Lewis & Clark County Water Quality Protection District
2021 Raven Road Groundwater Quality Monitoring Report

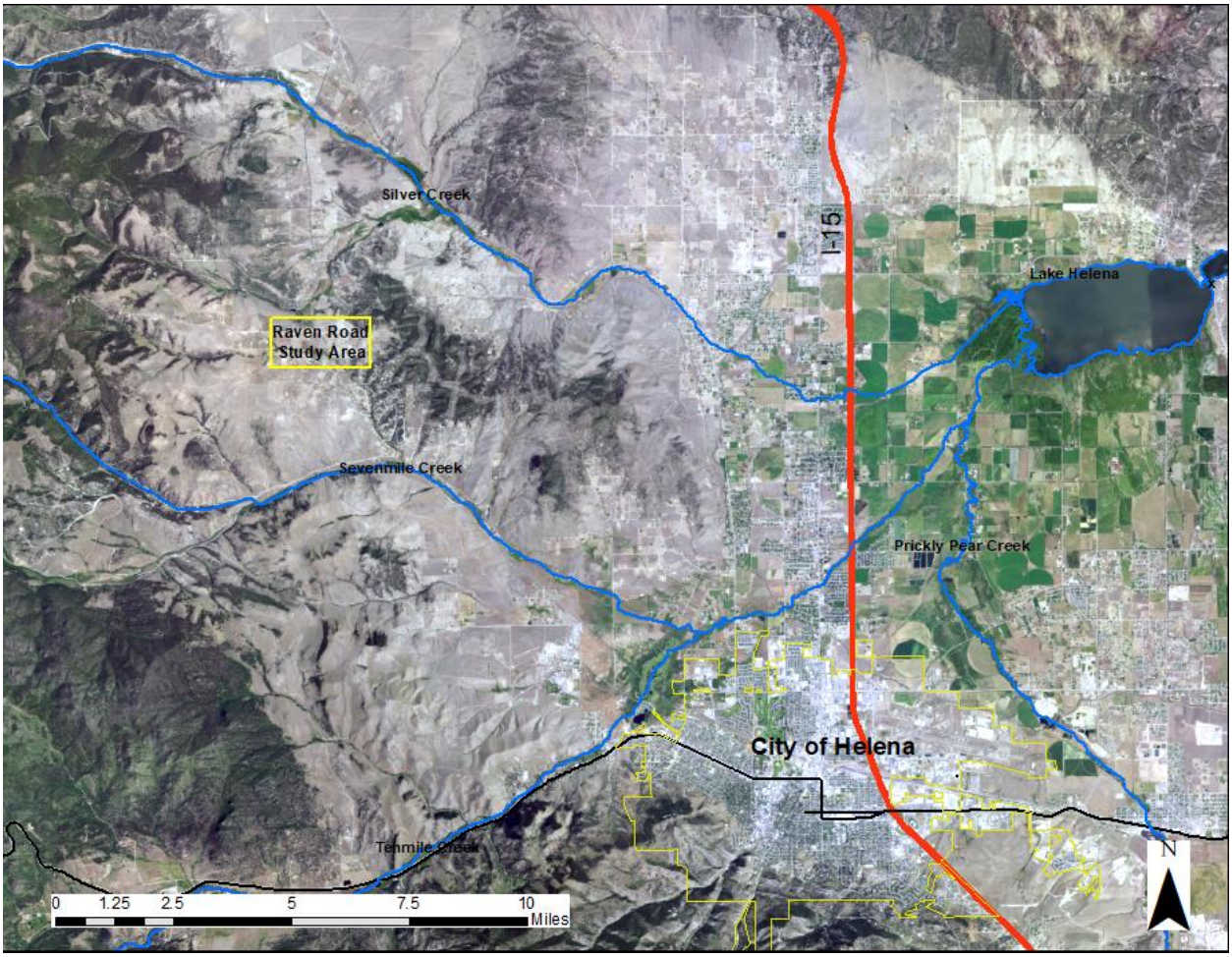

Figure 1. The Raven Road groundwater study area located 8 miles northwest of Helena within the Lake Helena watershed.

Prepared by: Joel Ebert
Environmental Health Technician
Water Quality Protection District
Lewis & Clark County

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Project Summary

In 2015, the Lewis & Clark Water Quality Protection District (WQPD), in conjunction with the Environmental Studies program at Carroll College and the Montana Department of Environmental Quality (DEQ), performed a ground (drinking) water sampling project in the Raven Road area of the Helena valley. This project was initiated by high nitrate results in a public water supply (PWS) on Raven Road belonging to the Last Chance Chapel. To fully assess water quality conditions in local groundwater, sixteen wells were sampled in March 2015 (including the PWS well) and eight of those wells were resampled in September 2015. Results indicated nitrates exceeding the maximum contaminant level (MCL) of 10 mg/L in three of the wells, arsenic exceeding the MCL of 0.01 mg/L in ten of the wells, and uranium exceeding the MCL of 0.03 mg/L in one of the wells. High nitrates are believed to be from localized sources (manure piles, septic systems, etc.) and arsenic and uranium are believed to originate from local geologic sources.

In 2021, WQPD decided a follow-up of the study was necessary. The goal was twofold: to reassess contaminant levels in ground (drinking) water of the area and to reconnect with residents to ensure that they were informed of groundwater issues and that any questions or concerns they had about their water were being addressed. Sampling was performed by WQPD staff in October 2021. Five wells from the previous project and one new well were sampled for this effort. Study results indicate persisting levels of high nitrates, arsenic, and uranium in the same wells that were sampled in 2015.

Introduction

The Raven Road study area is located 8 miles northwest of Helena in low upland hills just west of the Scratchgravel Hills (Figure 1). Raven Road runs east-west along a bench that serves as a drainage divide for Threemile Creek to the north and Park Creek to the south. Threemile Creek discharges to Silver Creek and Park Creek discharges to Sevenmile and eventually Tenmile Creek, all of which are part of the Lake Helena watershed.

Groundwater in the area generally follows topography, flowing west to east as the Raven Road bench descends to meet Birdseye Road. The static water level in area wells is relatively shallow (<100ft) and wells are drilled into fractured shale and limestone bedrock. Water isotope data from some wells upgradient of the Last Chance Chapel, a small, transient non-community public water supply, indicate a recharge source influenced by surface water, whereas wells from downgradient areas near to and east of Birdseye Road show isotope signatures more indicative of groundwater sources.

Nitrate samples exceeding the MCL of 10 mg/L at the Last Chance Chapel PWS were the impetus for a 2015 groundwater study in the Raven Road area. Since December 2008, samples from this PWS have exceeded the nitrate MCL on eighteen different occasions as reported by Montana DEQ.

DEQ reports also reveal at least one instance of a positive coliform bacteria result in the PWS. DEQ officials determined that a failing septic system located upgradient from the well was most

likely to blame (DEQ Individual Activity Report, 2015). In addition to this proximal source, faulty sampling methodologies may have played a role in the high nitrate concentrations observed. A new septic system was installed in October 2017 and nitrate concentrations have steadily declined since.

The current 2021 Raven Road study was developed by WQPD staff as a follow-up to the 2015 study examining the Last Chance Chapel PWS nitrate issue. The goals for this project were to determine if nitrates as well as arsenic and uranium were still a threat to public health and to inform the Raven Road area residents about the quality of their drinking water.

Methods

For this study, six private residential wells were sampled one time in October 2021. The 2015 area study, well logs in GWIC, and PWS records were all considered when choosing wells for this study. Each well owner was contacted in person by WQPD staff who explained the project and acquired permission to do the sampling. The Last Chance Chapel PWS was not one of the wells selected, as the WQPD had sufficient data from DEQ monitoring.

Wells were sampled for water quality parameters listed in the *2021 Raven Road Groundwater Monitoring Project Plan* and the WQPD's *Quality Assurance Plan: Groundwater and Surface Water Monitoring Program*. Static water level measurements were taken with a sonic water level meter before turning on any water. All samples were taken after a period of purging the well and stabilization of field parameters to ensure accurate representation of area groundwater. Samples were immediately placed into ice packed coolers and taken to Energy Laboratories in Helena for analysis following proper chain of custody procedures. A blank sample was taken at the first sampling location and a duplicate sample was taken at the second sampling location. Sample collection, analysis, and data management followed procedures established in the *Quality Assurance Plan*.

Results

Results from the 2015 and 2021 sampling events are shown in Table 1. Two sampling events occurred in 2015; one sampling event occurred in 2021. As such, each well in the Table 1 may have one to three results associated with it.

In 2021, two wells exceeded the 10 mg/L drinking water standard for nitrate. Two wells had elevated nitrate (5-8 mg/L) that did not exceed the drinking water standard. Two wells exceeded the standard for arsenic (0.01 mg/L). One well exceeded the standard for uranium (0.03 mg/L).

Well #	Date	Specific Conductivity (us/cm)	DO (mg/L)	TDS (mg/L)	Alkalinity, Total as CaCO3 (mg/L)	Bicarbonate as HCO3 (mg/L)	Cl (mg/L)	SO4 (mg/L)	Br (mg/L)	Hardness as CaCO3 (mg/L)	NO3+NO2 as N (mg/L)	N total (mg/L)	Phosphorus, Total as P (mg/L)	As (mg/L)	Ca (mg/L)	Fe (mg/L)	Mg (mg/L)	K (mg/L)	Na (mg/L)	U (mg/L)
1	March-15	745	8.55	706	180	230	130	179	0.190	476	3.94	4.40	0.001	0.004	102	<0.03	54	2	39	0.0060
2	March-15	1124	5.72	1100	180	220	210	357	0.300	--	9.54	9.70	0.013	0.007	142	<0.03	88	3	68	0.0063
	September-15	1108	14.83	1190	180	220	200	337	0.250	677	11.80	12.80	0.004	0.007	130	<0.03	86	3	67	0.0063
	October-21	1810	5.50	1240	170	210	227	361	0.900	738	13.50	--	0.008	0.007	143	<0.03	93	3	74	0.0070
3	March-15	535	6.19	493	270	330	37	79	<0.015	378	3.51	3.70	0.019	0.002	87	<0.03	39	3	20	0.0023
4	March-15	1002	2.42	972	220	260	151	324	0.200	--	1.15	1.25	0.046	0.069	151	<0.03	28	2	124	0.0240
	September-15	990	5.89	980	150	180	147	373	0.050	472	1.22	1.38	0.006	0.031	152	<0.03	23	2	108	0.0139
5	March-15	501	8.29	452	220	270	45	88	0.036	--	2.91	2.96	0.016	0.004	74	<0.03	41	2	19	0.0029
	October-21	901	9.20	585	210	260	71	126	0.260	399	4.98	--	0.014	0.004	82	<0.03	47	2	22	0.0030
6	March-15	336	1.42	296	240	290	7	22	0.028	240	0.61	0.67	0.073	0.006	52	<0.03	27	3	11	0.0023
7	October-21	524	4.30	318	130	160	27	57	0.060	221	8.20	--	0.004	0.000	47	<0.03	25	1	10	0.0013
8	March-15	1689	3.07	2210	250	310	135	1160	<0.015	1350	<0.01	<0.04	<0.001	0.010	289	1.63	153	3	89	0.0115
	September-15	1724	5.88	2150	260	310	155	1070	<0.015	1320	<0.01	0.09	<0.001	0.004	285	0.39	148	3	89	0.0123
	October-21	2550	0.40	2000	270	330	172	920	0.120	1260	<0.01	--	0.004	0.007	274	0.78	139	3	113	0.0128
9	March-15	677	2.77	693	180	220	78	256	0.320	381	0.24	0.27	0.014	0.017	68	0.10	51	4	65	0.0011
10	March-15	655	0.22	517	230	280	36	232	0.140	412	<0.01	0.04	0.017	0.032	86	0.39	48	2	47	0.0012
11	March-15	888	6.47	655	320	380	42	71	0.070	297	1.33	2.34	0.019	0.008	62	0.03	35	2	66	0.0164
	September-15	635	5.16	650	230	280	33	213	0.080	385	<0.01	<0.04	0.006	0.029	79	0.17	46	2	46	0.0012
12	March-15	506	0.18	464	210	250	23	136	0.090	281	<0.01	<0.04	0.013	0.009	59	0.28	33	2	43	0.0003
13	March-15	463	0.30	390	230	280	24	79	0.060	198	<0.01	<0.04	0.010	0.077	39	0.03	25	2	70	0.0150
	October-21	661	0.60	401	230	280	21	77	0.150	188	<0.01	--	0.006	0.016	39	0.04	22	2	65	0.0021
14	March-15	469	0.79	417	170	210	32	99	0.090	--	2.31	2.25	0.007	0.025	47	<0.03	18	2	68	0.0056
15	September-15	450	5.98	434	180	220	27	91	0.060	180	1.14	<0.04	0.004	0.023	45	<0.03	16	2	65	0.0028
15	March-15	977	9.29	930	290	350	88	89	0.038	462	46.70	59.00	0.016	0.030	79	<0.03	65	3	106	0.0288
	September-15	990	12.72	1010	290	360	93	93	<0.015	507	53.80	59.00	0.006	0.030	87	<0.03	71	3	105	0.0288
	October-21	1690	8.30	1110	280	340	118	99	0.100	578	81.00	--	0.020	0.030	98	0.07	81	3	105	0.0306
16	March-15	666	6.26	587	330	400	40	63	0.022	344	18.10	19.90	0.013	0.017	64	<0.03	45	4	72	0.0400
	September-15	656	10.43	608	300	370	38	66	<0.015	343	19.30	<10	0.004	0.015	66	<0.03	43	4	71	0.0340
17	March-15	354	2.34	325	170	210	12	58	0.017	147	2.60	1.55	0.016	0.053	35	<0.03	14	1	51	0.0020
	September-15	330	12.79	323	160	200	11	55	<0.015	130	0.78	0.50	0.005	0.049	34	<0.03	11	1	54	0.0010

Table 1. Water quality results from the 2015 and 2021 Raven Road sampling events. Results in red exceed the drinking water standard.

Analysis and Discussion

The results from this study illustrate contaminants that are a threat to public health persist in the groundwater of the Raven Road area. Since 2015, three wells experienced an increase in nitrates and the new well for the 2021 study was high also. High nitrate values most likely stem from site-specific local sources as there is little evidence to suggest that what had been affecting the Last Chance Chapel PWS was affecting the other wells in the area. Arsenic and uranium concentrations in groundwater are also of some concern for water users in the area. This is consistent with regional studies which have determined that arsenic is often present in shallow, fractured shale and limestone aquifers (Swierc, 2016).

In the complex, fractured bedrock groundwater system of the Raven Road area it is difficult to point the finger at one specific source of contaminants. In such cases, best management practices are the most effective way of protecting water users' health. Making a conscious effort to protect wellheads, properly store manure and fertilizers, and perform routine septic maintenance is the first step in preventing nutrient contamination. In the case of naturally occurring contaminants like arsenic and uranium, water treatment systems (e.g., reverse osmosis) may be required.

Property owners participating in the 2021 study each received their water quality results and a letter explaining those results. Mitigation strategies and fact sheets for their specific contaminants were included also.