Lewis and Clark County Water Quality Protection District

Tenmile Creek Groundwater Monitoring Program

2019 Summary Report

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1.0 Introduction

In the spring and early summer of 2018, spring runoff fed by heavy late-winter snowpack and spring rains caused Tenmile Creek to overflow its banks, resulting in surface flooding, and subsequent high groundwater levels within the Tenmile Creek flood zone in the Helena Valley. Residents of this area contended with both overland flooding of homes and property as well as basement flooding caused by rapidly rising, and lingering shallow groundwater.

In response to the flooding events in 2018, the Lewis and Clark County Water Quality Protection District (WQPD) expanded their groundwater monitoring network by establishing a Tenmile Creek Groundwater Monitoring Program, focused on measuring groundwater levels within the flood-prone areas of the Tenmile Creek and Silver Creek floodplains (Figure 1). This report presents the results of groundwater level monitoring conducted by the WQPD in 2019 and the WQPD's community outreach efforts.

2.0 Project Area and Physical Setting

The Lake Helena watershed is located in west-central Montana in Lewis & Clark and Jefferson counties. Helena, Montana's capitol city, lies near the center of the watershed. The Lake Helena watershed is part of the Upper Missouri Watershed (USGS 8-digit hydrologic cataloging unit number 10030101). Primary streams in the Project Area include Prickly Pear Creek, Tenmile Creek, Sevenmile Creek and Silver Creek (Figure 1). The primary discharge point for both streams and groundwater is Lake Helena.

The Project Area includes the lower segments of Tenmile Creek, Silver Creek and adjacent alluvial fan terrains within the southwestern portion of the Helena Valley. Upon entering the Helena Valley downstream of its confluence with Sevenmile Creek, Tenmile Creek flows through residential and agricultural lands in the Helena Valley before its confluence with Prickly Pear Creek. The Project Area consists of an alluvial fan complex with Tenmile Creek, Prickly Pear Creek, and Silver Creek forming individual coalescing alluvial fan systems. When streamflow in Tenmile Creek exceeds bankfull flow, overbank flows access normally dry alluvial fan channels and distribute flood water through a series of northeast trending alluvial flow paths (Figure 2). These overflow channels and paths are well-defined, and are activated periodically during spring runoff events, most recently during high flow events of 2011 and 2018. A variety of roads, culverts, ditches and other developed infrastructure retain and redirect these flows as they move through residential areas resulting in a variety of flood-related impacts to residential neighborhoods.

3.0 Program Goals and Objectives

The main goals of the Tenmile Creek Groundwater Monitoring Program are to gain a better understanding of groundwater dynamics within the Tenmile Creek flood zone, and to provide residents, local officials, and decision makers with information and tools to better understand and prepare for impacts caused by flooding in the area. This is achieved through the following objectives:

1. Collect groundwater level measurements within the Tenmile Creek flood zone.

2. Make data available to the public on-line.

3. Conduct public meetings to present, share, and disseminate information.

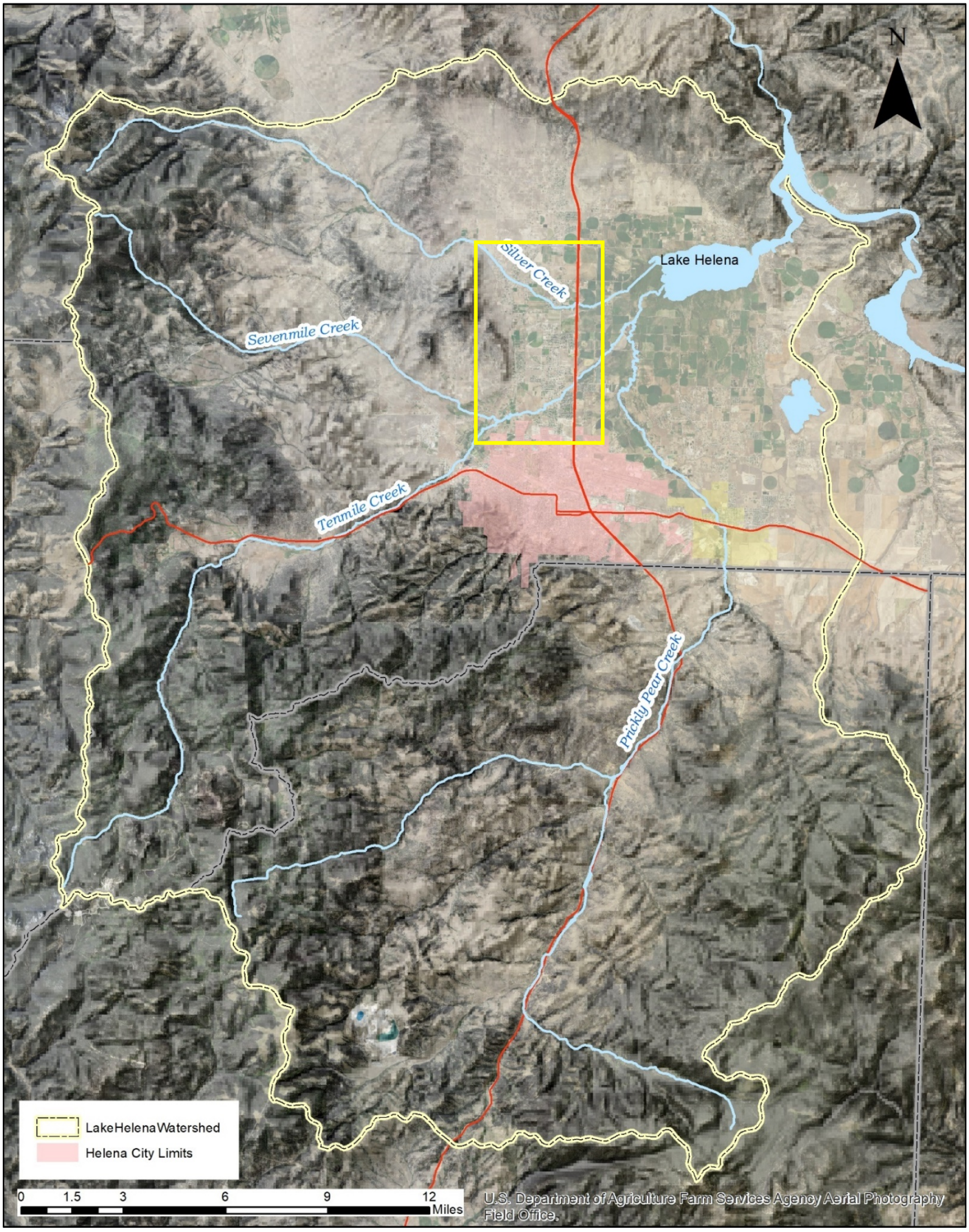

Figure 1. Regional map of Project Area and the Lake Helena watershed

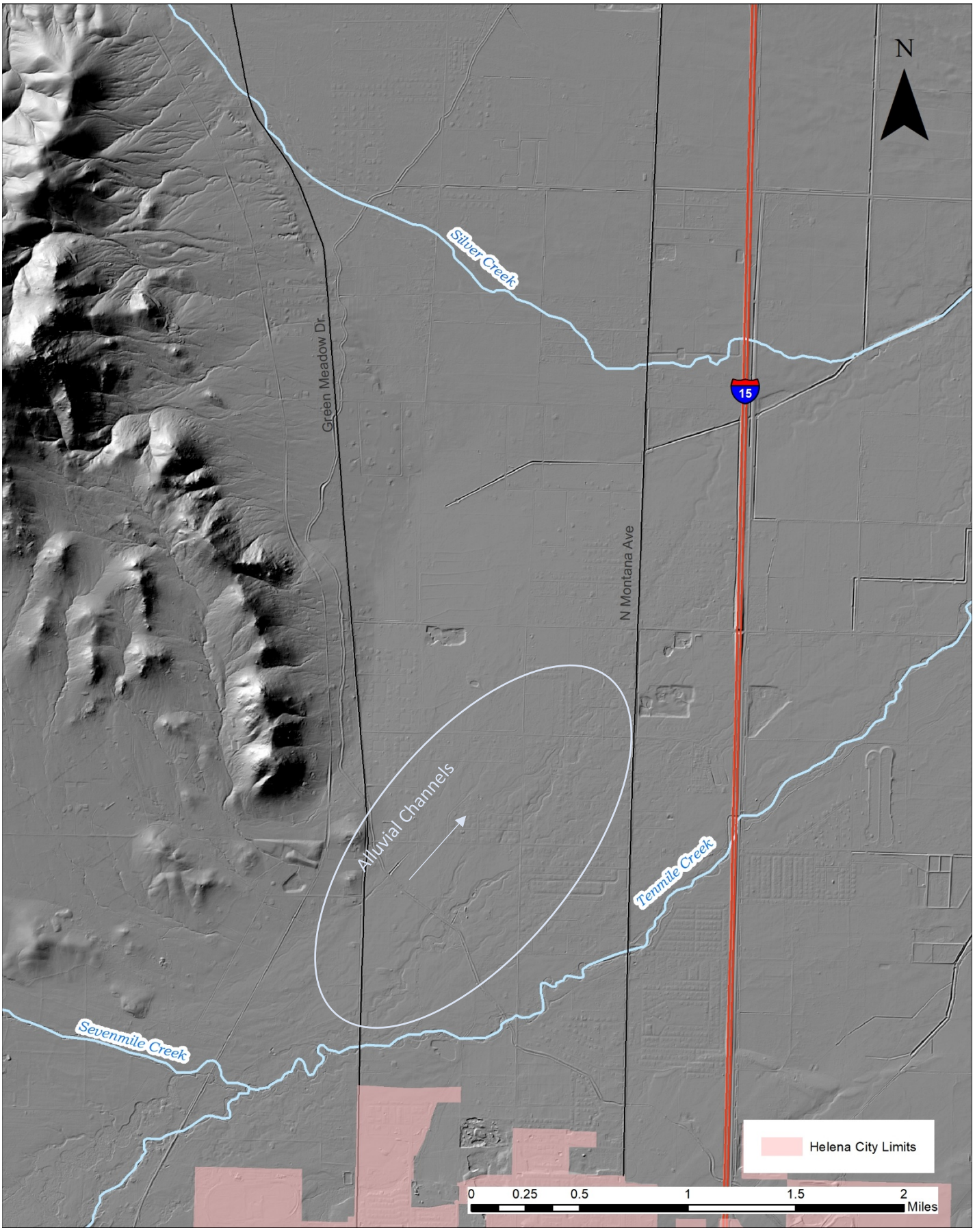

Figure 2. Alluvial fan channels in the Project Area

4.0 Methods

4.1 Data Collection

Field monitoring consisted of measuring water levels in 22 wells within the Tenmile Creek and Silver Creek flood zones and adjacent areas (Table 1, Figure 3). Monitoring locations included 17 residential wells and 5 dedicated monitoring wells, four of which were drilled in May of 2019. Water levels were measured with an electric sounding tape, following procedures outlined in Cunningham and Schalk (2011). Water levels were measured weekly at each monitoring location from mid-March though late June of 2019, and then measured once every two months through October.

Table 1. Well monitoring locations

Map ID**	GWIC ID	Latitude	Longitude	Well Address	Ground Elevation (ft)	Well Depth (ft)
1	293450	46.630038	-112.043559	287 Ohana Ct	3746.4	60
2	61215	46.645904	-112.037226	546 Mill Rd	3774.4	42
3	302696	46.644423	-112.031875	Motsiff / McHugh*	3770.3	25
4	61368	46.644188	-112.028648	775 Motsiff Rd	3766.5	NA
5	256510	46.640981	-112.026216	964 Cheryl Road	3770.6	58
6	239110	46.640978	-112.027552	910 Cheryl Road	3771.3	60
7	892195	46.645859	-112.015984	Mill Rd*	3774.4	23
8	61260	46.649587	-112.028470	5260 Kerr Drive	3756.3	43
9	278709	46.653312	-112.028317	5502 Kerr Dr	3746.7	43
10	302701	46.653157	-112.020893	Forestvale / N Montana*	3739.4	28
11	61189	46.654177	-112.022008	5560 N Montana	3739.0	52
12	255363	46.658243	-112.015939	Rossiter School*	3724.3	25
13	300744	46.662269	-112.015803	6170 Goodwin Dr	3717.2	21
14	65043	46.663597	-112.025927	940 Vallejo Dr	3724.4	47
15	65088	46.666124	-112.019456	1208 Hilmen Rd	3713.8	52
16	302706	46.666063	-112.013411	Hilmen Rd*	3708.1	17
17	278687	46.677900	-112.021900	6804 N Montana Ave	3713.5	NA
18	302709	46.680431	-112.030891	Rinay Rd*	3731.5	20
19	197571	46.690000	-112.051484	7125 Sagebrush Rd	3793.7	130
20	258300	46.688540	-112.054076	7085 Green Meadow Dr	3798.5	140
21	191555	46.675316	-112.042587	Applegate Dr/Norris Rd*	3736.7	29
22	61196	46.655662	-112.038284	Forestvale Cemetery	3752.0	41

*Monitoring well

** Map ID corresponds to labeled wells in Figure 2

4.2 Data and Records Management

All field data collected by the WQPD under this plan is recorded on field sheets, transcribed into Microsoft Excel spreadsheets and managed in-house by the WQPD. Field data collected includes well ID, static water level, date and time. In addition to in-house management of data files, static water level data is also input into the Montana Ground Water Information Center (GWIC) database at the Montana Bureau of Mines and Geology.

Data is made available to the public through an ESRI on-line mapping application (ESRI Story Map) that links well monitoring locations in the Tenmile Creek flood zone to water-level data collected by WQPD and contained in the GWIC database. This Story Map can be accessed at https://arcg.is/1qO1Pf.

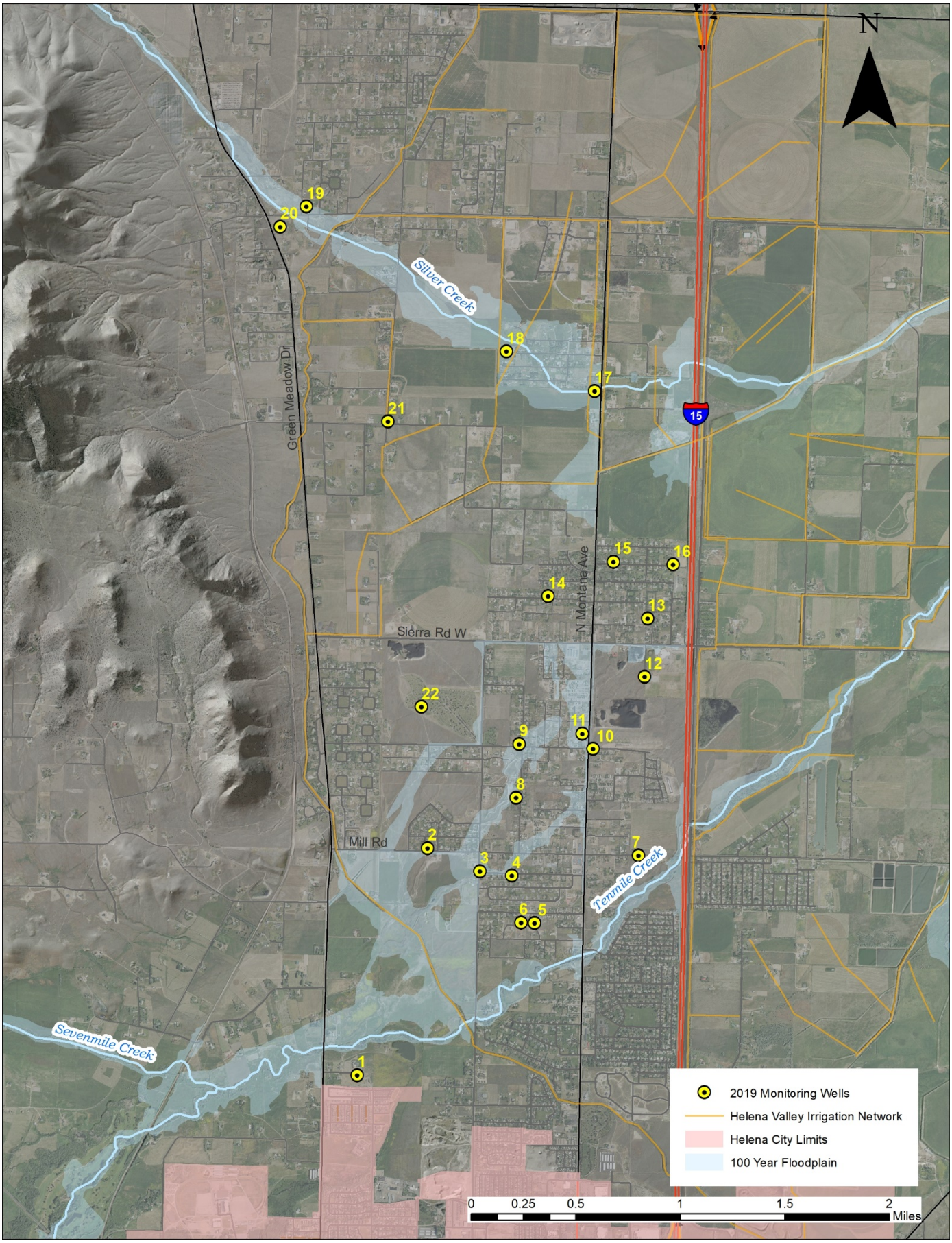

Figure 3. Monitoring wells in relation to irrigation network and 100-year floodplain

4.3 Outreach

In addition to understanding groundwater dynamics, another main goal is to provide information to residents who live in and adjacent to the Tenmile Creek floodplain. Giving residents easy access to pertinent information such as groundwater levels, surface water flows, and links to other helpful resources, as well as informing them of how to best prepare and protect themselves, their families and their properties, can help build community resilience to flood events and reduce potential property damage costs.

In collaboration with community and county partners, Helena Valley Flood Committee (HVFC), Lewis & Clark County Disaster and Emergency Services, Lewis & Clark Public Health, and Lewis & Clark County Public Works, the Lewis & Clark County Water Quality Protection District hosted a three-part "Flood Preparedness Series" of public meetings (Figure 4) in early 2019. Topics for these meetings included: 1) Hydrology & Flooding of Tenmile Creek, 2) Community Planning & Preparedness for Flooding, and 3) Hands-on Emergency Preparedness Fair. All residents living within the Valley Flood Mitigation District (>1,400 residents) were notified of the series through the mail. Additionally, the event was promoted widely through all forms of social and news media outlets. Collectively, approximately 300 residents attended the three events.

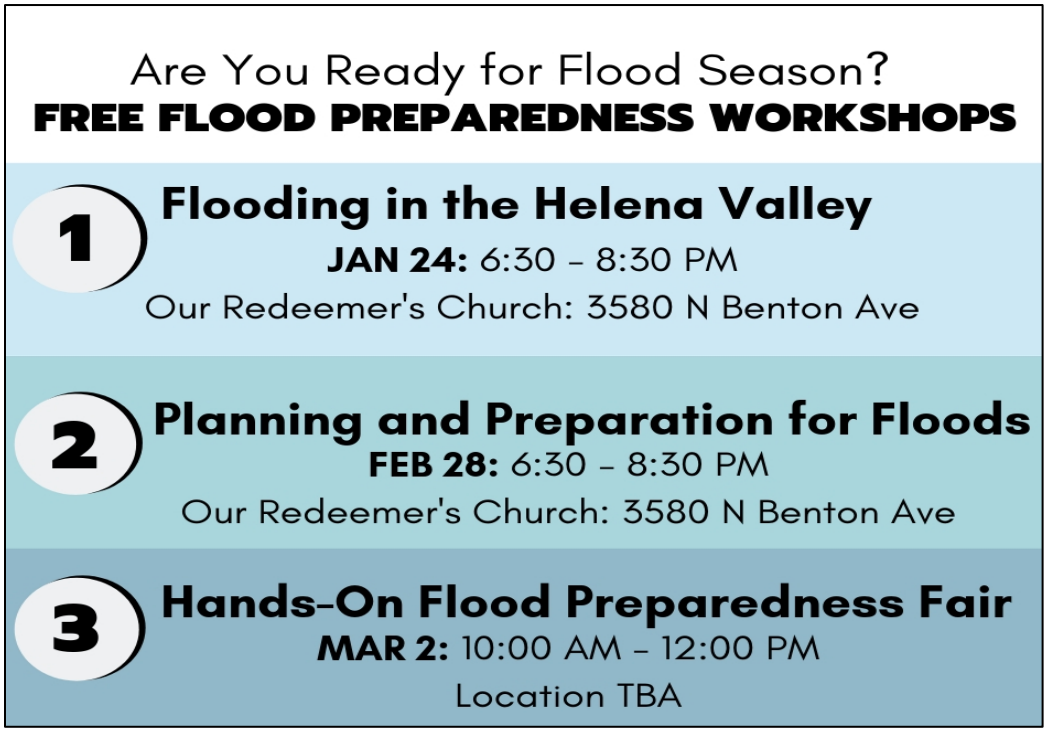

Figure 4: Flyer announcing 2019 flood-preparedness meetings in the Helena valley

5.0 Results and Discussion

Water levels from 22 wells within the Tenmile Creek and Silver Creek flood zones were measured from March 2019 through October 2019. Figure 6 shows these wells in relation to the 100-year floodplains on Tenmile and Silver Creeks. Wells in the area are generally shallow (<60' total depth) and typically maintain static water levels at less than 25' below ground surface. Table 2 shows basic summary statistics for water level measurement data collected in 2019.

	Table 2. Summary statistics for all well monitoring locations (March 2019 – October 2019)							
	Map ID	**GWIC ID**	**Well Address**	**Ground Elevation (ft)**	**Well Depth (ft)**	**Water Level Summary Statistics (ft)**		
						Min	**Max**	**n**
Adjacent to Tenmile Creek	1	293450	287 Ohana Ct	3746.4	60	5.4	9.4	15
	7	892195	Mill Rd	3774.4	23	6.6	10.1	17
Tenmile Creek Flood Zone	2	61215	546 Mill Rd	3774.4	42	16.3	24.7	13
	3	302696	Motsiff / McHugh	3770.3	25	14.1	19.5	7
	4	61368	775 Motsiff Rd	3766.5	NA	11.4	16.9	17
	5	256510	964 Cheryl Road	3770.6	58	10.3	14.0	17
	6	239110	910 Cheryl Road	3771.3	60	10.5	15.3	17
	8	61260	5260 Kerr Drive	3756.3	43	16.3	20.7	17
	9	278709	5502 Kerr Dr	3746.7	43	13.5	17.5	17
	10	302701	Forestvale / N Montana	3739.4	28	17.1	19.1	8
	11	61189	5560 N Montana	3739.0	52	18.6	20.9	17
	12	255363	Rossiter School	3724.3	25	10.6	12.8	17
	13	300744	6170 Goodwin Dr	3717.2	NA	9.1	10.3	17
	14	65043	940 Vallejo Dr	3724.4	47	8.5	10.5	17
	15	65088	1208 Hilmen Rd	3713.8	52	4.9	7.2	17
	16	302706	Hilmen Rd	3708.1	17	5.7	6.0	9
	21	191555	Applegate Dr/Norris Rd	3736.7	29	6.9	12.9	14
	22	61196	Forestvale Cemetery	3752.0	41	23.4	26.8	4
Silver Creek Flood Zone	17	278687	6804 N Montana Ave	3713.5	NA	2.6	6.5	14
	18	302709	Rinay Rd	3731.5	20	2.3	6.0	8
	19	197571	7125 Sagebrush Rd	3793.7	130	53.8	62.5	17
	20	258300	7085 Green Meadow Dr	3798.5	140	56.6	62.7	17

n= Number of measurements
Map ID corresponds to labeled wells on Figure 3

Monitored wells can be divided into three categories based on location and seasonal response:

1. Wells within and adjacent to the Tenmile Creek flood zone (wells 2-6, 8-16, 21-22)
2. Wells located adjacent to Tenmile Creek (wells 1 & 7)
3. Wells within the Silver Creek flood zone (wells 17-20)

Wells within the Tenmile Creek Flood zone

A majority of the wells monitored are located within the Tenmile Creek flood zone. Depth to water was less than 25' for all wells during the monitoring period. The Helena Valley Irrigation District (HVID) irrigation canal has a significant influence on seasonal groundwater levels in the area, and all wells responded seasonally to water delivered through the HVID network of canals and ditches. The irrigation canal network is activated each spring when water from the Helena Regulating Reservoir is transmitted through the canal system and its lateral distribution ditches. Water flows through the network from early April until late September, during which time it infiltrates into the local groundwater table, raising groundwater levels downgradient of network distribution canals and ditches. Due to loading of the groundwater from the irrigation network, water levels from wells located within and adjacent to the network generally rise during the irrigation period and may remain elevated through October (Figure 5).

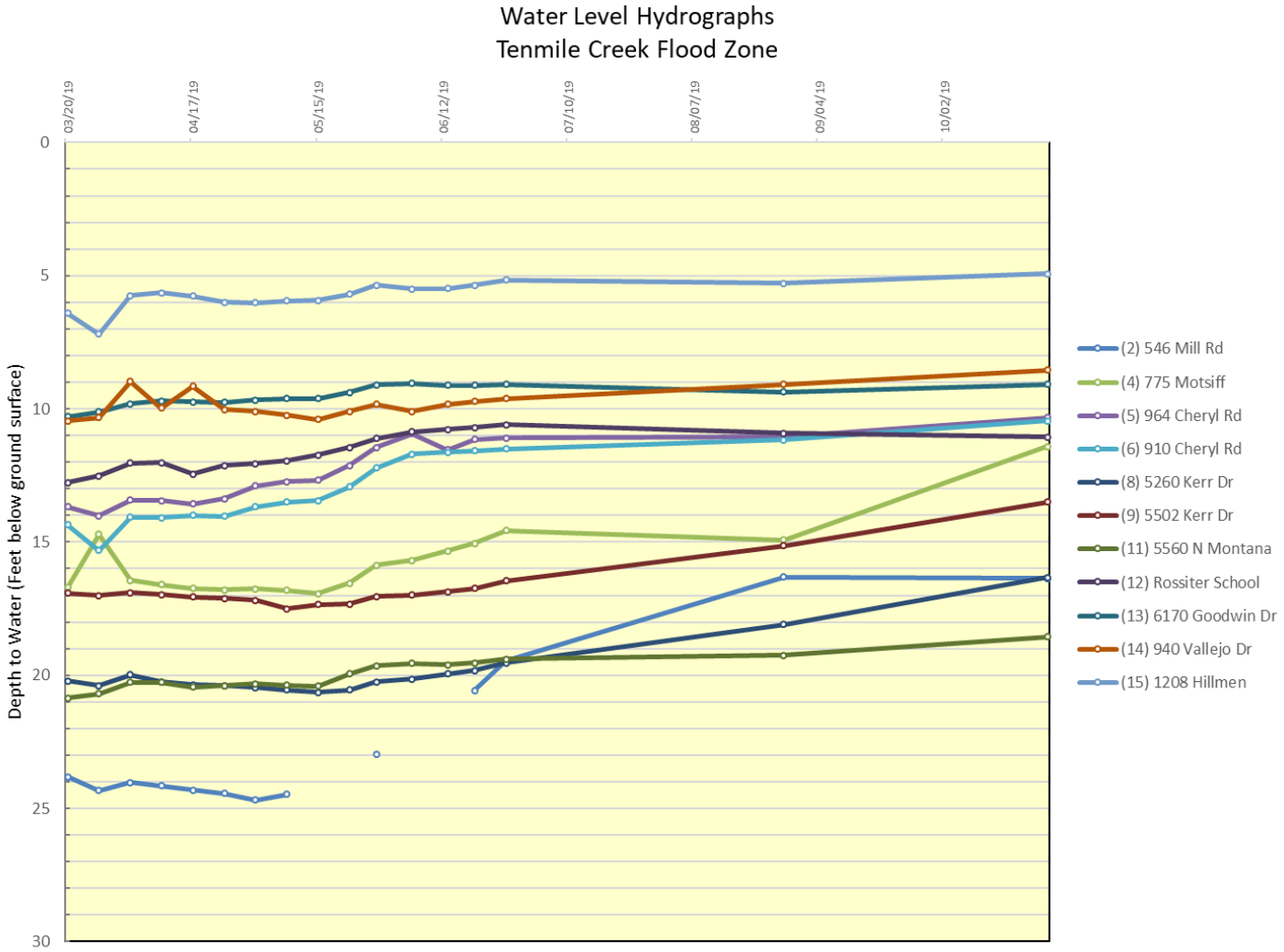

Figure 5: Groundwater levels from wells in the Tenmile Creek flood zone

Wells Adjacent to Tenmile Creek

Wells adjacent to Tenmile Creek include wells #1 & #7. Due to their close proximity to Tenmile Creek, seasonal water levels in these wells reflect direct recharge from Tenmile Creek and rise in the spring when Tenmile Creek is swollen from snowmelt runoff. Well # 7 (Mill Creek) is located within the HVID network and receives recharge from the irrigation system, whereas Well #1 is located upgradient from the irrigation network and does not receive irrigation recharge. The hydrographs in Figure 6 show both wells in relation to runoff flows in Tenmile Creek, measured at the Williams Street USGS gauging station approximately 3 miles upstream of the Project Area. Note that water levels in Well #1 decline after runoff, while water levels in Well #7 are maintained through the season due to recharge from the HVID irrigation network.

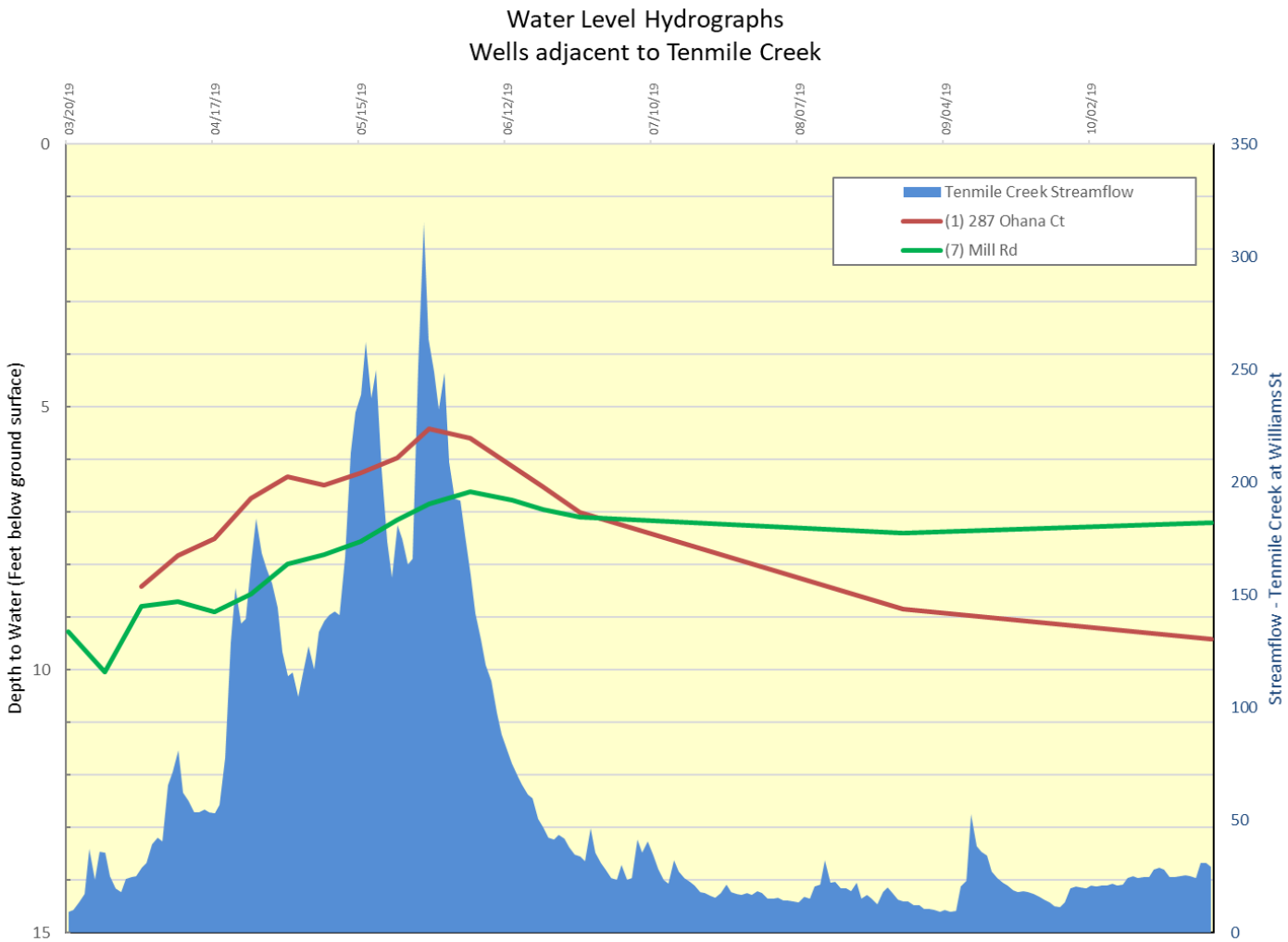

Figure 6: Groundwater levels from wells adjacent to Tenmile Creek

Wells within the Silver Creek Flood zone

Within the Silver Creek flood zone, four wells were chosen for water level measurements. Two of these wells (19 & 20) are located upgradient of the irrigation canal, while two (17 & 18) are downgradient from the canal. Upgradient wells receive far less recharge water from the irrigation canal, are deeper, and depths to water range from 53' to 63' below ground surface, whereas depth to water in wells downgradient from the irrigation network is rather shallow and range from 2.3' to 6.5' below ground surface (Figure 7).

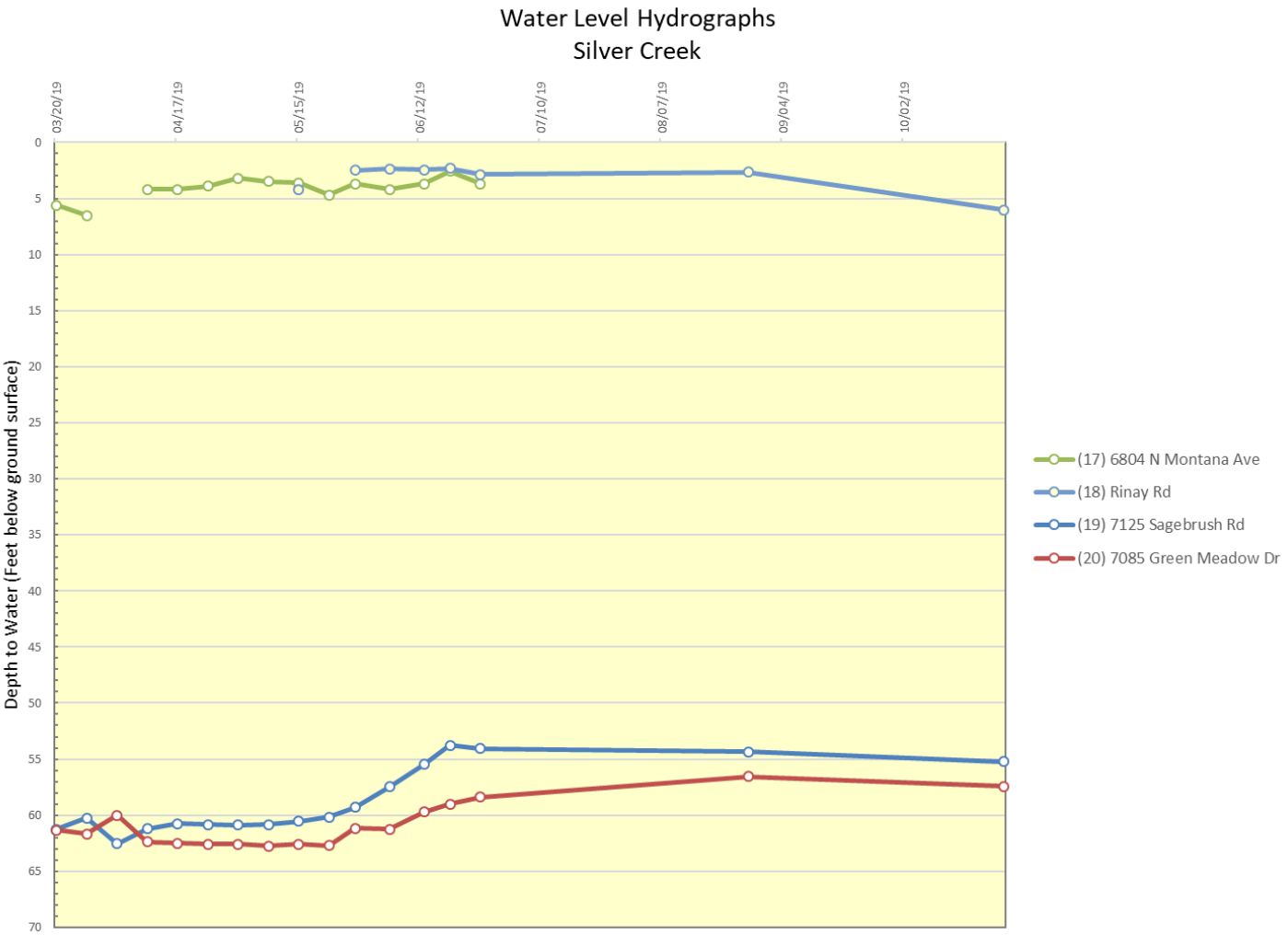

Figure 7: Groundwater levels from wells in the Silver Creek flood zone

Effects of Flooding

Twice in the past 10 years (2011 & 2018), spring and early summer streamflows in Tenmile Creek exceeded channel capacity near Green Meadow Drive upstream of the Project Area, resulting in flooding of downstream lands and residential neighborhoods (Figure 8). These flood flows follow established alluvial fan channels, and flooded areas were consistent with the floodprone area defined by the 100-year floodplain (Figure 3). Infrastructure (roads, ditches, culverts, buildings) within this area diverts flood flows through a network of natural and man-made flow paths, resulting in a chaotic mix of flow retention and flow transmission. In many cases, flow transmission is hindered by undersized culverts & ditches, low-lying areas, and other restrictions that cause ponding and retention of flows within the residential areas (Figure 9).

When flood waters are retained, they infiltrate downward saturating valley-fill sediments and can result in rapidly rising groundwater. To illustrate, rapid groundwater rise was measured in well # 4 on Motsiff Rd in early May of 2018, during the same time Tenmile Creek overflows were flooding nearby residential neighborhoods. Groundwater levels in this well rose over 14 feet within two weeks (from April 30th to May 15th). Figure 10 shows 2018 streamflow on Tenmile Creek, and the coincident rise in groundwater level from 18.3' on 4/30/18 to ~4.0' on 05/15/2018. High groundwater levels persisted throughout the summer months, with several residents reporting continued pumping of groundwater from basements until early September of 2018.

During normal years, groundwater levels in the area are typically at levels that do not contribute to groundwater infiltration into basements. However, when streamflow in Tenmile Creek (measured at the USGS gauging station at Williams St) exceed ~375 CFS, the potential exists for flows to leave the main channel and flood downstream neighborhoods. This has happened twice in the recent past (2011 & 2018). Figure 11 shows the magnitude of groundwater rise during these events.

During flooding events, flood waters can pick up a variety of contaminants from the surface which can be transmitted to domestic wells, either from flood water entering the wellhead at the surface or from contaminated shallow groundwater entering the well in the subsurface. Since many of the wells in the project area are shallow (<60' deep), wells in the area are at increased risk of contamination from floodwater.

Next Steps

The WQPD maintains a monitoring network of over 20 wells within the Tenmile Creek and Silver Creek flood zones, with increased frequency of monitoring from late March through June. Water level data is collected, uploaded to GWIC databases, and typically viewable on the WQPD's on-line mapping application within a day. This allows residents to access groundwater data quickly and prepare accordingly. Additional wells may be added to the monitoring network as need arises.

In addition to measuring groundwater levels, the WQPD, in partnership with the Montana Department of Natural Resources and Conservation (DNRC) and Lewis & Clark County Public Works is installing a new stream gauging station on Sevenmile Creek, upstream of the Project Area. This station will allow the WQPD to measure springtime flow contributions from Sevenmile Creek to Tenmile Creek and will assist in evaluating how streamflow from both Tenmile Creek and Sevenmile Creek contributes to downstream flooding.

Figure 8: Overbank flows immediately downstream of Green Meadow Drive

Figure 9: Flooded neighborhoods downstream from Figure 8

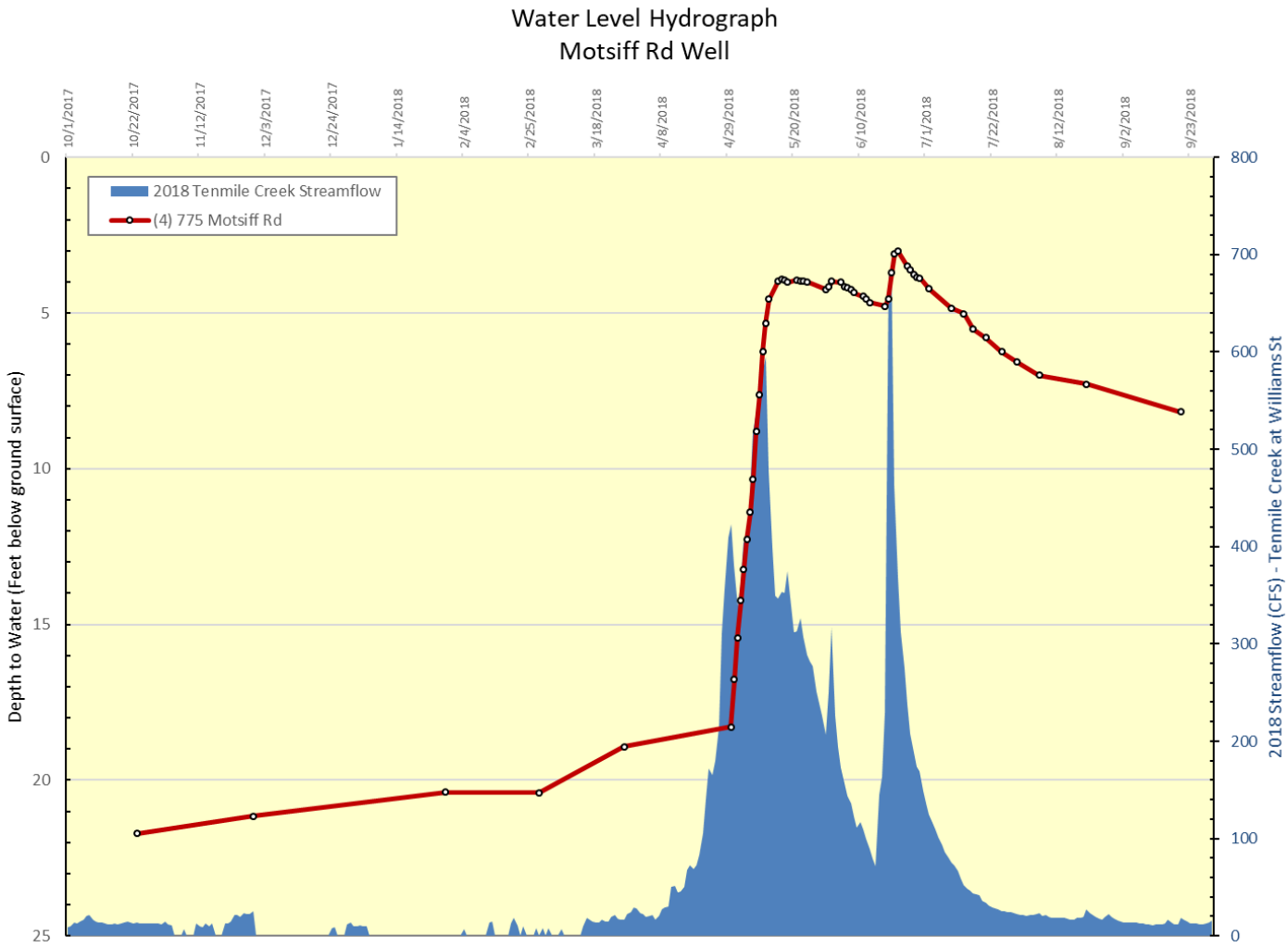

Figure 10: 2018 streamflow and accompanying rise in groundwater in well #4

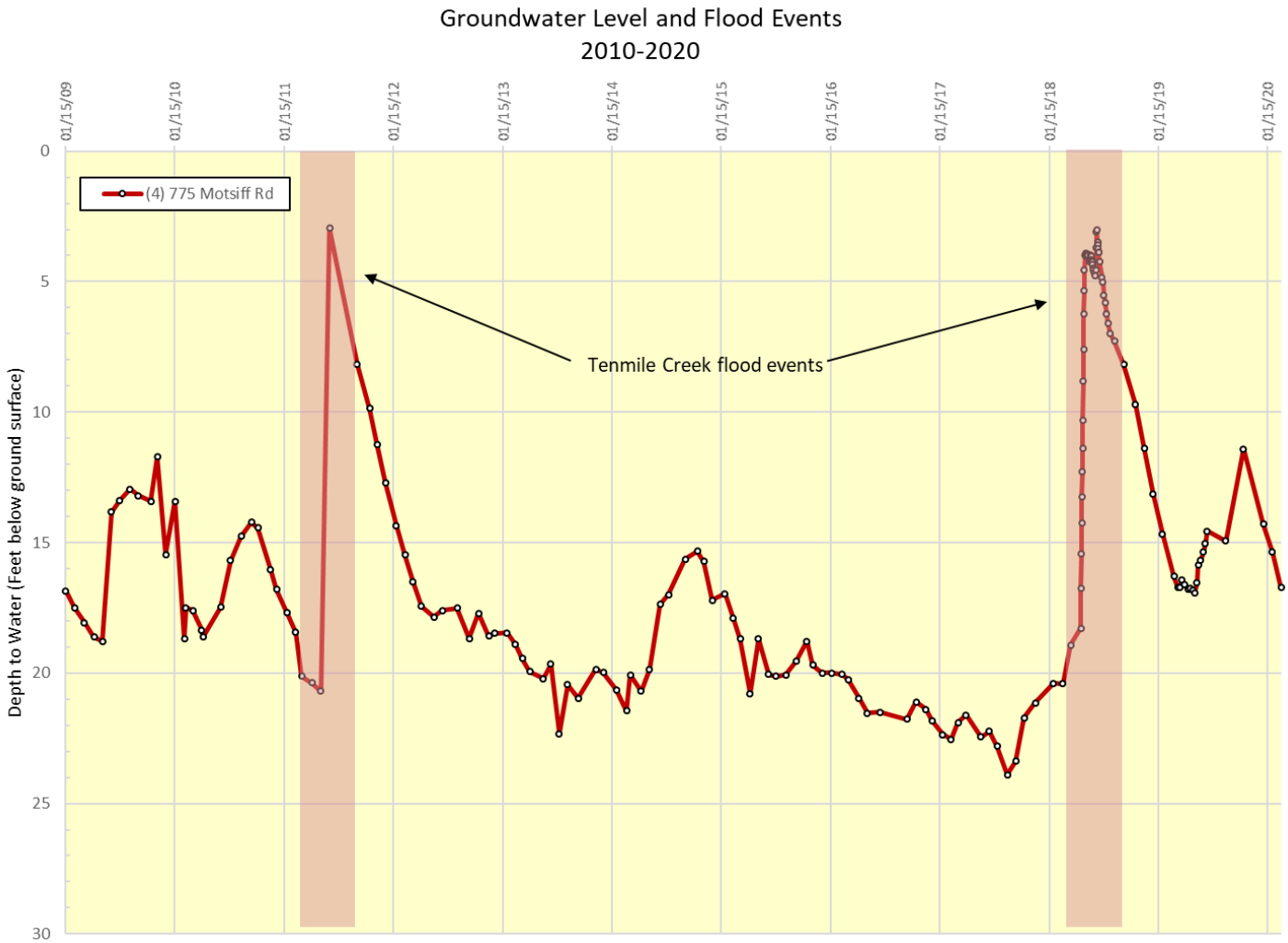

Figure 11: Groundwater level (Well #4) and Tenmile Creek flooding events (2010-2020)

References

Briar, David W., and James P. Madison, 1992. *Hydrogeology of the Helena Valley-fill aquifer system, west-central Montana*. No. 92-4023. US Geological Survey; Books and Open-File Reports Section [distributor]

Cunningham, William L., and Charles W. Schalk, 2011. "Groundwater technical procedures of the US Geological Survey." *US Geological Survey Techniques and Methods 1–A1*.