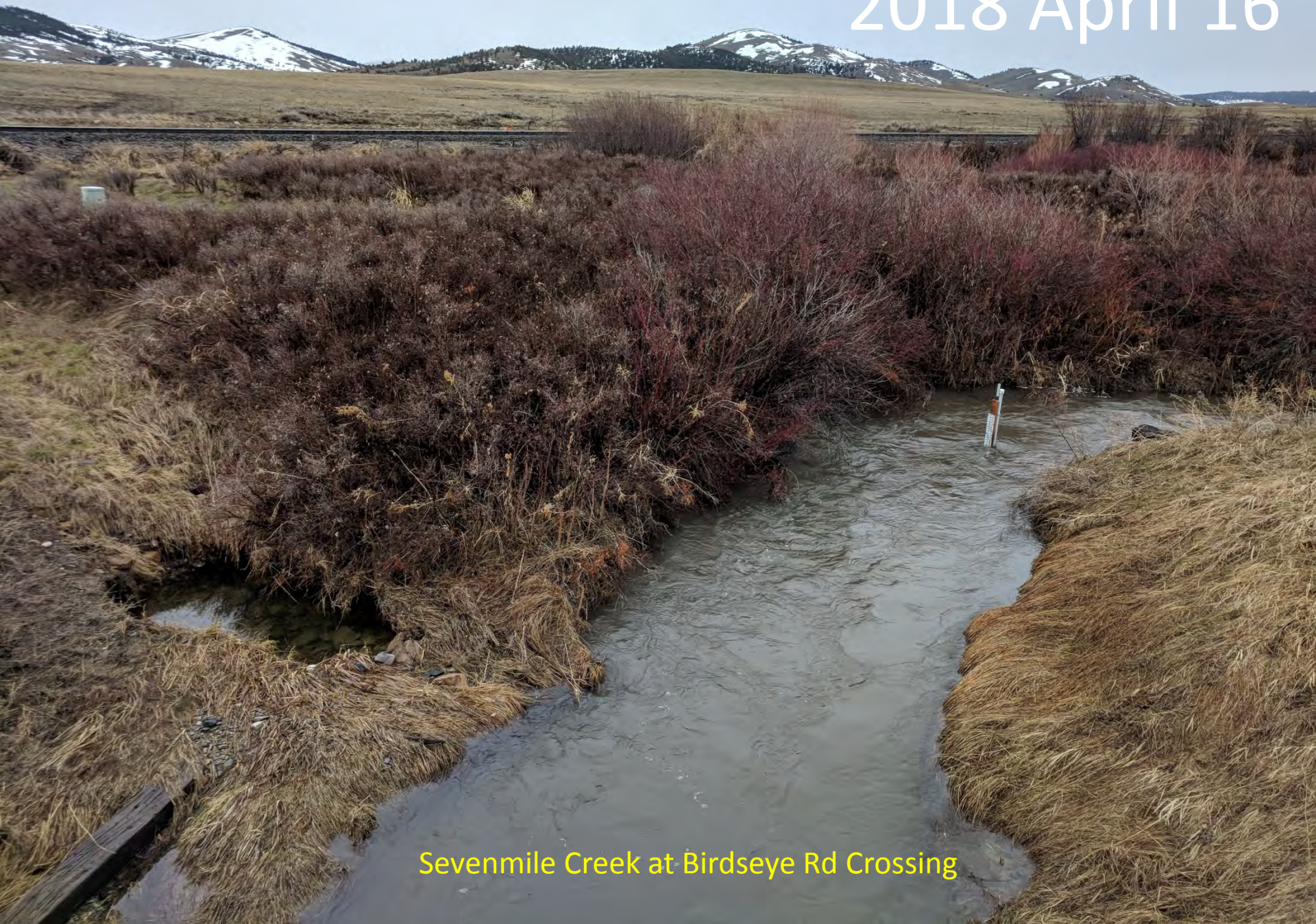
2018 March 22



Canyon Ridge Subdivision



2018 April 16



Sevenmile Creek at Birdseye Rd Crossing

2018 April 27





2018 May 3



2018 April 29



Tenmile Creek at Green Meadow Drive

2018 May 9



Tenmile Creek at Frontage Rd





2018 May 9





08/14/2017 13:32



2018 May 1

Green Meadow Drive



Just below the confluence of Tenmile Creek and Sevenmile Creek



2018 May 1



Just downstream of Green Meadow Drive



2018 May 1



2018 May 1



2018 May 1



2018 May 1



McHugh Dr

N

Mill Rd





Green Meadow Dr

McHugh Dr

S

N

2018 May 1

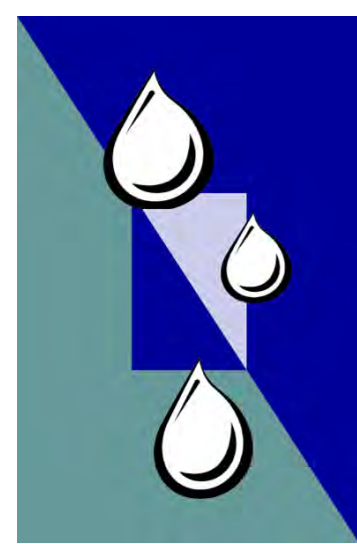
Kerr Dr

N





Flooding: How did it get like this?



Natural Physical and Environmental Factors:

- Valley setting/slope
- Mountain Snowpack
- Valley Snowpack
- Timing of Snowmelt
- Spring Precipitation



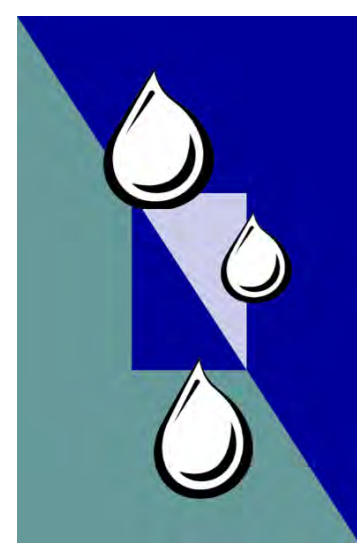
Hydrologic Response:

- Streamflow
- Activation of alluvial channels
- Rising Groundwater



Physical Setting

- Watershed
- Surface and Groundwater Flow
- Typical GW depths
- Valley/Stream Slope
- Alluvial Fans
- Valley Topography
- Infrastructure





Silver Creek

Sevenmile Creek

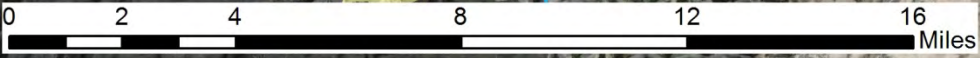
Tenmile Creek

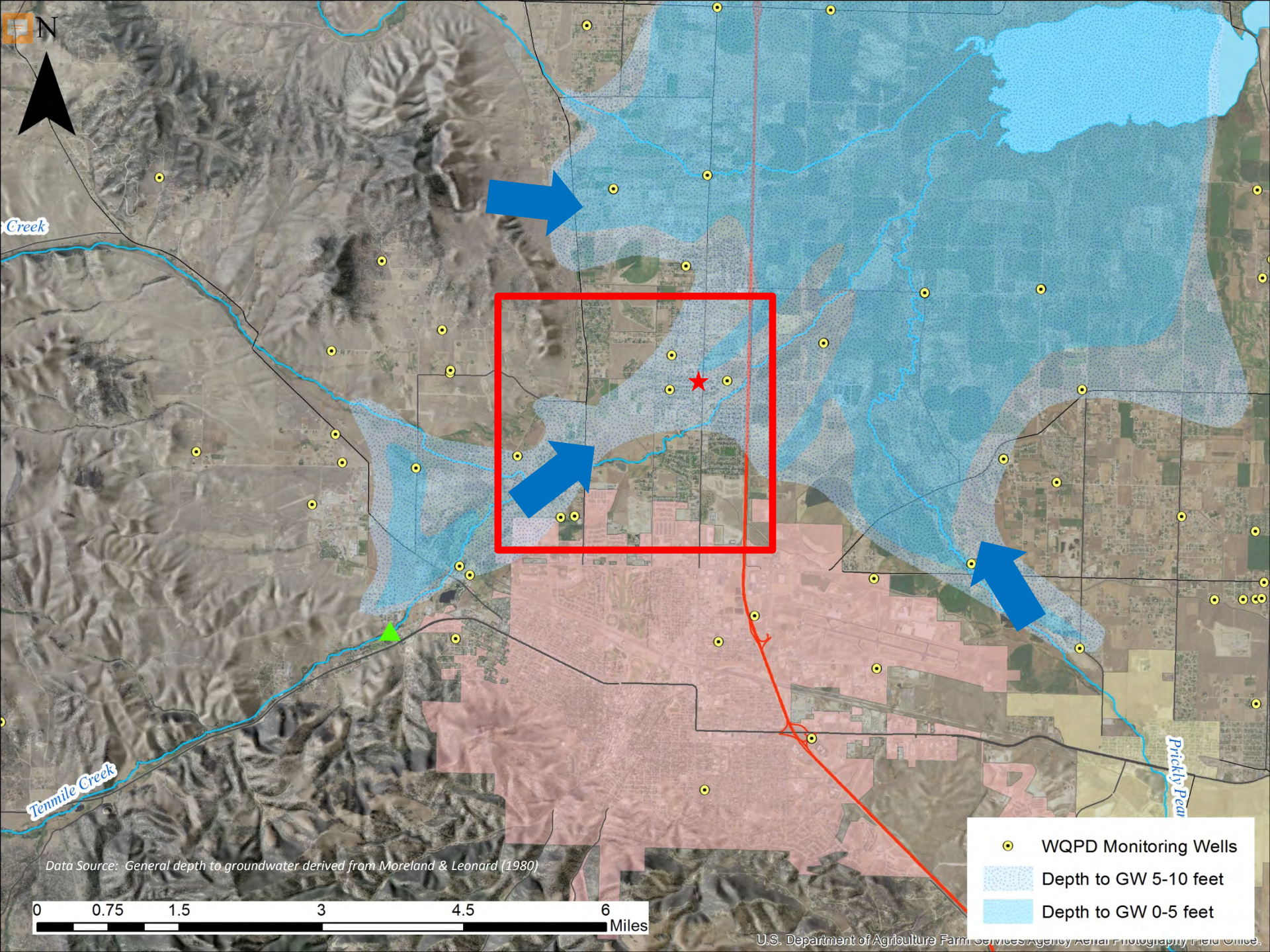
Prickly Pear Creek

Williams St USGS gauging station

Rimini USGS gauging station

Frohner Meadows Snotel



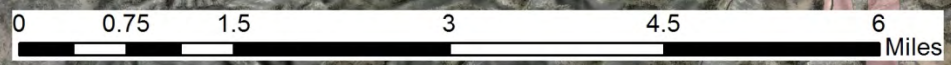


Creek

Tenmile Creek

Prickly Pear

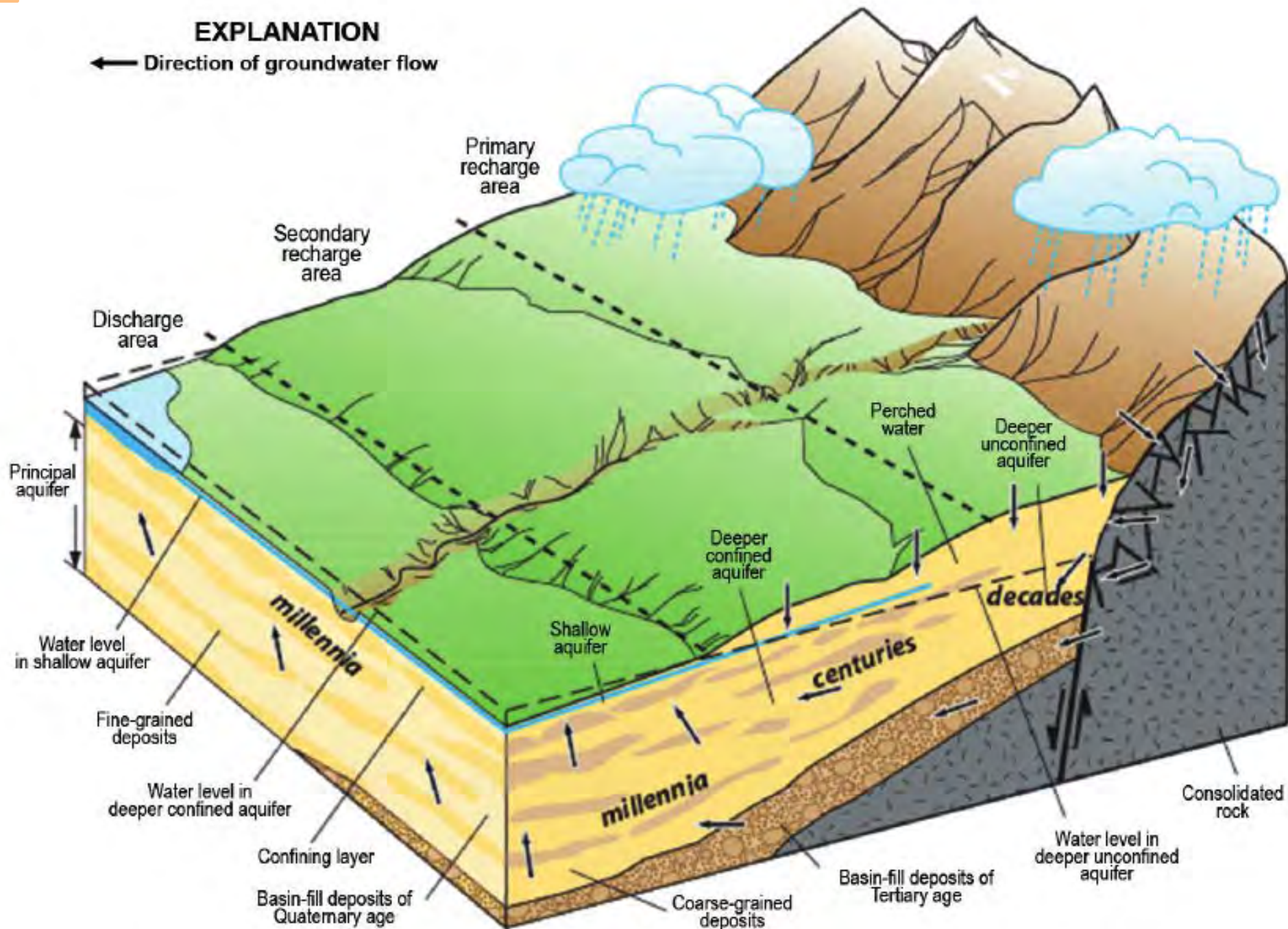
Data Source: General depth to groundwater derived from Moreland & Leonard (1980)

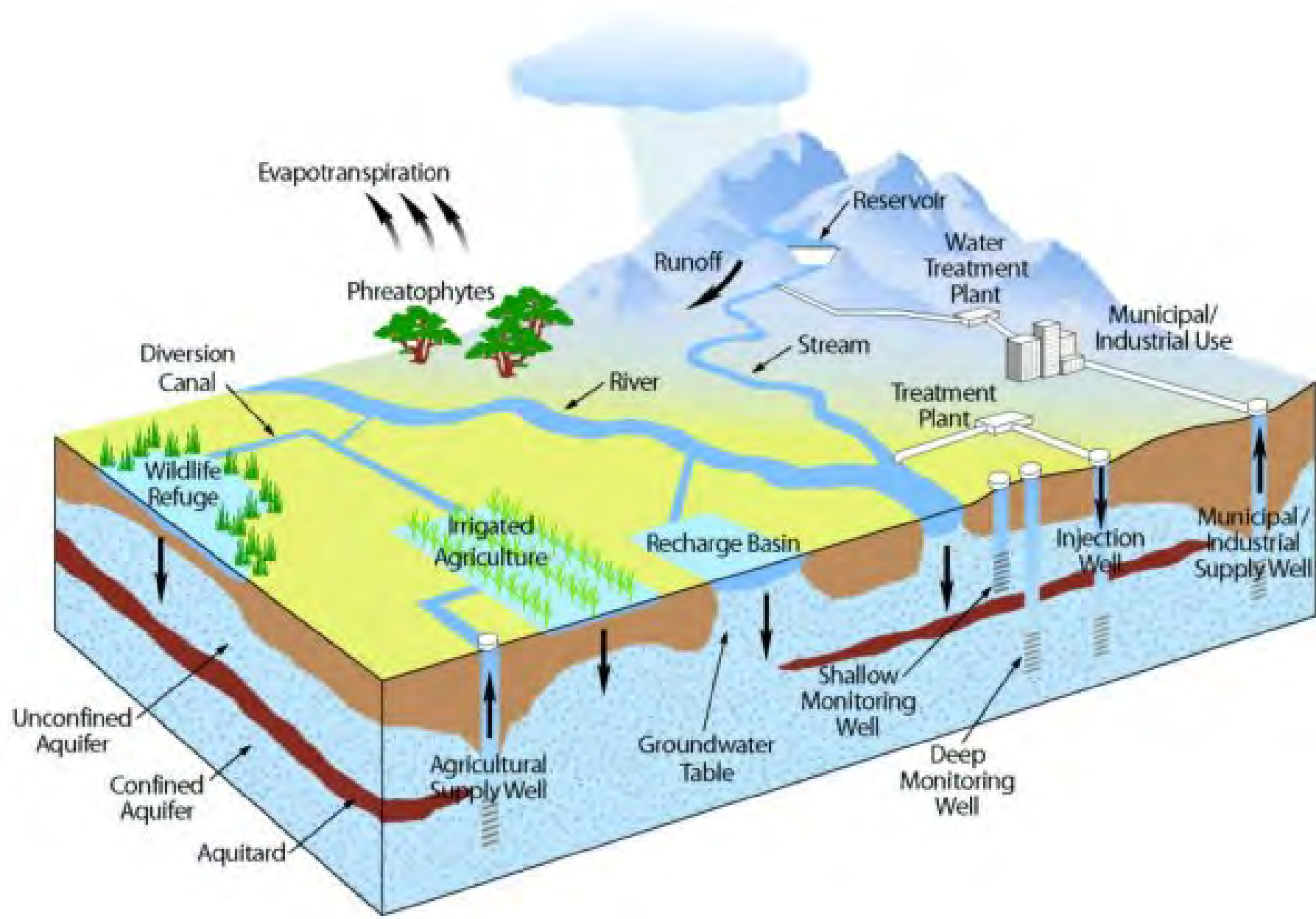


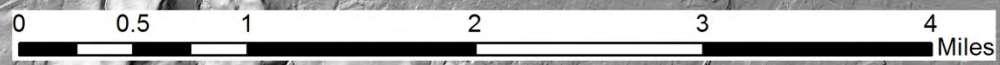
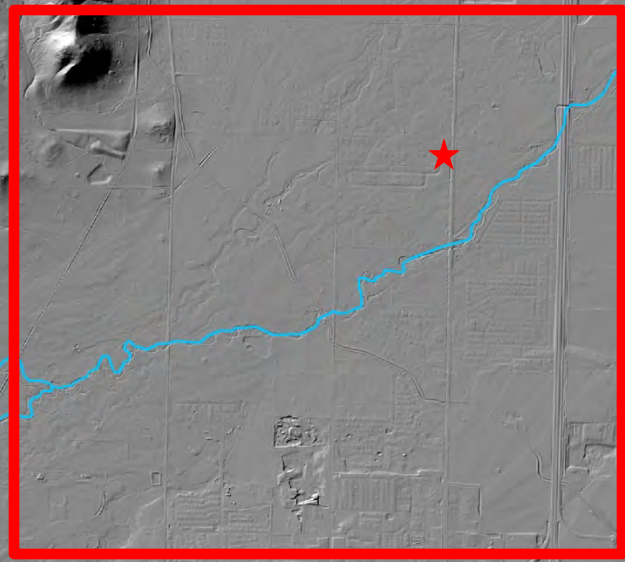
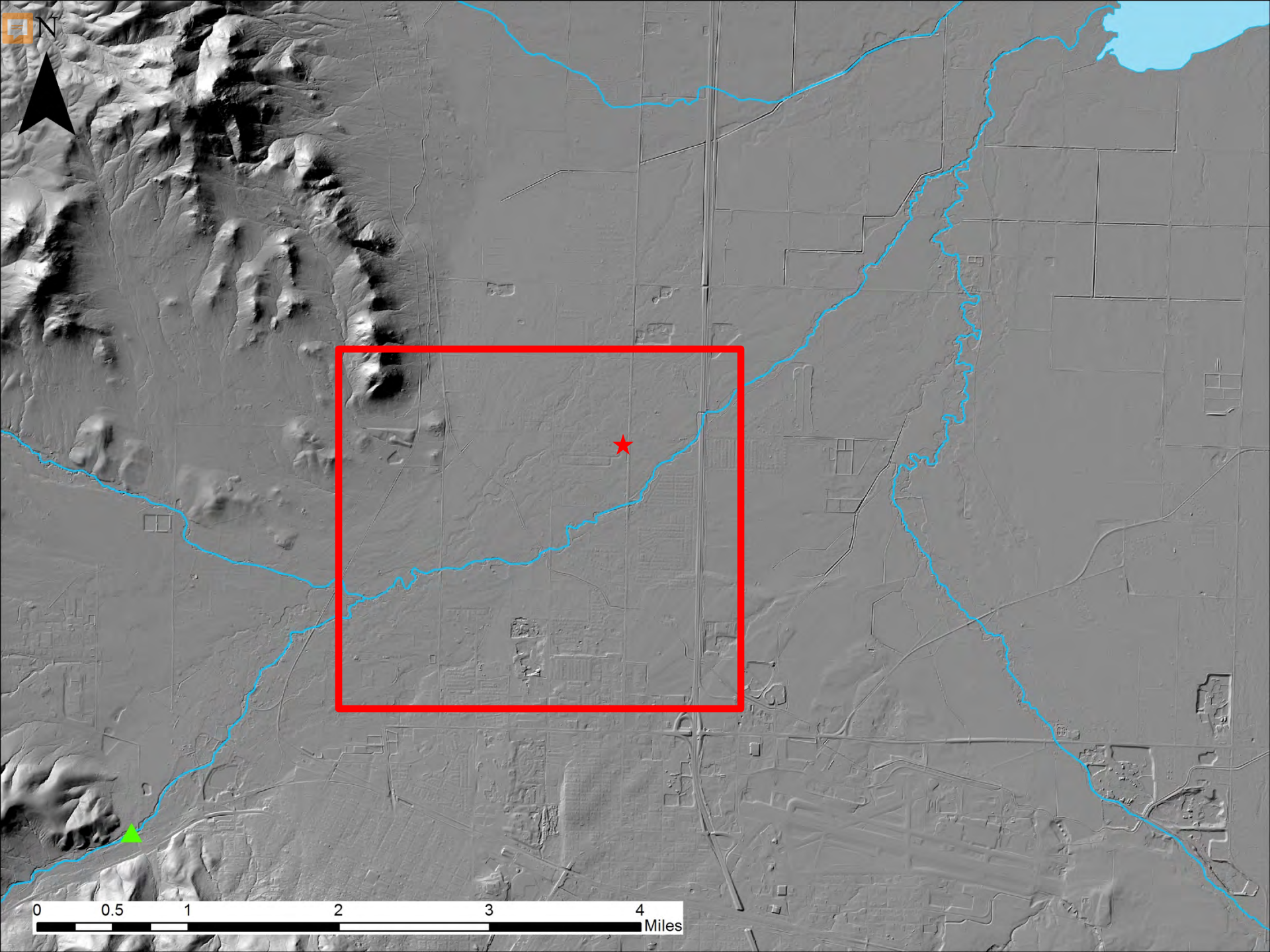
- WQPD Monitoring Wells
- Depth to GW 5-10 feet
- Depth to GW 0-5 feet

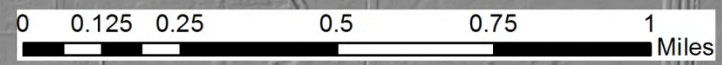
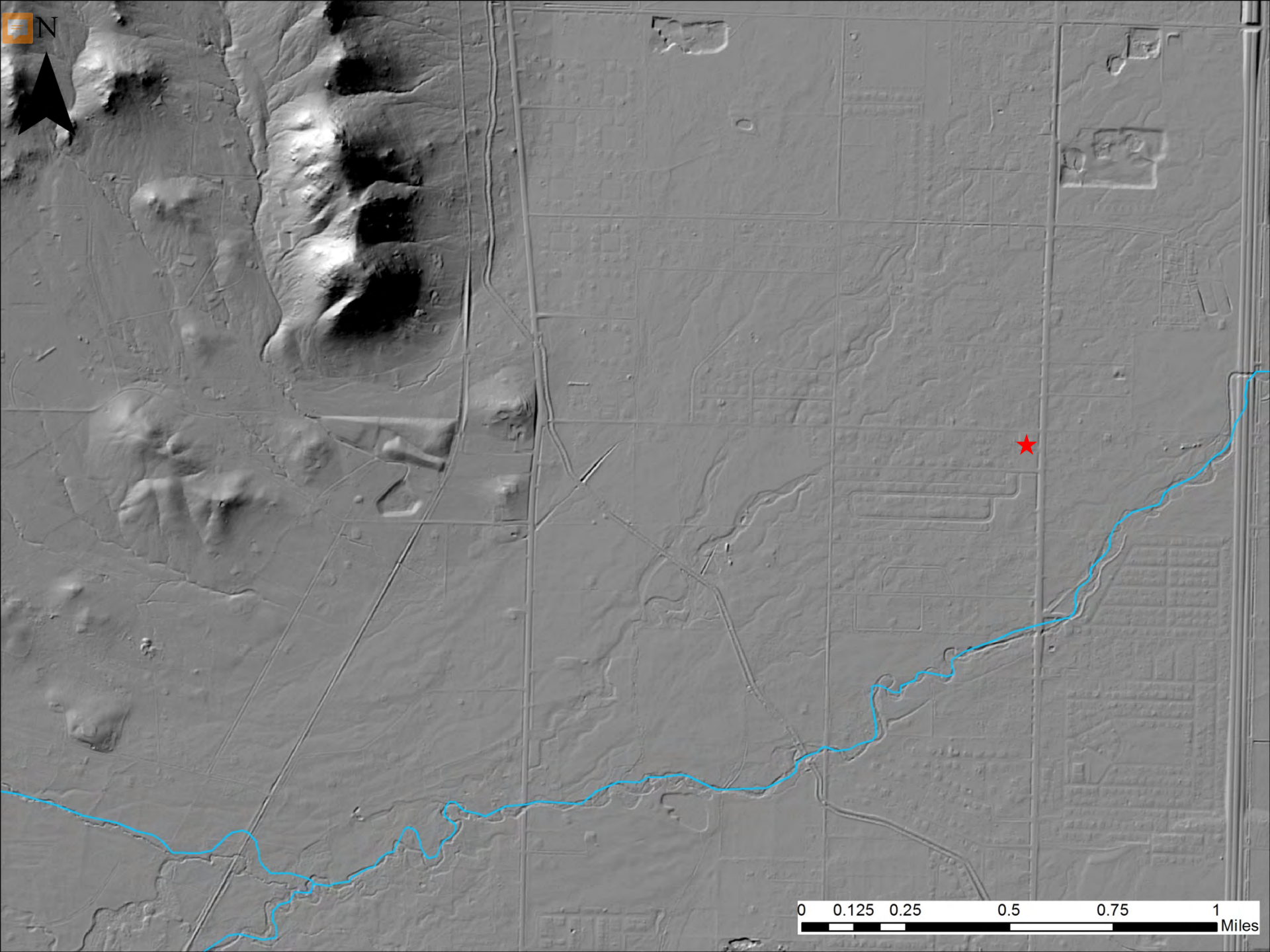
EXPLANATION

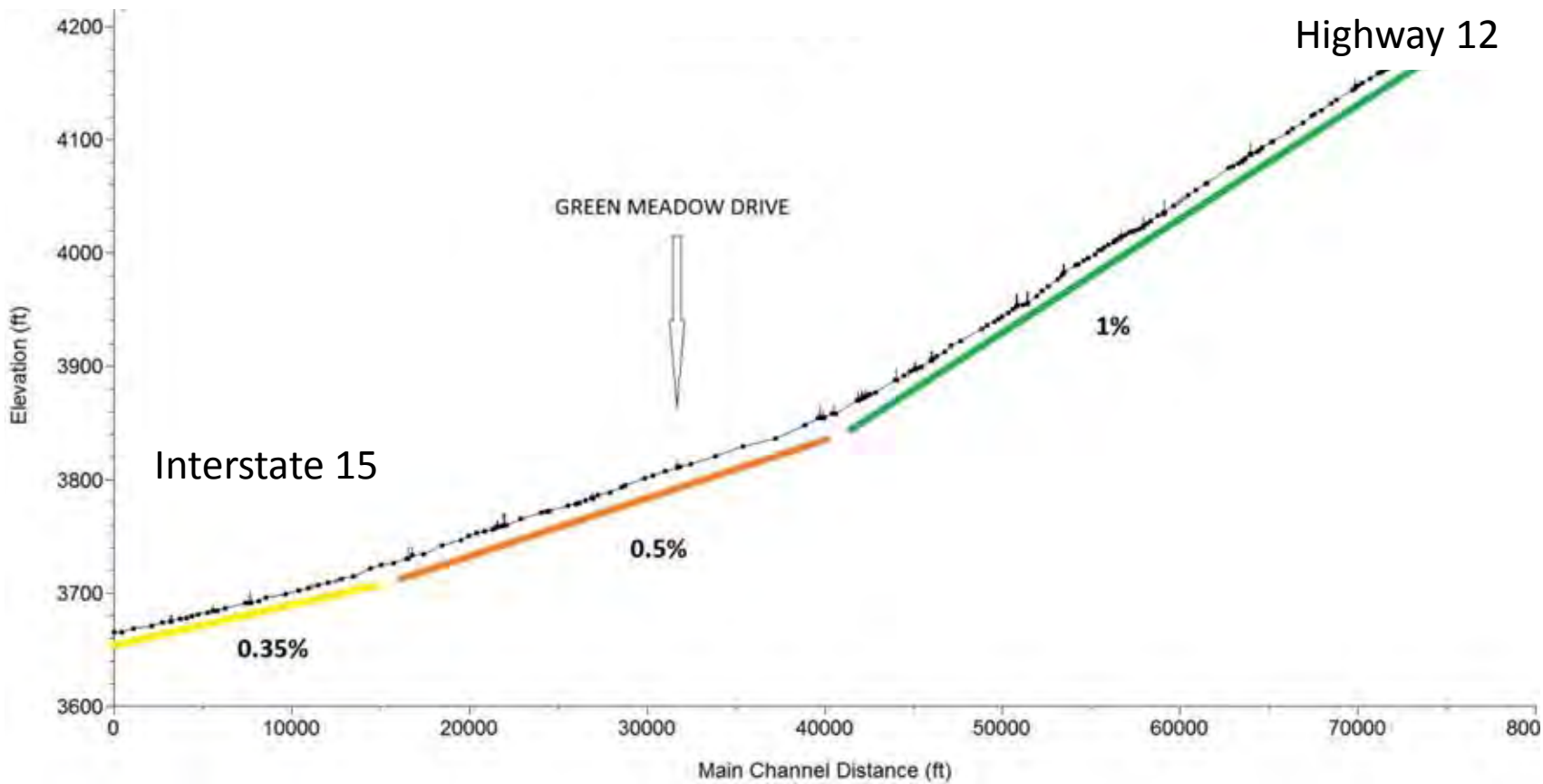
← Direction of groundwater flow











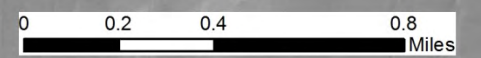
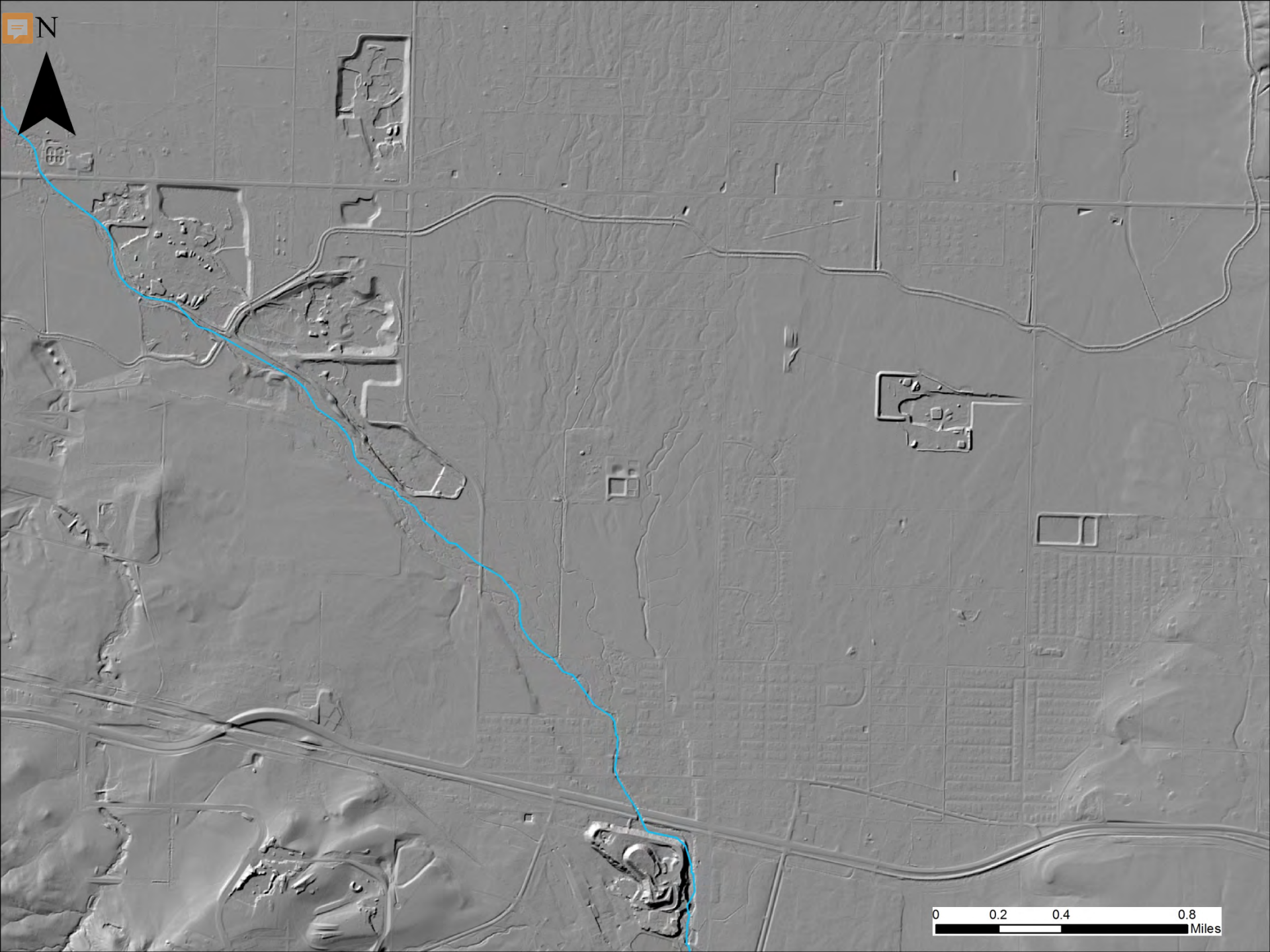
Streambed profile illustrating grade break just upstream of Green Meadow Drive.

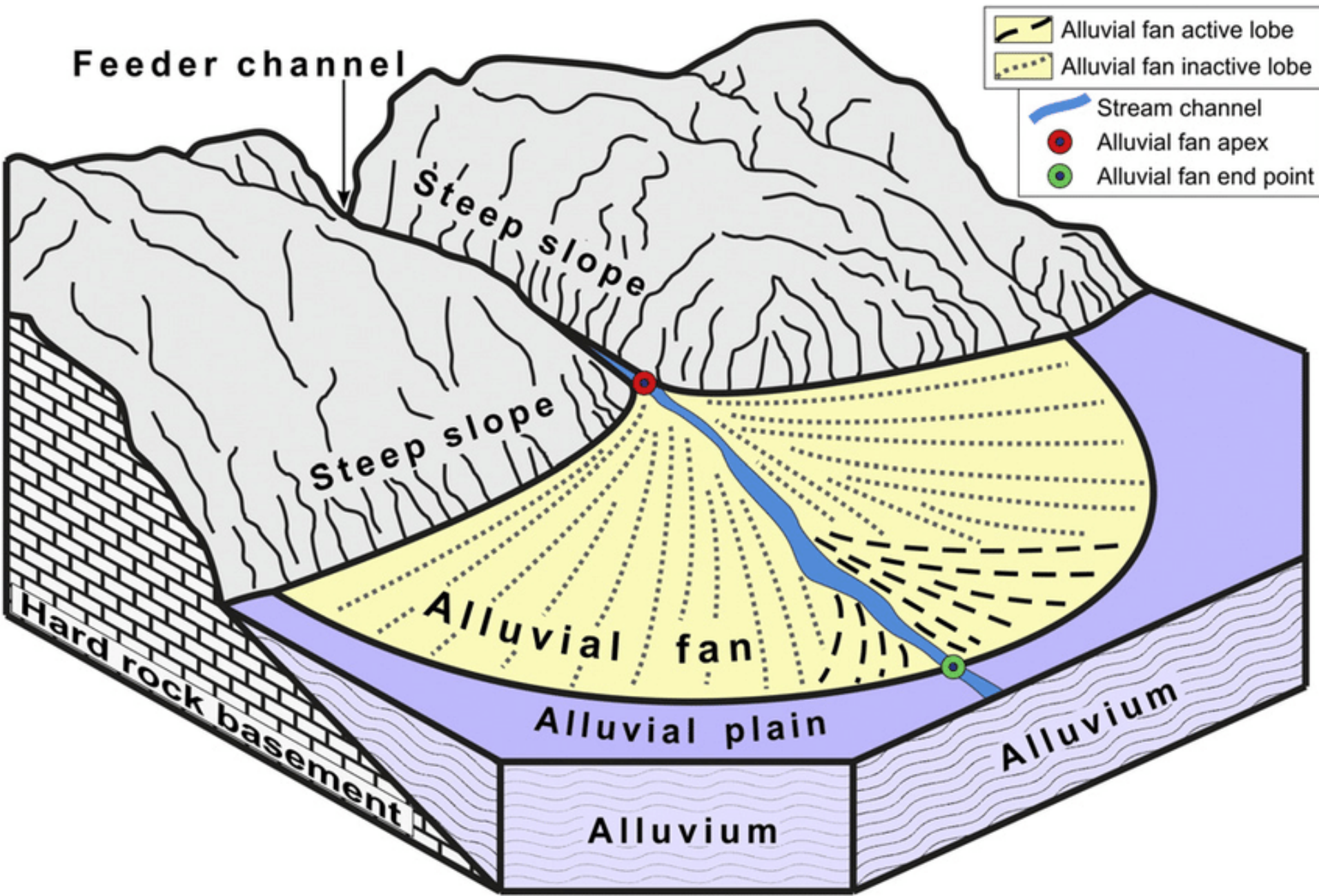


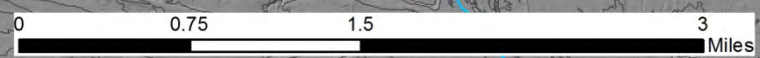
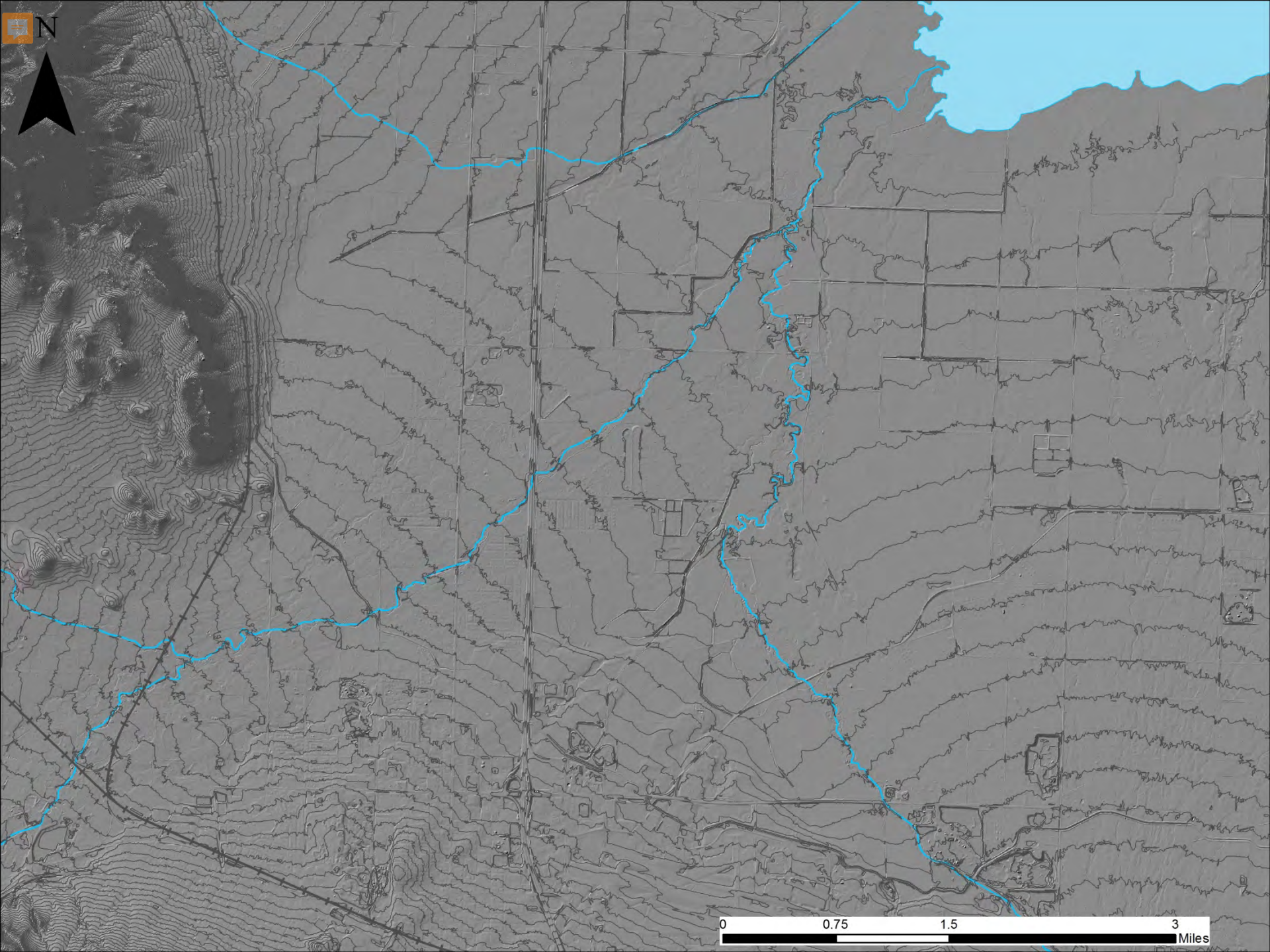
Green Meadow Drive

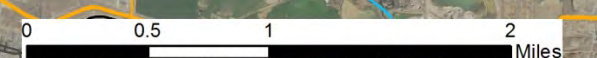
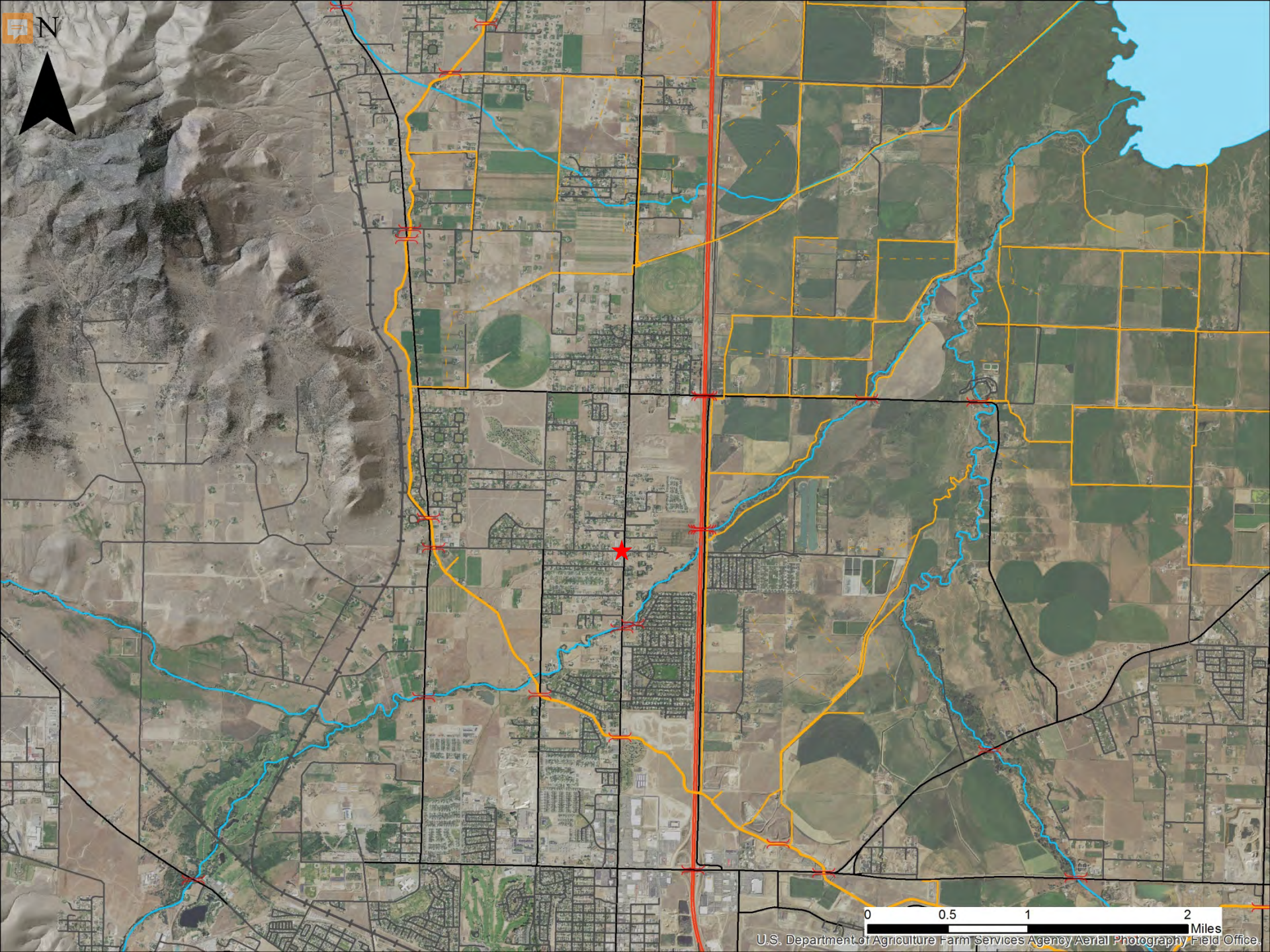












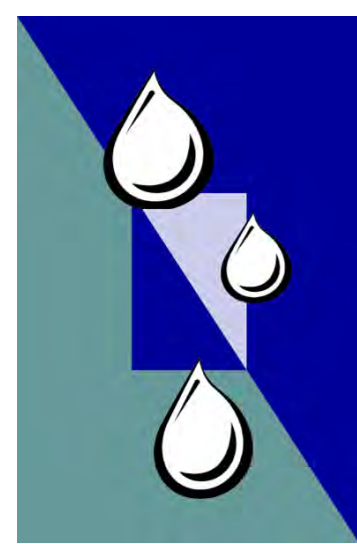
U.S. Department of Agriculture Farm Services Agency Aerial Photography Field Office



Brief Break...

Hydrologic Setting Review

- Watershed Size
- Surface and Groundwater Flow
- Typical GW depths
- Valley/Stream Slope
- Alluvial Fans
- Valley Topography
- Infrastructure

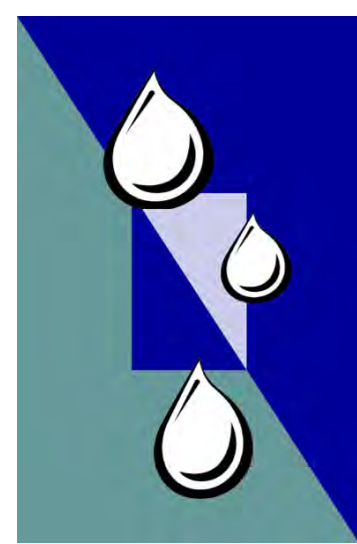




Now...enter 2018...

Factors:

- Precipitation
- Mountain Snowpack
- March-April Valley Snow
- Elevated Spring GW





Silver Creek

Sevenmile Creek

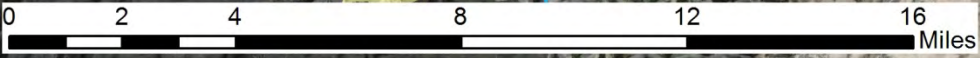
Williams St USGS gauging station

Tenmile Creek

Rimini USGS gauging station

Frohner Meadows Snotel

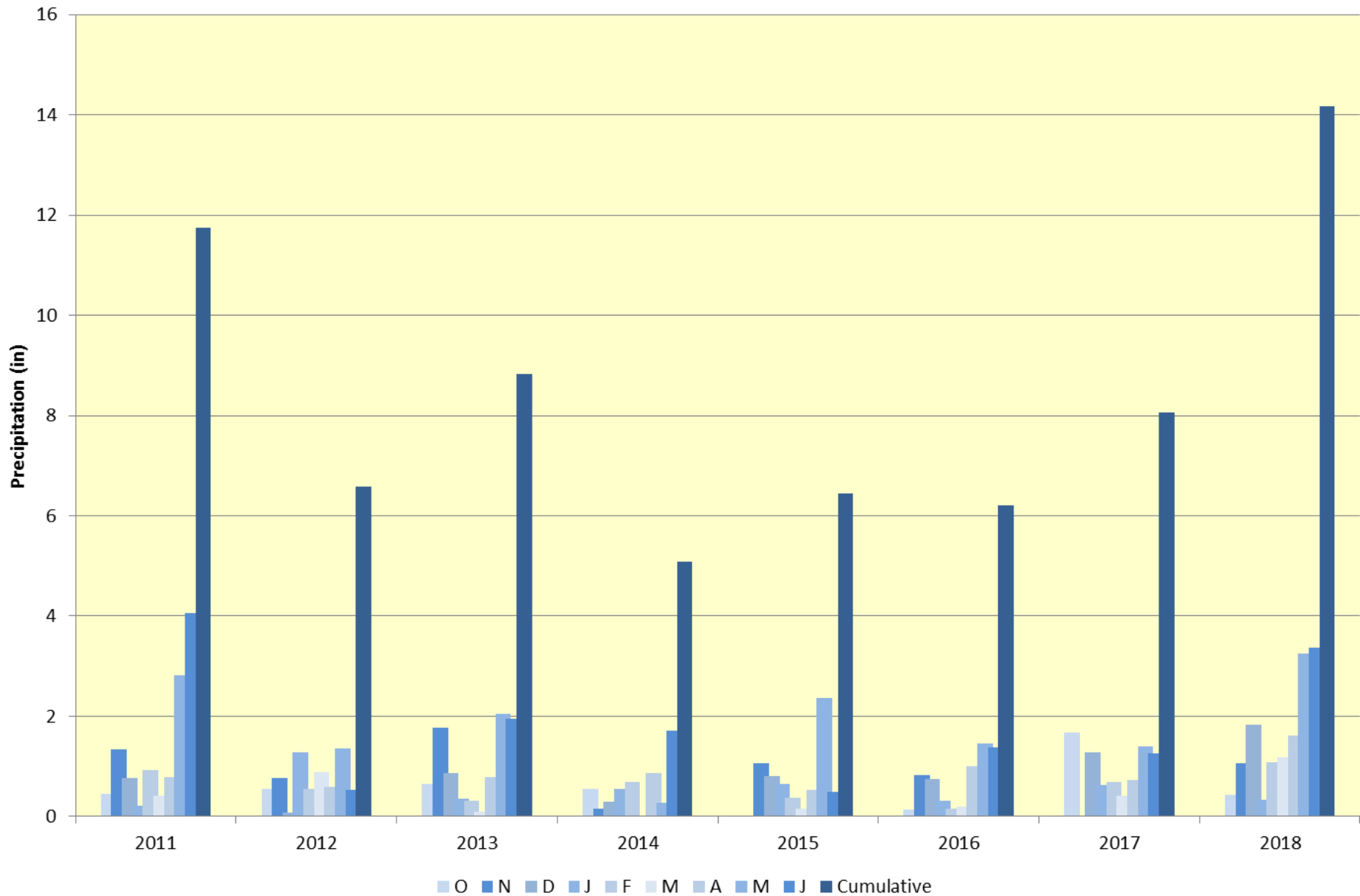
Prickly Pear Creek

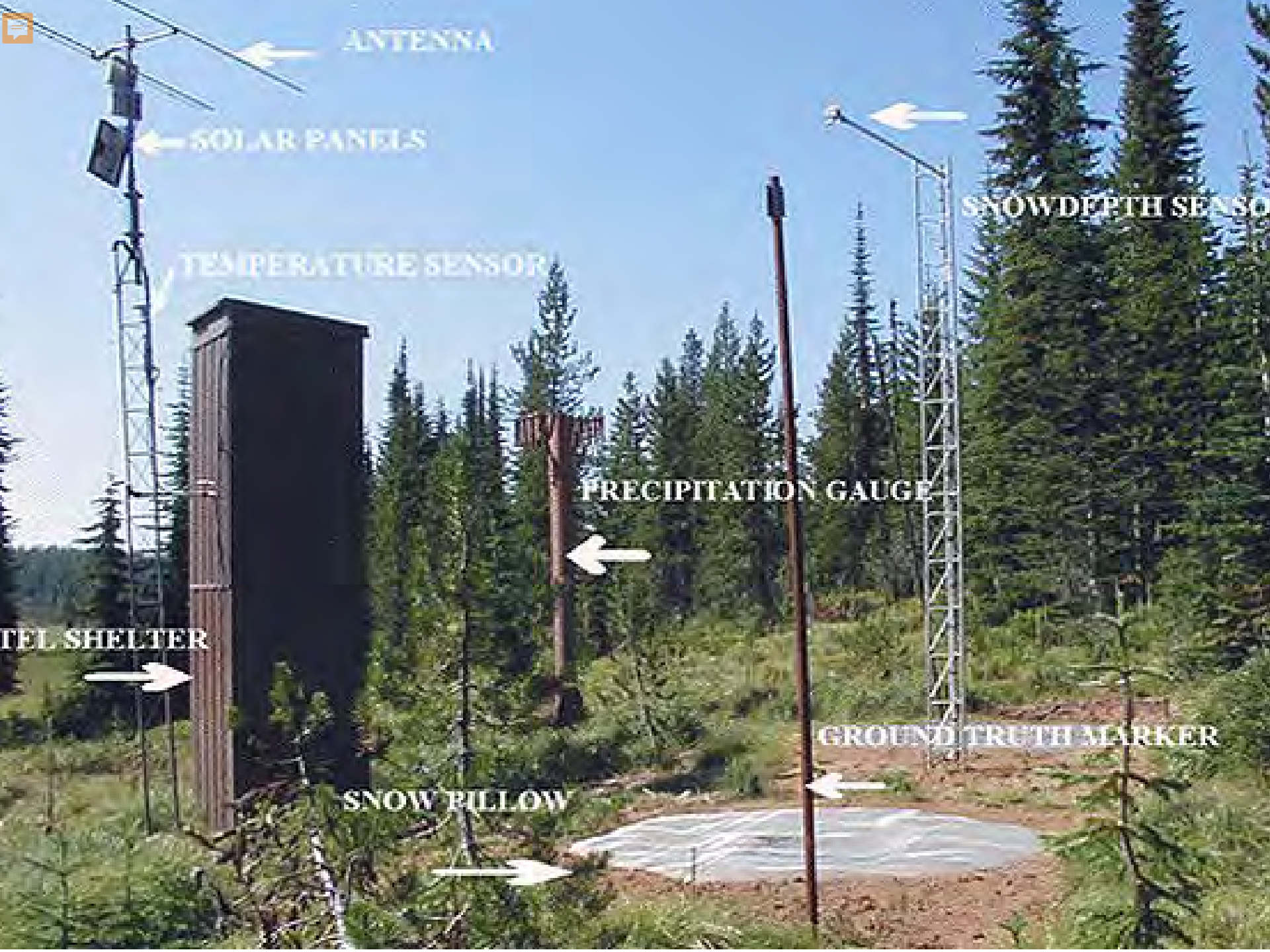




Helena Monthly Precipitation

Oct-June





ANTENNA

SOLAR PANELS

TEMPERATURE SENSOR

SNOWDEPTH SENSOR

PRECIPITATION GAUGE

TEL SHELTER

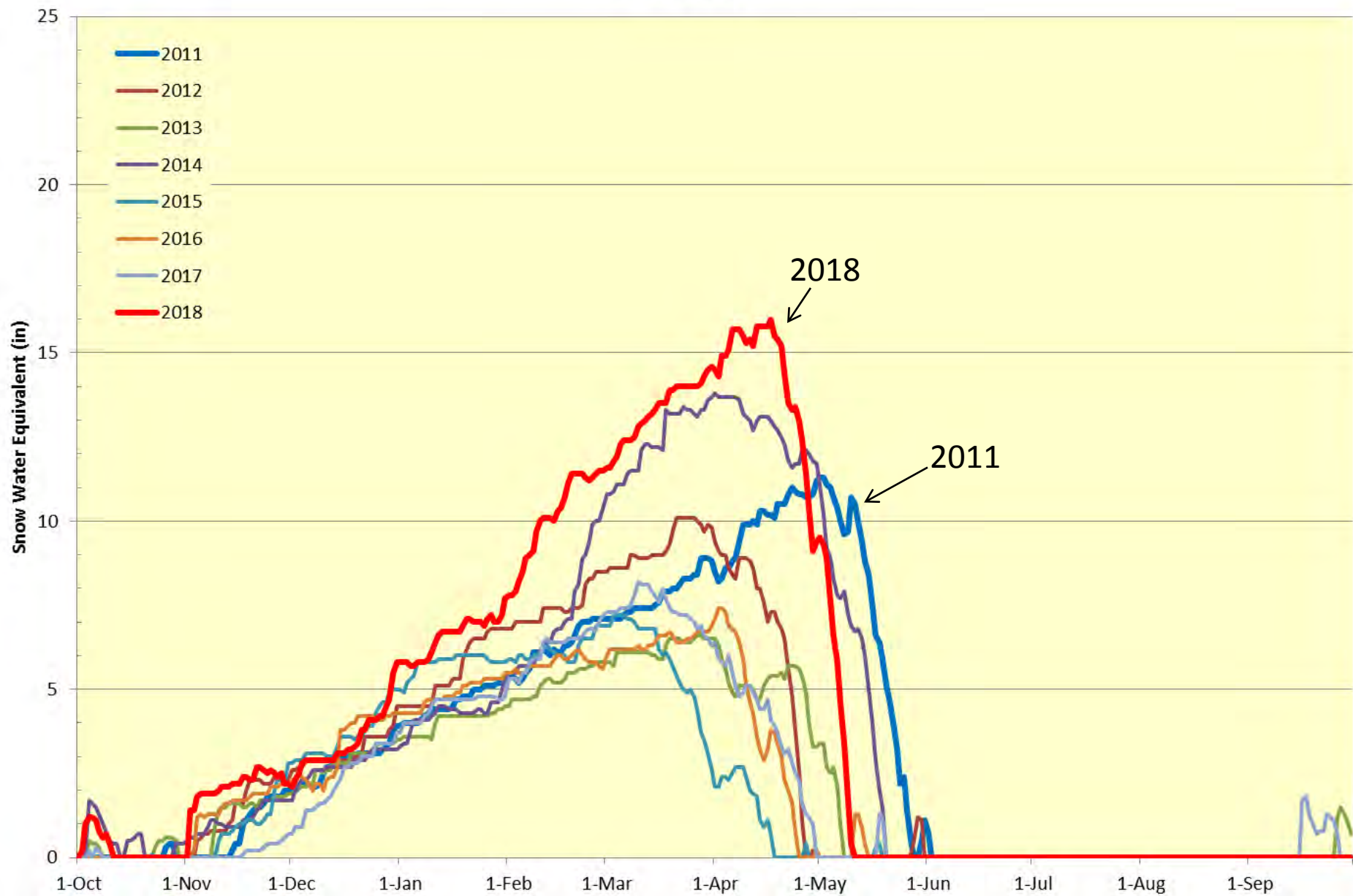
GROUND TRUTH MARKER

SNOW PILLOW



Frohner Meadows Snotel Data

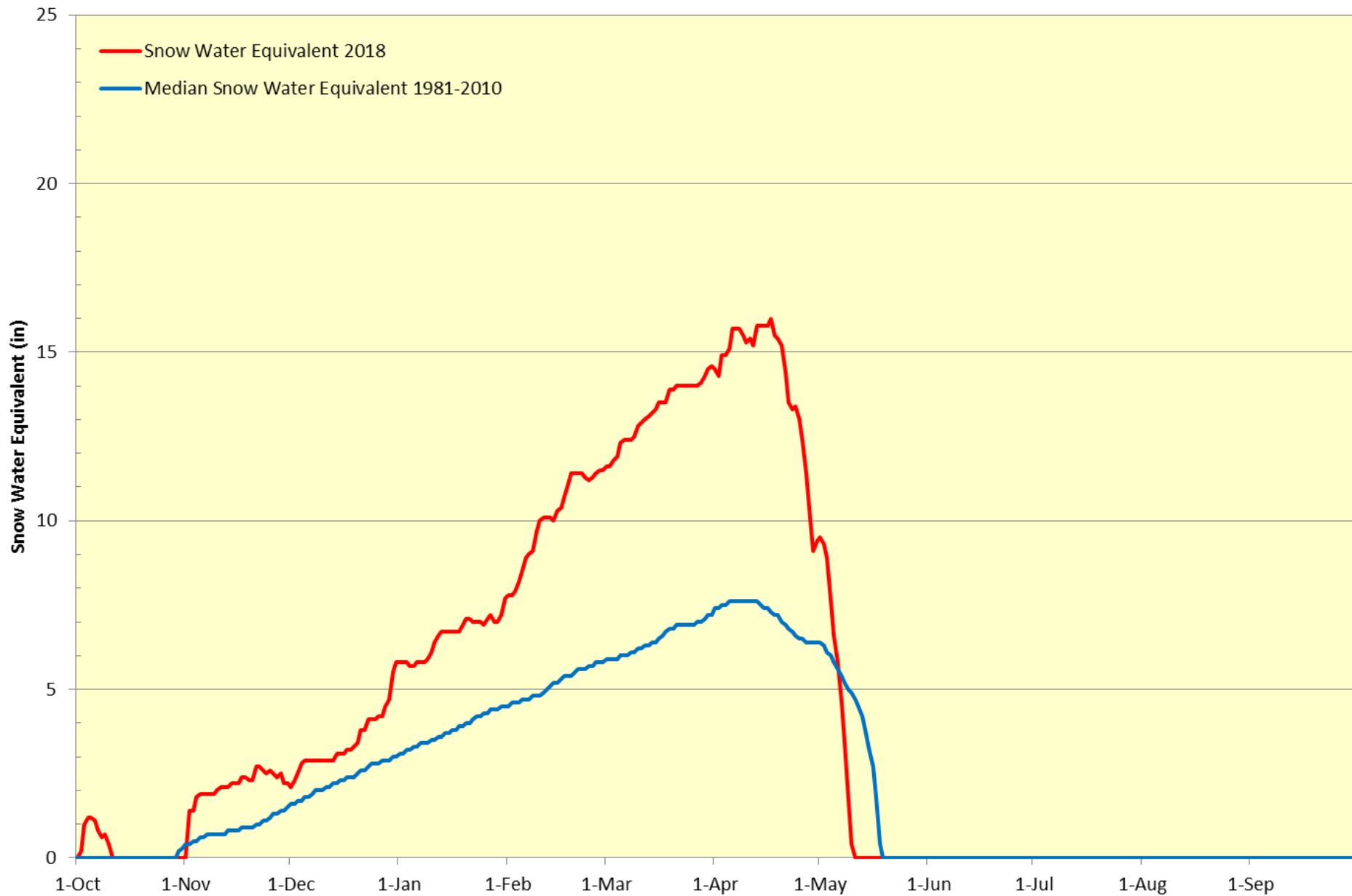
2011-2018





Frohner Meadow Snotel Data

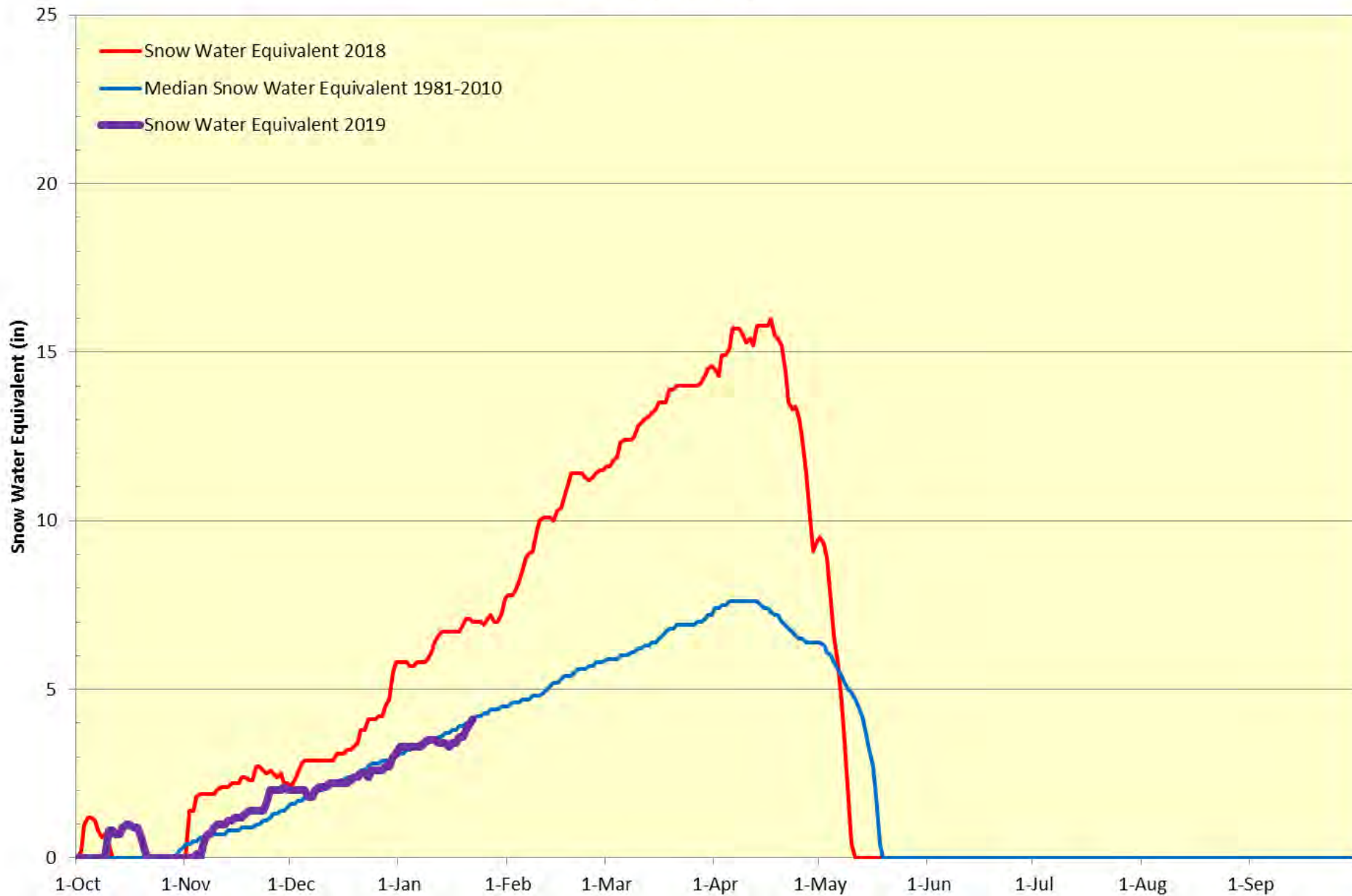
2018 Water Year



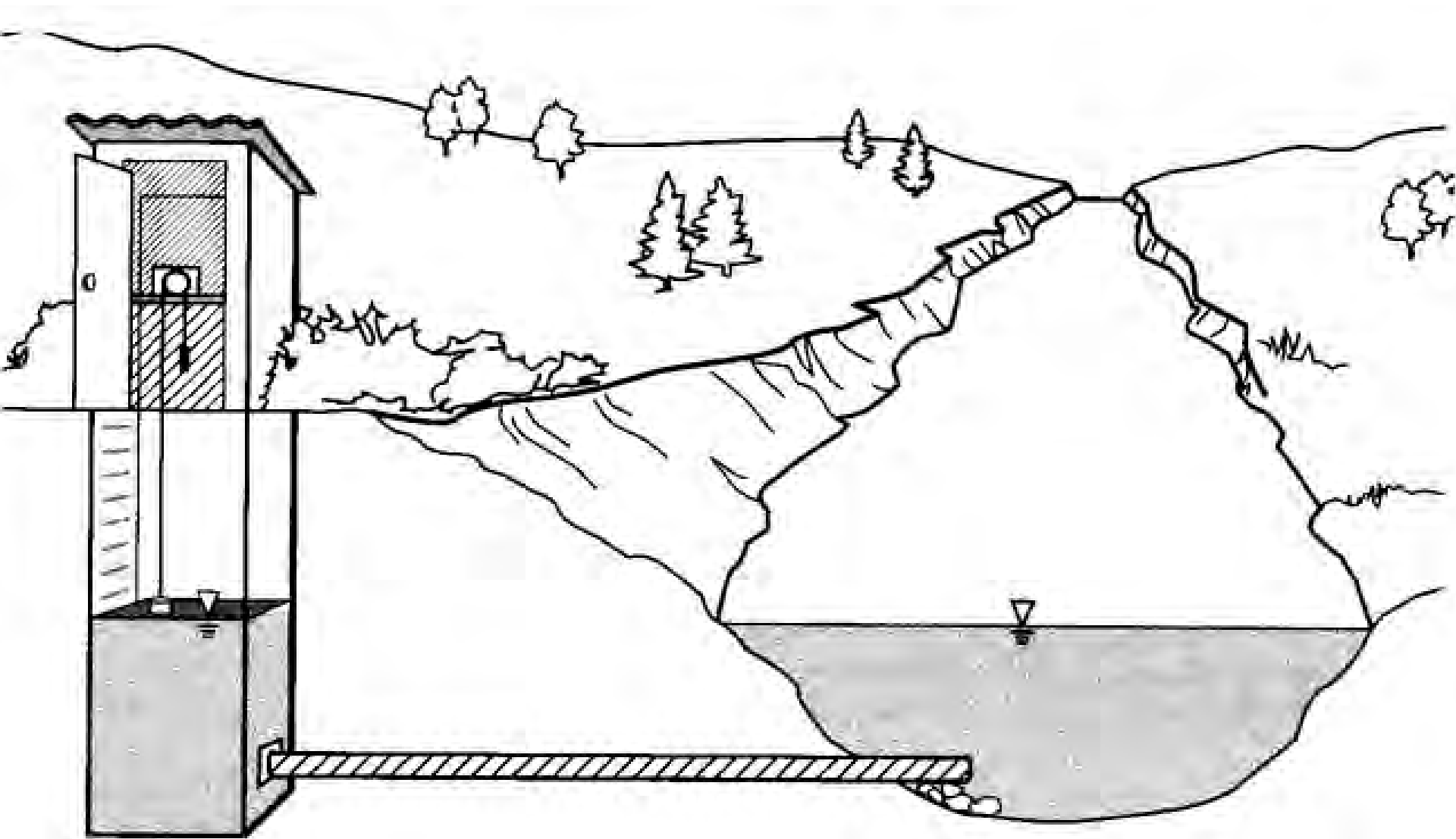


Frohner Meadow Snotel Data

2018 Water Year



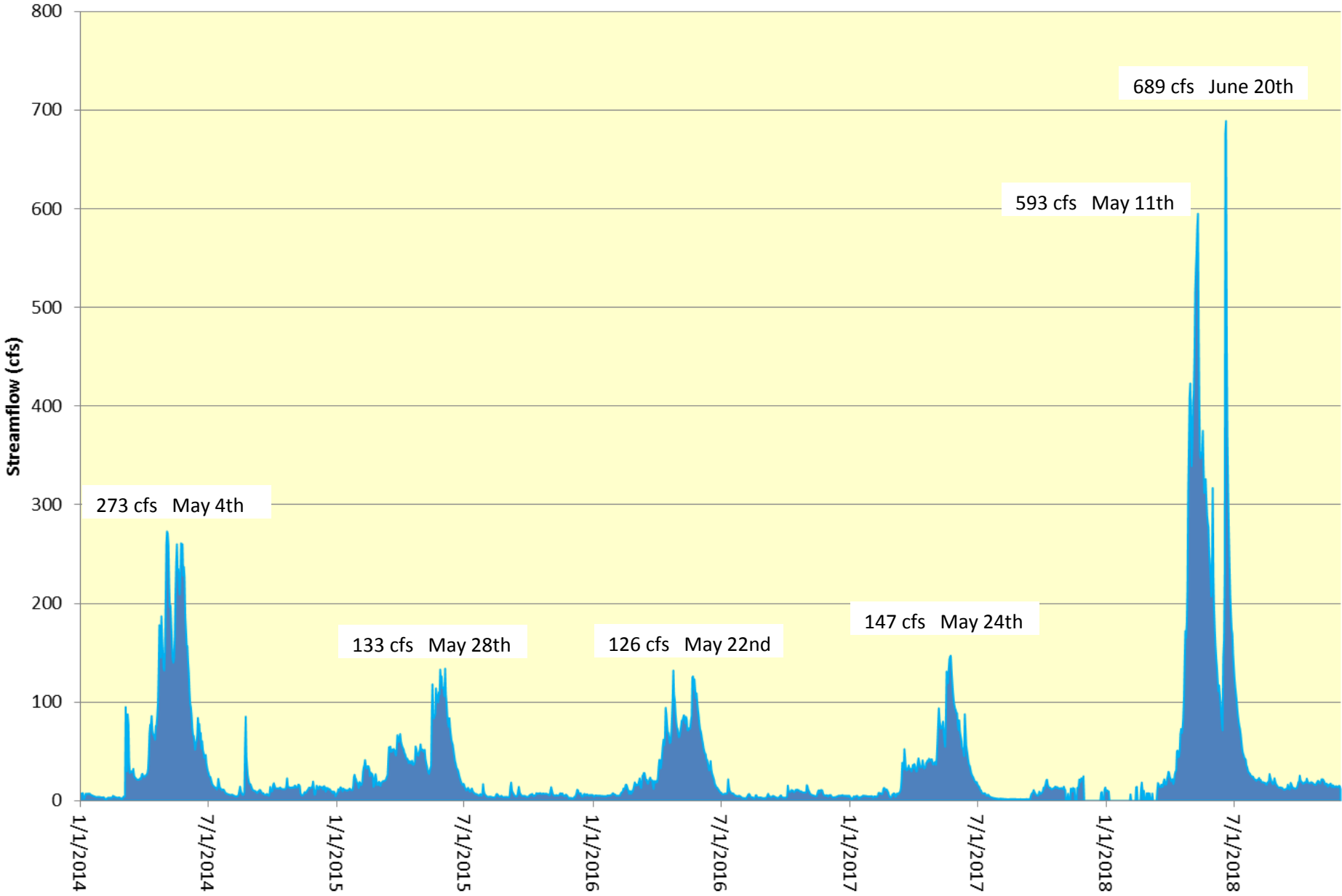
USGS Stream Gauging Station





Tenmile Creek Streamflow

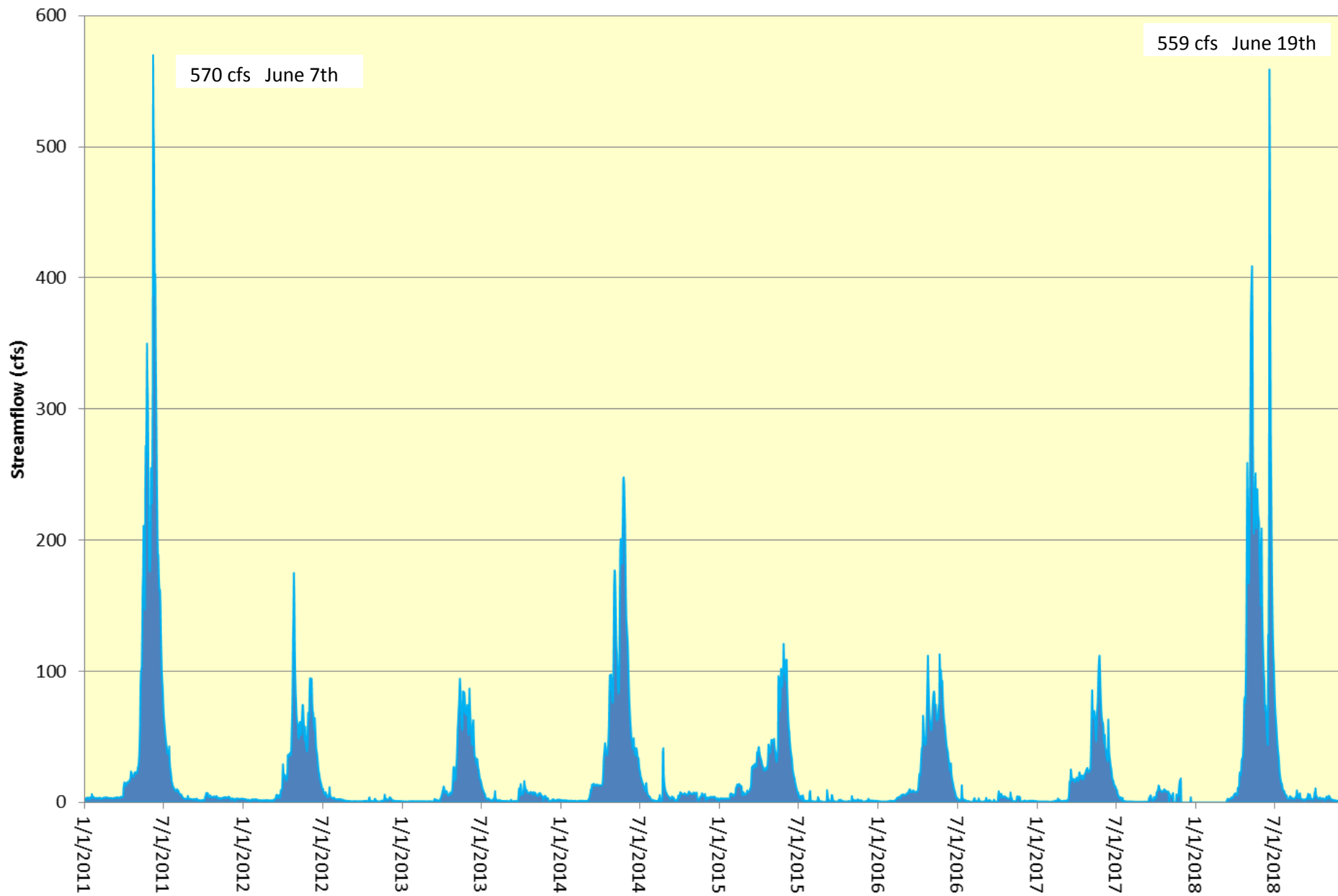
USGS Williams St Gauge 6063000 2014-2018





Tenmile Creek Streamflow

USGS Rimini Gauge 6062500 2011-2018





2018 May 1





2018 May 1





2018 June 15





2018 June 15

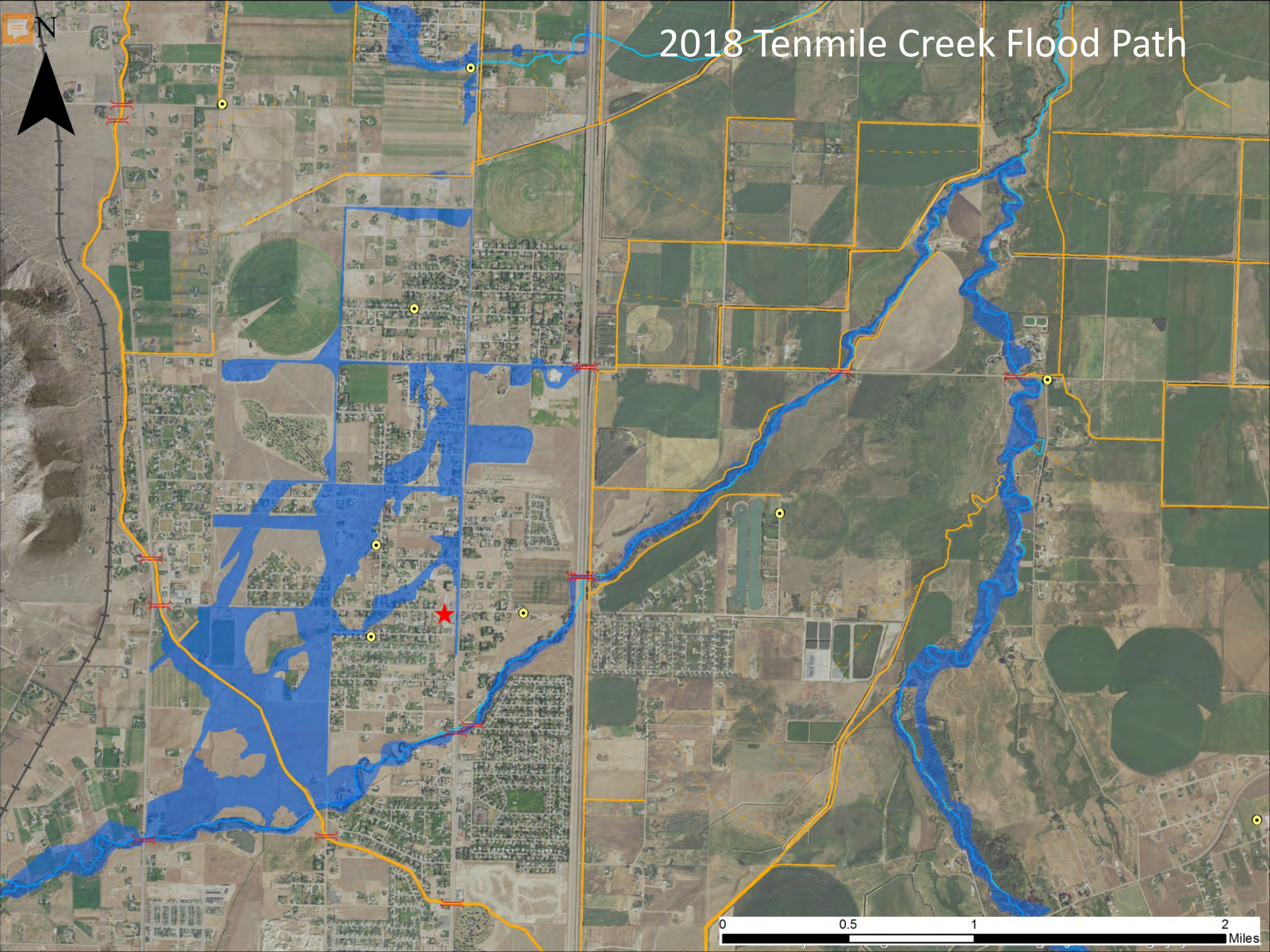




2018 June 15



2018 Tenmile Creek Flood Path



0 0.5 1 2 Miles

2018 May 1



Kerr Dr

N

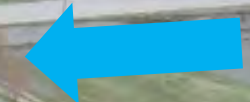


2018 May 1

N

McHugh Dr

Mill Rd



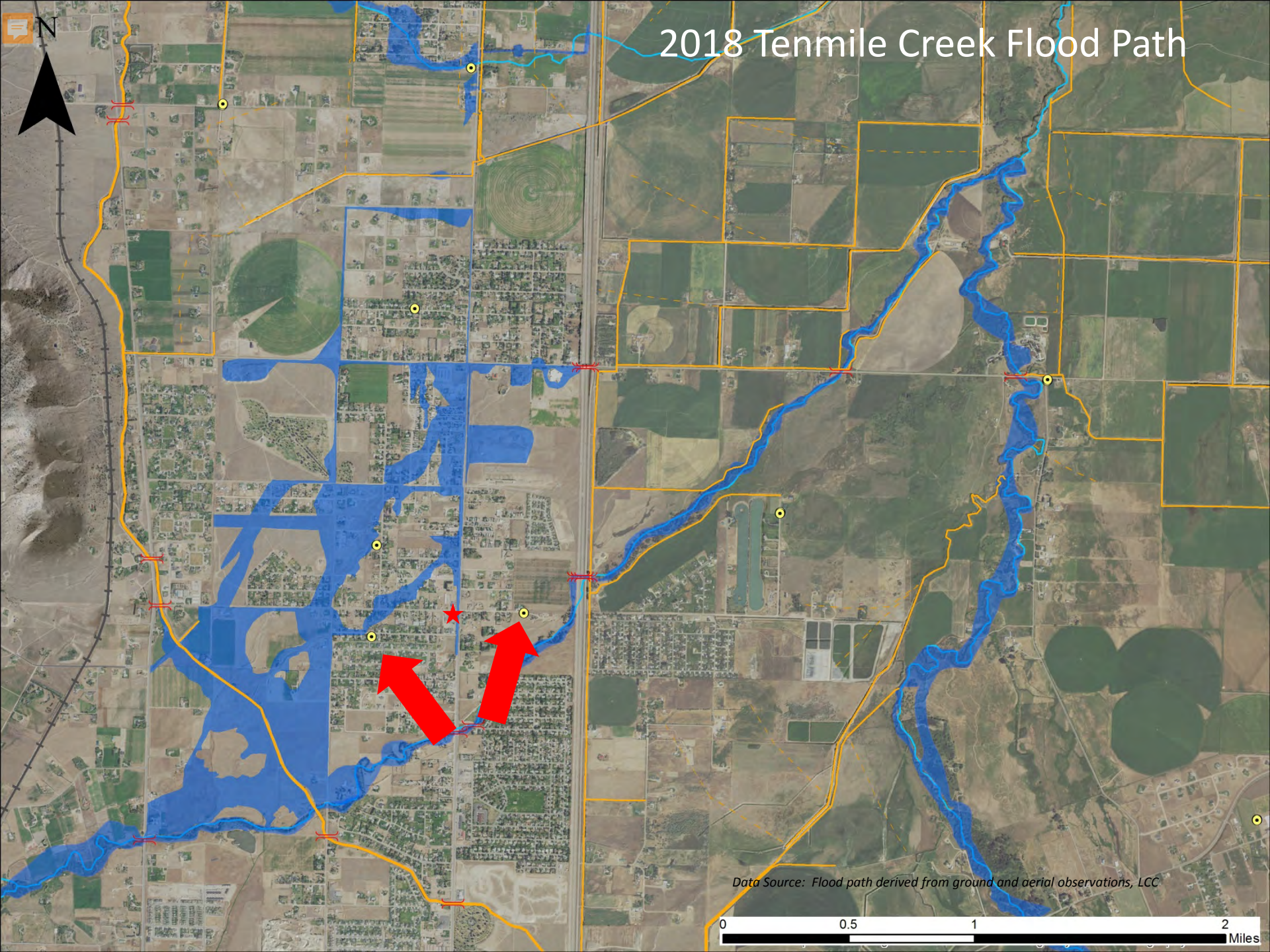
2018 May 1

McHugh Dr

Stadler Dr



2018 Tenmile Creek Flood Path



Data Source: Flood path derived from ground and aerial observations, LCC

0 0.5 1 2 Miles



Motsiff Rd

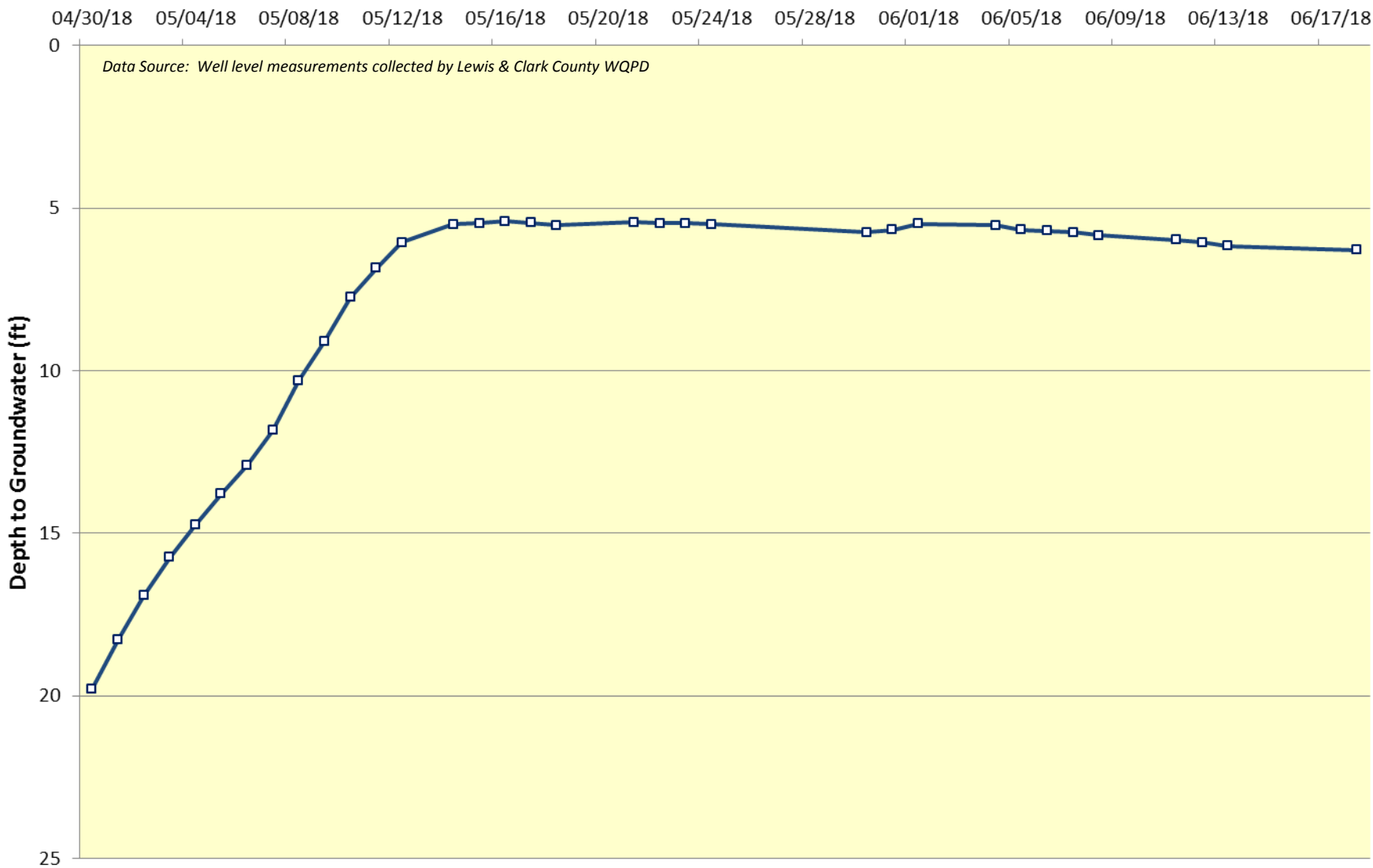
Residential Well Hydrograph

GWIC ID 61368



Groundwater Levels on Motsiff Rd

April - June 2018

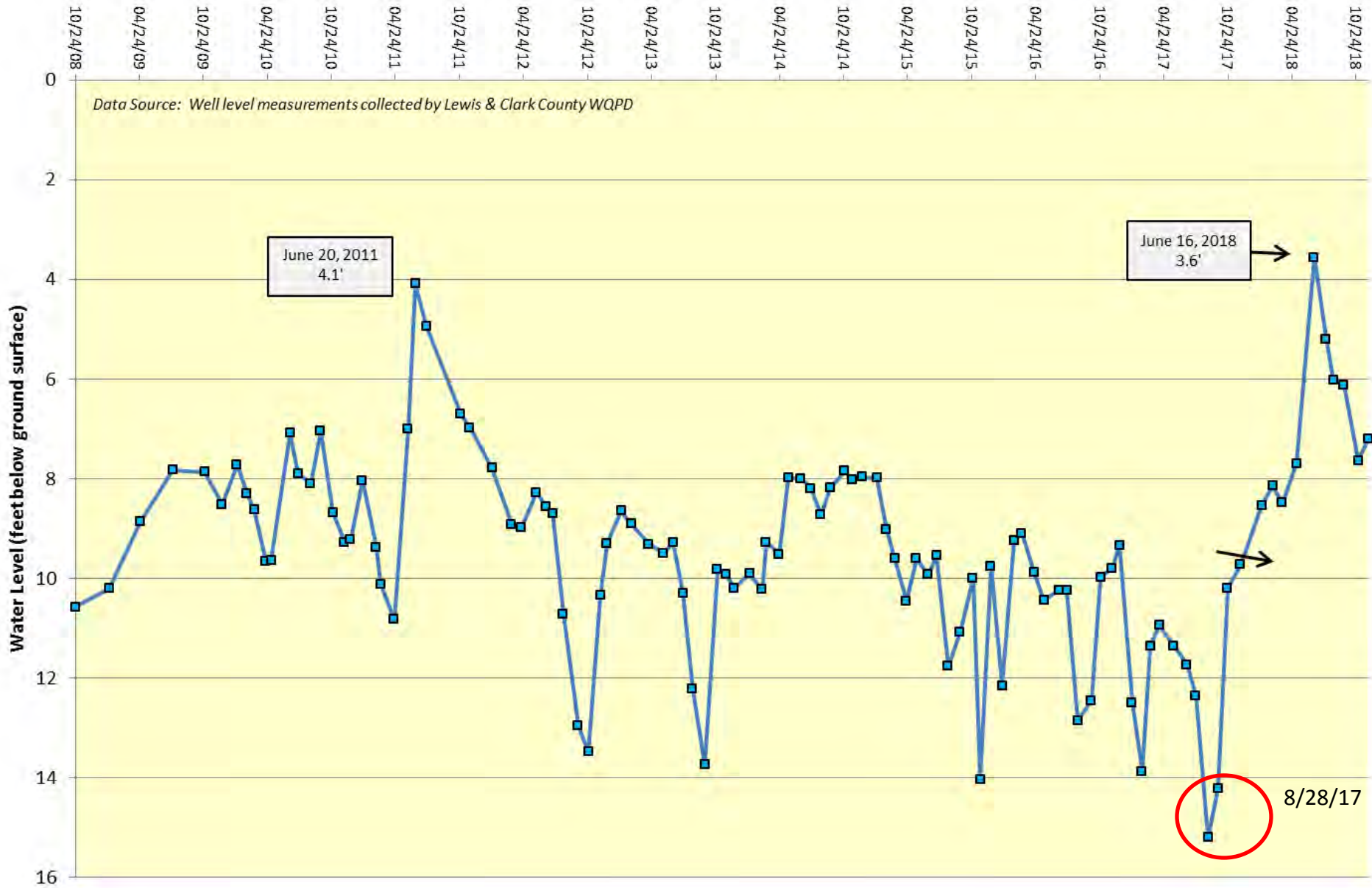


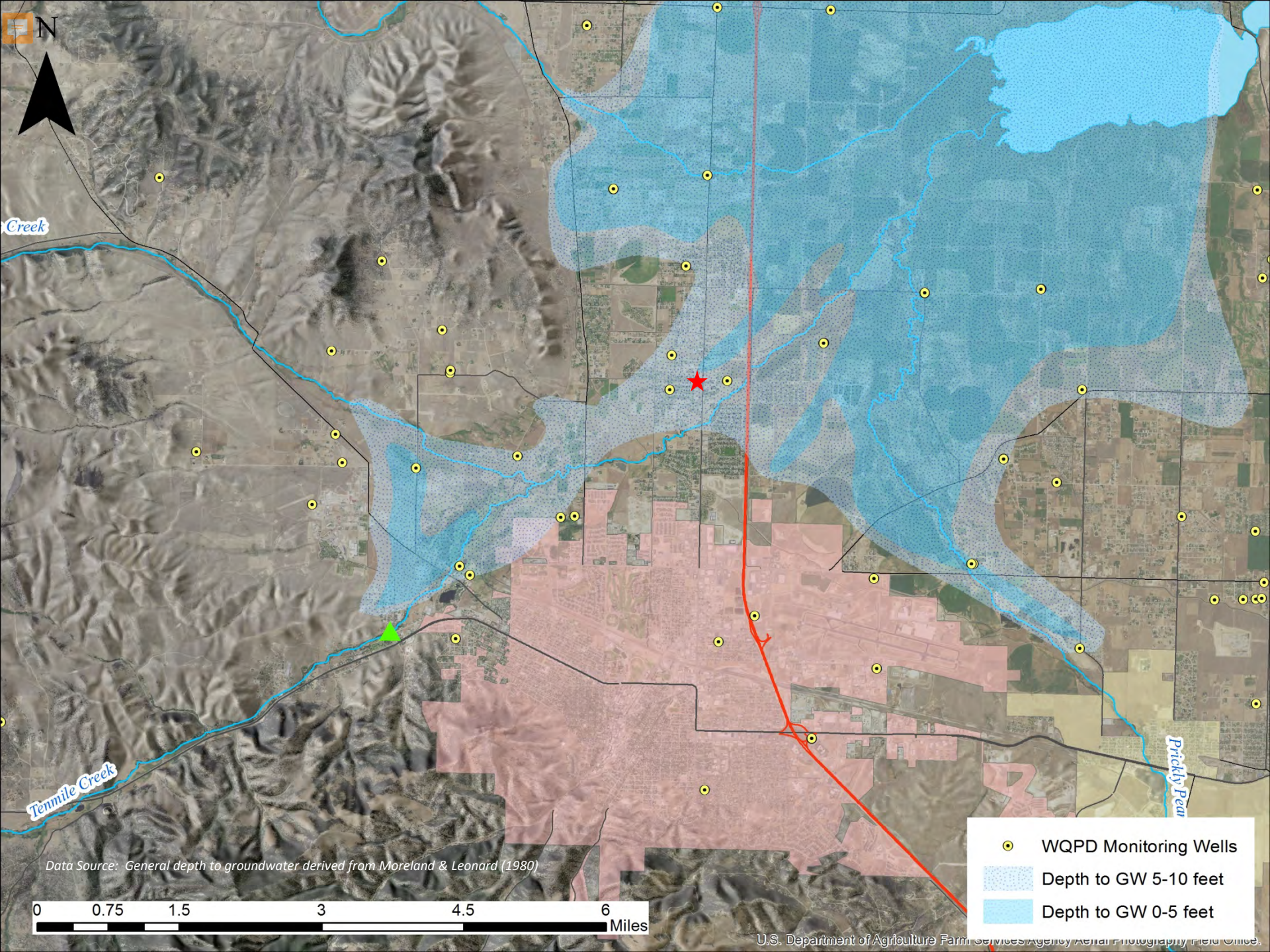


Mill Rd

USGS Well Hydrograph

GWIC ID 82195



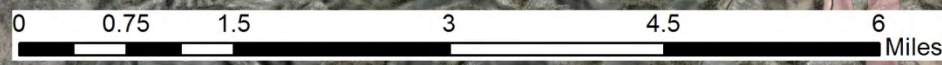





Creek

Tenmile Creek

Picky Pear

Data Source: General depth to groundwater derived from Moreland & Leonard (1980)



-  WQPD Monitoring Wells
-  Depth to GW 5-10 feet
-  Depth to GW 0-5 feet

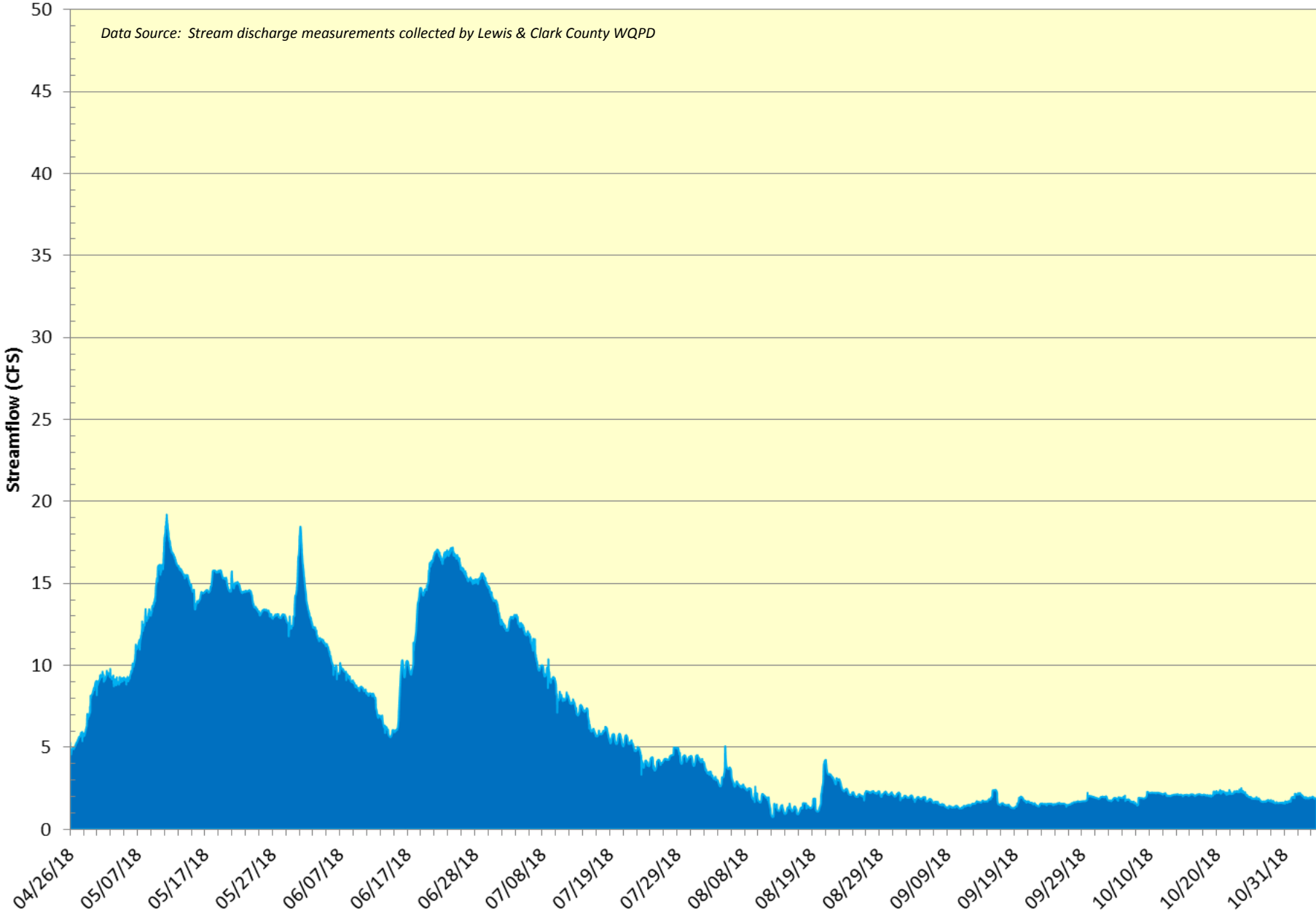


Silver Creek Gauging station - WQPD



Silver Creek 2018 Estimated Streamflow

Data Source: Stream discharge measurements collected by Lewis & Clark County WQPD

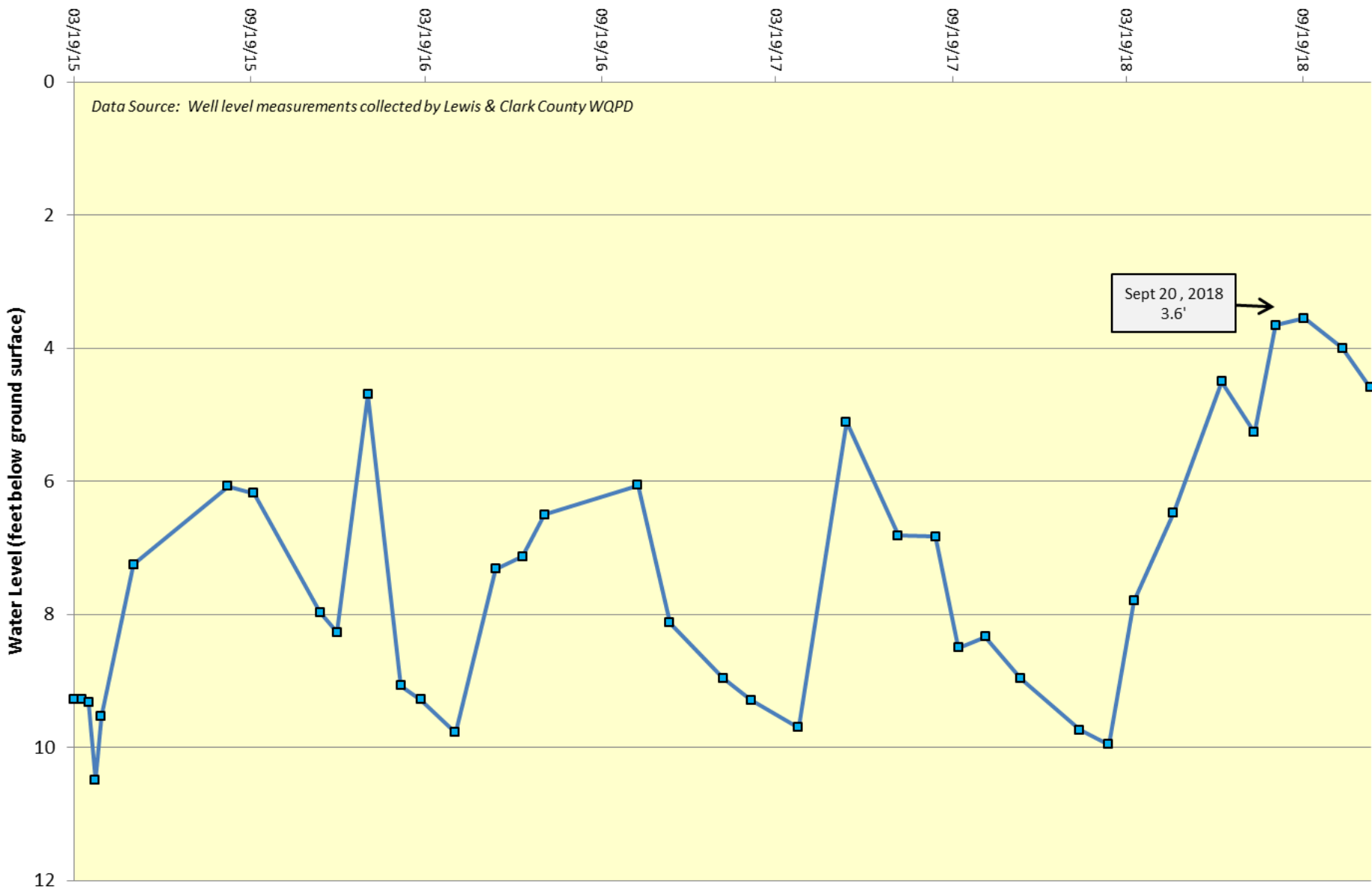




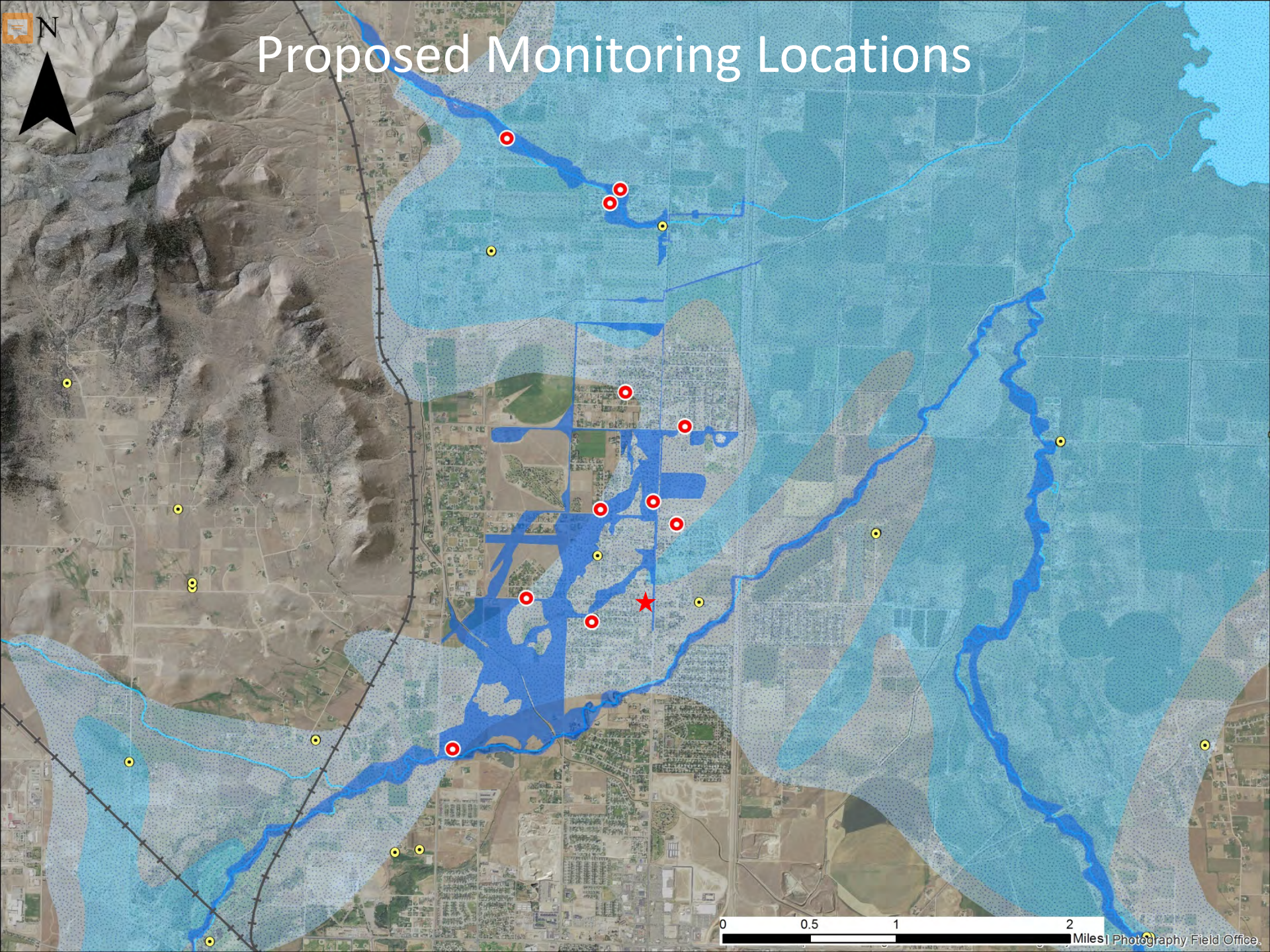
North Montana

Residential Well Hydrograph

GWIC ID 278687



Proposed Monitoring Locations



Summary



General timeline of events

- Winter 2017-2018 – High Snowpack
- Spring 2018 (March/April) – lingering valley snowpack. 10” in March, 6” in April
- Mid-march snowmelt flooding in low areas
- Late April through mid-May TMC high flows (>300cfs) – peak May 11 (595 cfs)
- TMC out of main channel, activates alluvial channel April 29/30 – May 12/13
- GW levels rise rapidly
- Widespread basement flooding in area of activated alluvial channel

Key Factors:

- Precip/snowmelt/valley & creek setting
- 2 phases of surface flooding (valley snowmelt & mountain runoff)
- Activation of alluvial fan channels at high flow
- Rapid GW rise in and adjacent to surface flow-paths form local surface water recharge to GW

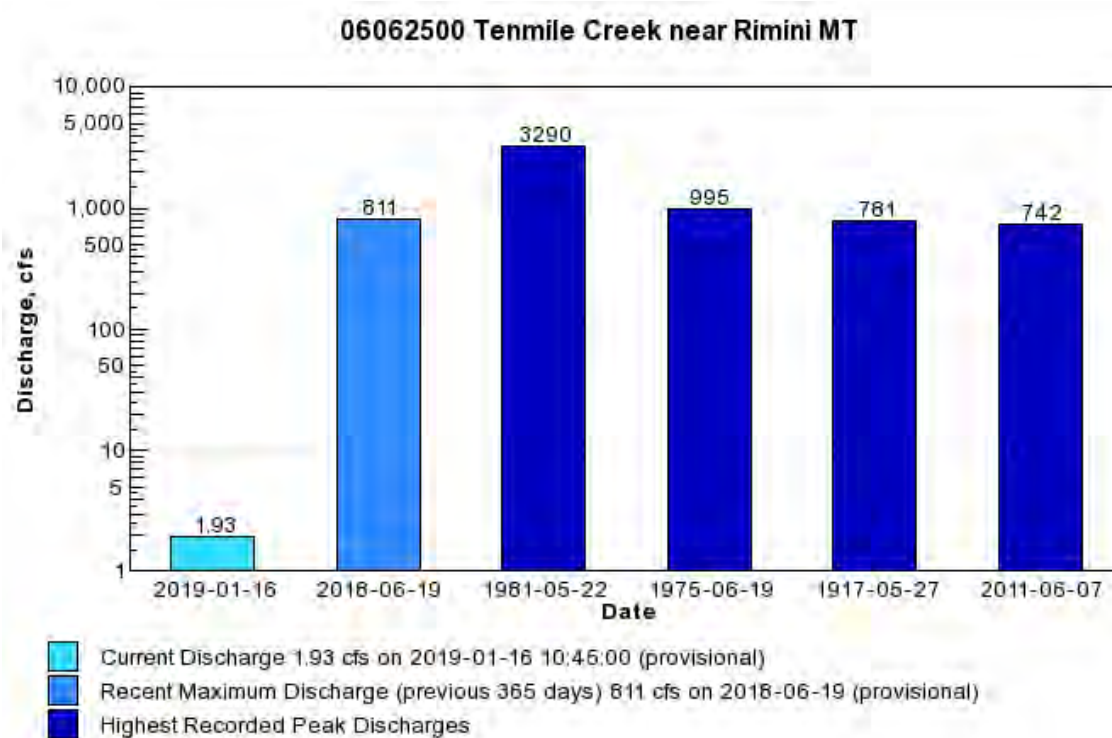
Future steps by WQPD:

- Expand monitoring network to collect additional SW & GW data in spring



Keep in mind....

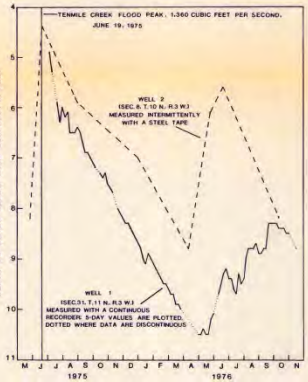
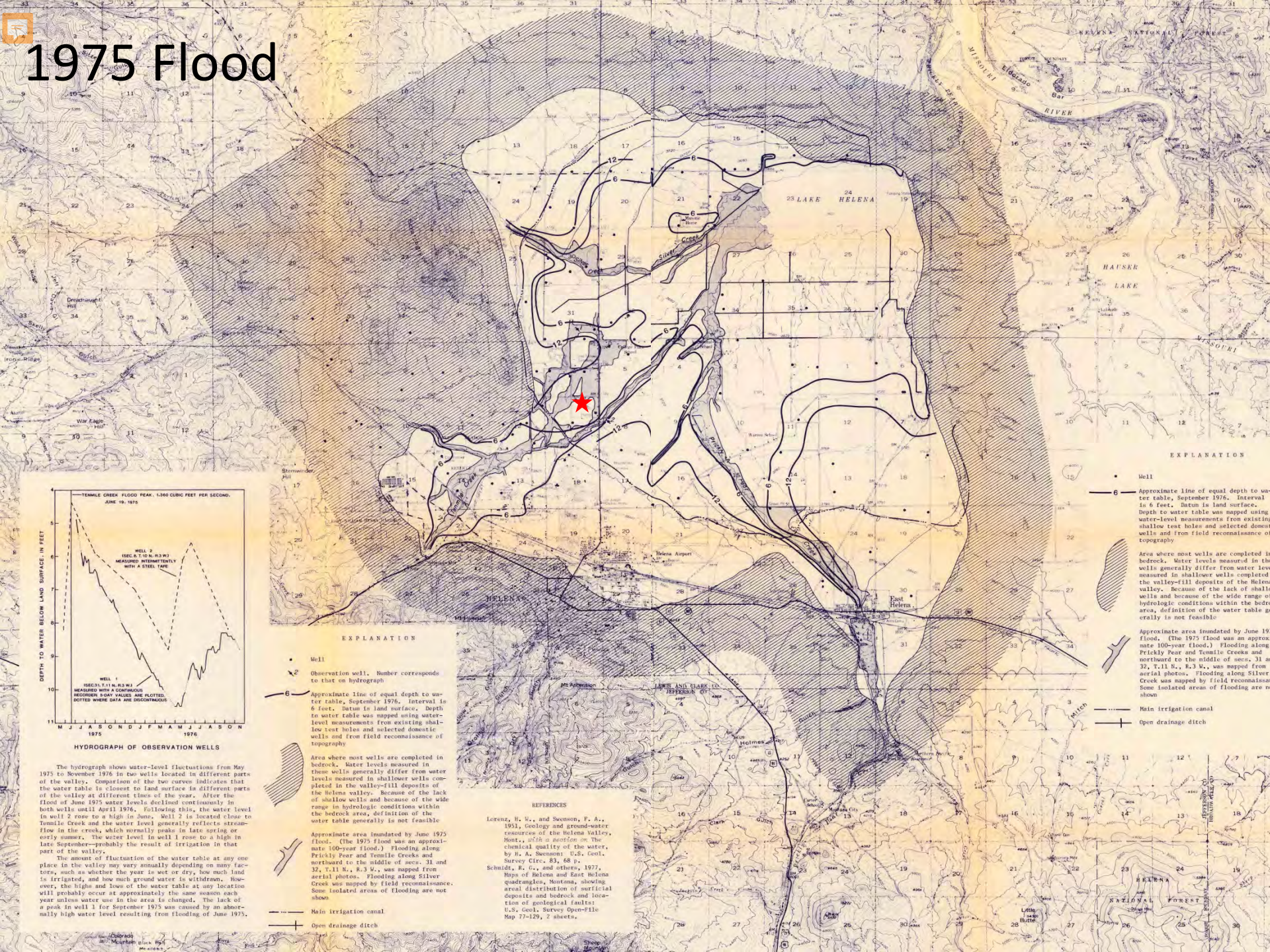
Tenmile Creek Flooding is a periodic event...



USGS WaterWatch

Additional flooding in 1879 – 1892 – 1917 – 1927 – 1938 – 1944 – 1949 – 1953 – 1955 – 1956 – 1957 - 1969... (ACOE 1973)

1975 Flood



HYDROGRAPH OF OBSERVATION WELLS

The hydrograph shows water-level fluctuations from May 1975 to November 1976 in two wells located in different parts of the valley. Comparison of the two curves indicates that the water table is closest to land surface in different parts of the valley at different times of the year. After the flood of June 1975 water levels declined continuously in both wells until April 1976. Following this, the water level in well 2 rose to a high in June. Well 2 is located close to Tenmile Creek and the water level generally reflects streamflow in the creek, which normally peaks in late spring or early summer. The water level in well 1 rose to a high in late September—probably the result of irrigation in that part of the valley.

The amount of fluctuation of the water table at any one place in the valley may vary annually depending on many factors, such as whether the year is wet or dry, how much land is irrigated, and how much ground water is withdrawn. However, the highs and lows of the water table at any location will probably occur at approximately the same season each year unless water use in the area is changed. The lack of a peak in well 1 for September 1975 was caused by an abnormally high water level resulting from flooding of June 1975.

- EXPLANATION**
- Well
 - Observation well. Number corresponds to that on hydrograph
 - 6 — Approximate line of equal depth to water table, September 1976. Interval is 6 feet. Datum is land surface. Depth to water table was mapped using water-level measurements from existing shallow test holes and selected domestic wells and from field reconnaissance of topography
 - Area where most wells are completed in bedrock. Water levels measured in these wells generally differ from water levels measured in shallower wells completed in the valley-fill deposits of the Helena valley. Because of the lack of shallow wells and because of the wide range in hydrologic conditions within the bedrock area, definition of the water table generally is not feasible
 - Approximate area inundated by June 1975 flood. (The 1975 flood was an approximate 100-year flood.) Flooding along Prickly Pear and Tenmile Creeks and northward to the middle of secs. 31 and 32, T. 11 N., R. 3 W., was mapped from aerial photos. Flooding along Silver Creek was mapped by field reconnaissance. Some isolated areas of flooding are not shown
 - Main irrigation canal
 - Open drainage ditch

REFERENCES

Lorenz, H. W., and Swenson, F. A., 1953, Geology and ground-water resources of the Helena Valley, Mont., *with a section on the chemical quality of the water*, by H. A. Swenson; U.S. Geol. Survey Circ. 83, 68 p.

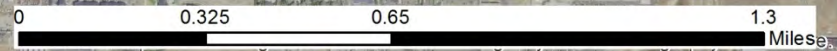
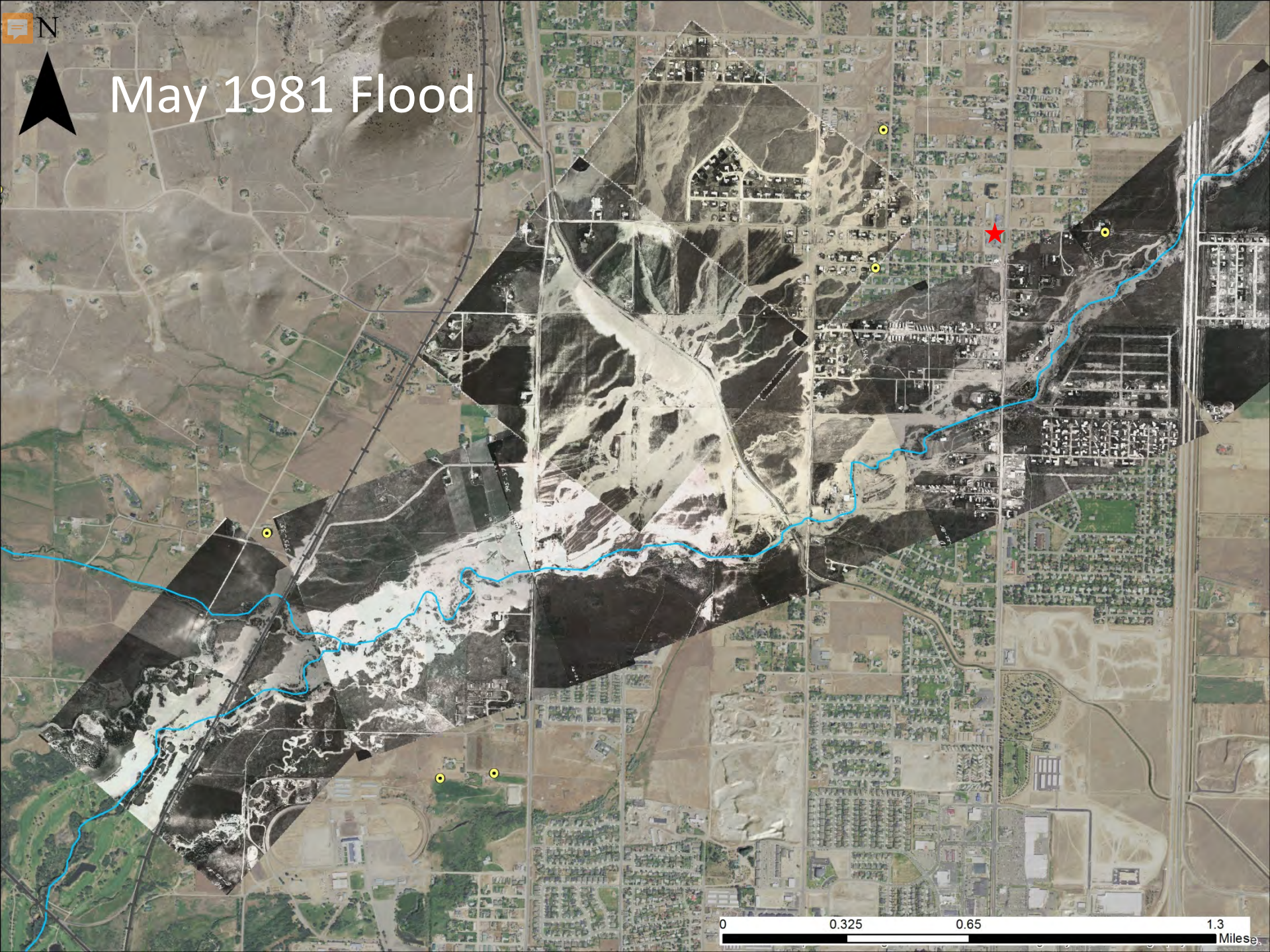
Schmidt, E. G., and others, 1977, Maps of Helena and East Helena quadrangles, Montana, showing areal distribution of surficial deposits and bedrock and location of geological faults; U.S. Geol. Survey Open-File Map 77-129, 2 sheets.

EXPLANATION

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May 1981 Flood





EXON

DAVE'S

36.99

38.99

Car Wash
Oil & Lube

WERRY HOLD
BUY 4 FOR 12

EXIT

EXIT

EXON

Peter Schade
Lewis & Clark County
Water Quality Protection District