Wastewater Spill into the Upper Gallatin River Watershed

Part 1. Effects on Water Quality Standards for Human Health

March 17, 2016

Prepared by:
Water Quality Standards and Modeling Section
Montana Department of Environmental Quality
Water Quality Planning Bureau
1520 E. Sixth Avenue
P.O. Box 200901
Helena, MT 59620-0901

WQPBWQSMTR-002

Suggested citation: Water Quality Standards and Modeling Section. 2016. Wastewater Spill into the Upper Gallatin River Watershed, Part 1. Effects on Water Quality Standards for Human Health. Helena, MT: Montana Dept. of Environmental Quality.

REPORT SUMMARY

Sometime on March 3, 2016 there was a mechanical failure in a storage pond for tertiary treated waste water used for golf course irrigation near Big Sky, Montana. The pond was located high in the watershed (8,148 feet elevation) and over the next four days approximately 30 million gallons of treated effluent discharged into and affected downstream waterbodies (Second Yellow Mule Creek, South Fork West Fork Gallatin River, West Fork Gallatin River, and the Gallatin River). DEQ began monitoring water quality in the spill affected area on March 5, 2016, and collected samples until March 12, 2016. The objective of this report (Part 1) is to address the effect of the spill on human health related water-quality standards. DEQ identified two human health parameters of concern at the onset of the spill; *Escherichia coli* (*E. coli*), and nitrate + nitrite (NO_3 + NO_2). Elevated levels of *E. coli* are linked to gastrointestinal disease, and elevated nitrate + nitrite can cause blue-baby syndrome in infants who drink the water. Ten sampling sites were established along the above-listed waterbodies, extending from the spill site itself downstream to the Gallatin River near Spanish Creek Road. Three of the sites were on unaffected local waterbodies in order to characterize background conditions during and after the spill. Samples collected from March 5th to March 7th represent the period when the spill was having its greatest effect, as water from the spill was a large proportion of stream flow in the upper tributaries. No human health water quality standards were exceeded during the March 5th-7th period at any of DEQ's ten sampling sites, nor in any samples collected after that time. Second Yellow Mule Creek (the direct recipient of the pond spill) appears to be showing an increasing trend in nitrate + nitrite concentrations; nitrate + nitrite in this stream should be monitored in future sampling events. Two additional parts of this report will be released in the coming weeks. Part 2 will address the spill's effects on aquatic life and fisheries, Part 3 will address measured levels of pharmaceuticals released during the spill.

1.0 INTRODUCTION AND OBJECTIVES

Sometime on March 3, 2016 there was a mechanical failure in a storage pond for tertiary treated waste water used for golf course irrigation near Big Sky, Montana. The pond was located high in the watershed (8,148 feet elevation) and over the next four days approximately 30 million gallons of the treated effluent discharged into and affected downstream waterbodies (Second Yellow Mule Creek, South Fork West Fork Gallatin River, West Fork Gallatin River, and the Gallatin River). DEQ began monitoring water quality in the spill affected area on March 5, 2016.

The effected waterbodies are all classified by the state of Montana as B-1. This means their water quality is to be maintained suitable for drinking, culinary, and food processing purposes after conventional treatment; bathing, swimming, and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl, and furbearers; and agricultural and industrial water supply.

The objective of this report (Part 1) is to address the effect of the spill on human health related water-quality standards. DEQ identified two human health parameters of concern at the onset of the spill (Water Quality Standards and Modeling Section, 2016); *Escherichia coli* (*E. coli*), and nitrate + nitrite (NO_3 + NO_2). Elevated levels of *E. coli* are strongly related to incidences of gastrointestinal disease (United Stated Environmental Protection Agency, 1986) and Montana's water quality standards are intended to minimize this risk. Elevated nitrate in drinking water causes methaemoglobinaemia, commonly called blue-baby syndrome. Infants below the age of six months who drink water containing nitrate in excess of the standard could become seriously ill and, if untreated, may die. This report will address both of these water quality parameters in the spill-affected area. **Figure 1-1** (next page) shows DEQ's ten sampling locations. Three sites (9, 6, and 4) are located in parts of the drainage not affected by the spill and were used to characterize background conditions. Two additional parts of this report will be released in the coming weeks. Part 2 will focus on the spill's effects on aquatic life and fisheries, Part 3 will address measured levels of pharmaceuticals released during the spill.

2.0 METHODS

Samples were collected as grabs after triple rinsing the HDPE sample bottles with site water (analytical details are in **Table 2-1**, next page). Field blanks (for evidence of inadvertent sample contamination) and duplicates (to assess repeatability) were collected. DEQ collects blanks and duplicates at the end of sampling trips; trips range from one to many days (here, the longest trip was three days). *E. coli* were enumerated using two methods: the membrane filtration method, and a multiple tube/tray method called Quanti-Tray®. The U.S. Environmental Protection Agency (EPA) states that under conditions of high turbidity, membrane filtration results should be compared to a parallel test using a multiple-tube technique to demonstrate applicability and comparability of results. Very high turbidity occurred during sampling so both methods were used. Due to short holding times, *E. coli* samples were not collected until March 7th so that they could be returned to the laboratory as quickly as possible.

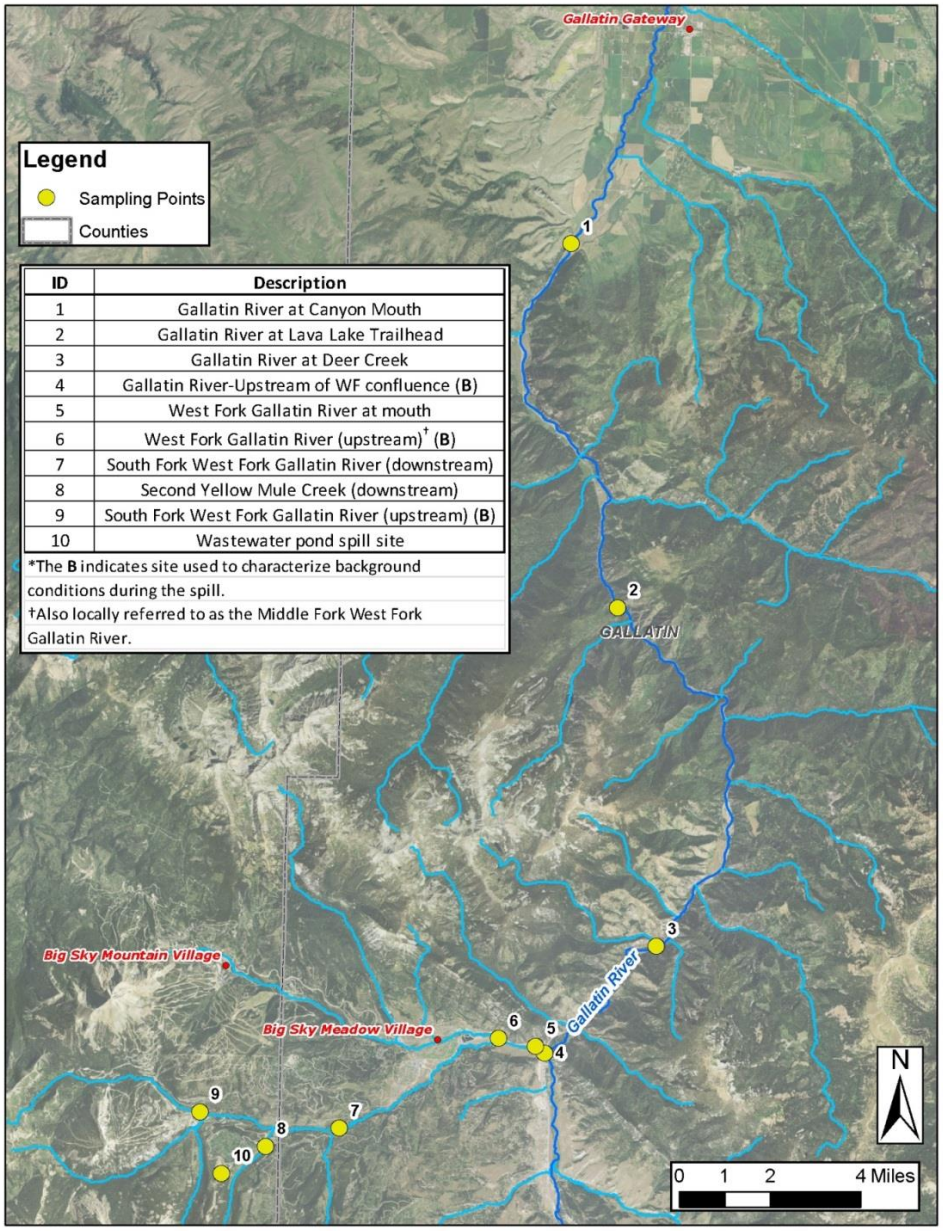

Figure 1-1. Map showing the ten sampling locations.

Table 2-1. Analytical Details for Water Quality Parameters in this Report.

Analyte	Preservation and Storage	Holding Time	Method	Required Reporting Limit
Nitrate + Nitrite	H_2SO_4, cool to <6°C (on ice)	28 days	EPA 353.2	0.02 mg/L
E. coli	Sodium thiosulfate, cool to <6°C (on ice)	6-8 hrs (regulatory); ≤24 hrs for non-regulatory purposes	EPA1603	1 CFU/100 ml
			A9223 B	1 MPN/100 ml

3.0 RESULTS AND DISCUSSION

It is known that *E. coli* survival in streams and rivers generally increases with colder temperatures (Blaustein, et al., 2013). However, human activity (swimming, wading) greatly decreases with very cold temperatures. In northern states *E. coli* standards are often less stringent for those months when water contact would only be via incidental exposure; this is the case in Montana.

Results for the *E. coli* sampling are shown in **Table 3-1**. The water quality standard for these streams during the cold winter months (November 1st to March 31st) is 1,260 CFU/100 ml for individual samples (Administrative Rules of Montana 17.30.623(2a)). In no case did any of the effected or background sites exceed the standards. All the samples collected on the mainstem Gallatin River were either below or right at the analytical detection limit. Field blanks were uncontaminated and duplicate values were reasonably similar (readers should note that bacteria counts tend to be somewhat variable).

Table 3-1. Enumeration of *E. coli* in samples collected on March 7, 2016.

	***E. coli* Method**[‡]	
Site Number and Name*	**Quanti-Tray (MPN/100 ml)**	**Membrane filtration (CFU/100 ml)**
(10) Wastewater pond spill site	124.6	110.0
(9) South Fork West Fork Gallatin River (upstream)(**B**)	2.0	2.0
(8) Second Yellow Mule Creek (downstream)	2.0	4.0
(7) South Fork West Fork Gallatin River (downstream)	8.5	4.0
(6) West Fork Gallatin River (upstream)[†] (**B**)	26.2	15.0
(5) West Fork Gallatin River at mouth	4.1	8.0
(5) West Fork Gallatin River at mouth (*field duplicate*)	12.1	11.0
(4) Gallatin River-Upstream of WF confluence (**B**)	<1	<1
(3) Gallatin River at Deer Creek	<1	<1
(2) Gallatin River at Lava Lake Trailhead	1.0	<1
(1) Gallatin River at Canyon Mouth	<1	<1
Field blank	<1	<1

* The **B** indicates site used to characterize background conditions during the spill.
[†] Also locally referred to as the Middle Fork West Fork Gallatin River.
[‡] MPN (most probable number) and CFU (colony forming units) are directly comparable.

The results for nitrate + nitrite are shown in **Table 3-2** (next page). The human health standard for nitrate + nitrite is 10 mg/L as N (Montana Department of Environmental Quality, 2012). The human health standard was not exceeded at any of DEQ's sampling locations. Even in the extremely unlikely case that each of the nitrate + nitrite samples was composed of 100% nitrite (recall that our measurement is the sum of nitrate + nitrite), the affected waterbodies would still not have exceeded the human health nitrite standard of 1 mg/L as N, which is also intended to prevent blue-baby syndrome (Montana Department of Environmental Quality, 2012).

Field blanks were uncontaminated and duplicate values were nearly identical. The highest measured concentration, 1.64 mg/L, was found in water spilling directly from the pond, but it should be noted that at that time the spill from the pond had dropped to a trickle because the pond was essentially empty. DEQ stopped sampling the mainstem Gallatin on March 9th as conditions had largely returned to background. In contrast, Second Yellow Mule Creek (the direct recipient of the pond spill) appears to be showing an increasing concentrations trend; this stream should continue to be monitored in the future.

Table 3-2. Concentrations of nitrate plus nitrite measured from March 5th to March 12th, 2016.

	Nitrate + nitrite concentration (mg/L)				
Site Number and Name*	**March 5th (Sat)**	**March 6th (Sun)**	**March 7th (Mon)**	**March 9th (Wed)**	**March 12th (Sat)**
(10) Wastewater pond spill site	0.15	0.18	1.64	flow ceased	flow ceased
(9) South Fork West Fork Gallatin River (upstream)(**B**)	0.18	0.19	0.18	0.21	0.21
(8) Second Yellow Mule Creek (downstream)	0.21	0.25	0.47	0.65	0.68
(7) South Fork West Fork Gallatin River (downstream)	0.21	0.25	0.29	0.36	0.36
(6) West Fork Gallatin River (upstream)† (**B**)	0.50	0.48	0.43	0.48	0.49
(5) West Fork Gallatin River at mouth	0.30	0.34	0.39	0.51	0.44
(5) West Fork Gallatin River at mouth (*field duplicate*)	*see March 7th result*		0.39	0.52	0.44
(4) Gallatin River-Upstream of WF confluence (**B**)	0.03	0.03	0.03	0.03	not collected
(3) Gallatin River at Deer Creek	0.06	0.06	0.05	0.04	not collected
(2) Gallatin River at Lava Lake Trailhead	0.04	0.06	0.04	0.01	not collected
(1) Gallatin River at Canyon Mouth	0.04	0.06	0.06	0.03	not collected
Field blank	*see March 7th result*		<0.01	<0.01	<0.01

* The **B** indicates site used to characterize background conditions during the spill.
† Also locally referred to as the Middle Fork West Fork Gallatin River.

4.0 CONCLUSIONS

DEQ collected water quality samples for two human health related parameters (*E. coli* and nitrate + nitrite) between March 5th and March 12th, 2016. Samples collected from March 5th to March 7th represent the period when the spill was having its greatest effect, as water from the spill was a large proportion of stream flow in the upper tributaries. No human health water quality standards were exceeded during the March 5th-7th period at any of DEQ's ten sampling sites, or in any samples collected after that time period. Second Yellow Mule Creek (the direct recipient of the pond spill) appears to be showing an increasing trend in nitrate + nitrite concentrations; this stream should continue to be monitored for nitrate + nitrite in future samplings.

5.0 REFERENCES

Blaustein, R. A., Y. Pachepsky, R. L. Hill, D. R. Shelton, and G. Whelan. 2013. *Escherichia Coli* Survival in Waters: Temperature Dependence. *Water Research.* 47: 569-578.

Montana Department of Environmental Quality. 2012. Circular DEQ-7: Montana Numeric Water Quality Standards. Helena, MT: Montana Department of Environmental Quality. http://deq.mt.gov/Portals/112/Water/WQPB/Standards/PDF/DEQ7/FinalApprovedDEQ7.pdf. Accessed 3/16/2016.

United Stated Environmental Protection Agency. 1986. Ambient Water Quality Criteria for Bacteria-1986. Washington, D.C.: Office of Water, United States Environmental Protection Agency. EPA440/5-84-002.

Water Quality Standards and Modeling Section. 2016. Big Sky Wastewater Spill, Sampling and Analysis Plan -Updated Version, 03/08/2016. Helena, MT: Montana Dept. of Environmental Quality. http://deq.mt.gov/Portals/112/Water/WPB/MPDES/pdfs/Updated%20SAP_Big_Sky_Spill.pdf.