Montana DEQ - Water Quality Standards Attainment Record

Reporting Cycle: 2020 **Assessment Record:** MT42K002_110.pdf **Status:** Completed

ASSESSMENT UNIT INFORMATION

Reporting Cycle:	2020
Assessment Unit:	MT42K002_110
Waterbody Name:	East Fork Armells Creek
Location Description:	EAST FORK ARMELLS CREEK, East Rosebud Mine outfall 020 (45.85887N, -106.6621W) to mouth (Armells Creek)

Water Type:	Size (Miles/Acres)	Use Class:
RIVER	37.43 MILES	C-3

Hydrologic Unit Code:	10100001
HUC Name:	Lower Yellowstone-Sunday
Watershed:	Lower Yellowstone
Basin:	Yellowstone
TMDL Planning Area:	Middle Yellowstone Tributaries
Ecoregion:	Northwestern Great Plains
County:	Rosebud County
Lat/Long AU Start (U/S):	45.85887 / -106.6621
Lat/Long AU End (D/S):	46.092603 / -106.761847

MONITORING INFORMATION

Date Assessment Started:	12/12/2017
Assessed By:	Nixon, Alan

CITATIONS

Citation	Location	Biological Data	Habitat Data	Chemistry Data
Western Energy Company (1976), Invertebrate and Water Quality: Studies of Four Armells Creek Stations, Two Rosebud Creek Stations, and One Reclamation Pond.1976	WQPB Ebrary	macroinvertebrates		General
Van Voast, Wayne A. ; Hedges, Robert B. ; McDermott, John J. (1977), Hydrogeologic Conditions and Projections Related to Mining Near Colstrip, Southeastern Montana, Bulletin 102	WQPB Ebrary			common ions, pH, conductivity, miscellaneous; metals
Botz, Maxwell K. (1978), Characteristics and Potential Impact of Wastewaters from a Coal-Fired Power Plant at Colstrip, Montana	WQPB Ebrary			common ions, pH, conductivity, miscellaneous; major nutrients; metals
Melancon, Susan ; Hess, Bryant C. ; Thomas, Robert B. (1979), Assessment of Energy Resource Development Impact on Water Quality: The Tongue and Powder River Basins, EPA-600/7-79-249	WQPB Ebrary	fish	riparian &/or instream surveys & physical features	common ions, pH, conductivity, miscellaneous; major nutrients; metals
Bahls, Loren L. (1980), Salinity and the Structure of Benthic Algae (Periphyton) Communities in Streams of the Southern Fort Union Region, Montana, USGS Research Grant #14-08-0001-G-503	WQPB Ebrary	algae	riparian &/or instream surveys & physical features	common ions, pH, conductivity, miscellaneous; major nutrients
Klarich, Duane A. ; Regele, Stephen M. ; Bahls, Loren L. (1980), Data Report for the Benthic Macroinvertebrate and Periphyton Community Inventory of Streams Draining the Southern Fort Union Coalfield Region of Southeastern Montana, USGS Research grant #14-08-0001-G-503	WQPB Ebrary	algae; fecal coliforms; macroinvertebrates		common ions, pH, conductivity, miscellaneous; major nutrients; metals; quantitative physical data
Klarich, Duane A. ; Regele, Stephen M. (1980), Structure, General Characteristics, and Salinity Relationships of Benthic Macroinvertebrate Associations in Streams Draining the Southern Fort Union Coalfield Region of Southeastern Montana,	WQPB Ebrary	algae; fecal coliforms; macroinvertebrates	riparian &/or instream surveys & physical features	common ions, pH, conductivity, miscellaneous; metals; quantitative physical data

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Citation	Location	Biological Data	Habitat Data	Chemistry Data
USGS Grant #14-08-0001-G-503				
(1981), Field Notes and Data Collected for "Biological Water Quality Monitoring Eastern Montana 1979"	DEQ PPA Data Archive			
Montana Standard (1981), Order Issued on Colstrip Seep: Montana Standard Newspaper Article 6/06/1981	Assessment Record			common ions, pH, conductivity, miscellaneous
(1997), Pre 1997 Field Assessments	Assessment Record	algae; chlorophyll; fecal coliforms; fish; macroinvertebrates	Land use; photo points; riparian &/or instream surveys & physical features	Rosgen type; benthic sediment data; bioaccumulation; common ions, pH, conductivity, miscellaneous; major nutrients; metals; quantitative physical data
Erbes, Dan (1998), Montana Dept. of Environmental Quality Letter to Office of Surface Mining and Reclaimation	Assessment Record			common ions, pH, conductivity, miscellaneous; quantitative physical data
Montana Department of Fish, Wildlife, and Parks (1999), Montana Rivers Information System (MRIS)	Assessment Record	algae; fish; macroinvertebrates; wildlife	Land use; riparian &/or instream surveys & physical features	common ions, pH, conductivity, miscellaneous; quantitative physical data
U.S. Geological Survey (199n), USGS Water Data for the Nation - NWIS	Assessment Record	algae; chlorophyll; fecal coliforms; fish; other bacteriological data	Land use; riparian &/or instream surveys & physical features	benthic sediment data; bioaccumulation; common ions, pH, conductivity,

Citation	Location	Biological Data	Habitat Data	Chemistry Data
				miscellaneous; major nutrients; metals; organics; quantitative physical data
(2005), DEQ Field Assessment Form	Assessment Record	algae; chlorophyll; fecal coliforms; fish; macroinvertebrates	Land use; photo points; riparian &/or instream surveys & physical features	Rosgen type; benthic sediment data; bioaccumulation; common ions, pH, conductivity, miscellaneous; major nutrients; metals; organics; quantitative physical data
Suplee, Michael W. (2005), Best Use of the June 2005 Nutrient Data Statistical Summaries	WQPB Ebrary	algae		major nutrients
Montana Department of Environmental Quality, Planning, Prevention and Assistance Division, Water Quality Planning Bureau (2006), STORET/Storease Data Archive [Electronic Resource]	DEQ Metcalf Multimedia Case	General; algae; chlorophyll; fecal coliforms; fish; macroinvertebrates; other bacteriological data	General; Land use; riparian &/or instream surveys & physical features	General; Rosgen type; benthic sediment data; common ions, pH, conductivity, miscellaneous; imagery data; major nutrients; metals; organics; quantitative physical data
Montana Department of Fish, Wildlife, and Parks (2006), Montana Rivers Information System (MRIS): Montana Fisheries Information System (MFISH) - http://maps2.nris.mt.gov/scripts/esrimap.dll?name=MFISH&Cmd=INST	Assessment Record	fish; wildlife	Land use; riparian &/or instream surveys & physical features	benthic sediment data; common ions, pH, conductivity, miscellaneous; quantitative physical data
Administrative Rules and Management Services	WQPB Ebrary	e-coli; fecal coliforms	riparian &/or instream	General; major

Citation	Location	Biological Data	Habitat Data	Chemistry Data
Division Deputy (2007), Administrative Rules of Montana, Subchapter 6: Surface Water Quality Standards and Procedures			surveys & physical features	nutrients; quantitative physical data
U.S. Department of Commerce, National Oceanic and Atmospheric Admin. (2008), Screening Quick Reference Tables (SQuiRTs), OR&R Report 08-1	WQPB Ebrary			benthic sediment data; organics
Davis, Windy N. ; Bramblett, Robert G. ; Zale, Alexander V. ; Endicott, Carol Leigh (2009), A Review of Potential Effects of Coal Bed Natural Gas Development Activities on Fish Assemblages of the Powder River Geologic Basin, DOI: 10.1080/10641260902737067	WQPB Ebrary	fish		toxicity tests
Drygas, Jonathan (2012), The Montana Department of Environmental Quality Metals Assessment Method-Final, WQPBMASTR-03	WQPB Ebrary			benthic sediment data; metals
Arcadis U.S., Inc (2014), Aquatic Survey Assessment	WQPB Ebrary	macroinvertebrates	riparian &/or instream surveys & physical features	General
Montana Department of Environmental Quality (2014), Department Circular DEQ-12A: Montana Base Numeric Nutrient Standards, Circular DEQ-12A	WQPB Ebrary			major nutrients
Montana Department of Environmental Quality (2015), Montana DEQ IEMB Permit Data	Assessment Record			quantitative physical data
Nicklin Earth and Water (2015), Addendum to the Comprehensive Evaluation of Probable Hydrologic Consequences Areas A, B and C Western Energy Rosebud Mine.			General; Land use	General
Environmental Resources Management (2016), 2015 East Fork Armells Creek Benthic	WQPB Ebrary	macroinvertebrates	riparian &/or instream surveys & physical	quantitative physical data

Citation	Location	Biological Data	Habitat Data	Chemistry Data
Macroinvertebrate Survey			features	
Montana Department of Environmental Quality, Planning, Prevention and Assistance Division, Water Quality Planning Bureau (2017), Habitat Assessment Template	WQPB Ebrary		General; riparian &/or instream surveys & physical features	
Montana Department of Environmental Quality (2017), Circular DEQ-7: Montana Numeric Water Quality Standards	WQPB Ebrary			common ions, pH, conductivity, miscellaneous; major nutrients; metals
Nixon, Al (2017), Armells Creek Water Quality Monitoring Project 2017: Nutrients, Metals, Salinity, and Habitat Sampling and Analysis Plan, Y17MASSAP-01	WQPB Ebrary	algae	riparian &/or instream surveys & physical features	benthic sediment data; common ions, pH, conductivity, miscellaneous; major nutrients; metals; quantitative physical data
Nixon, Alan ; Kron, Darrin (2017), East Fork Armells Creek Salinity Assessment and Armells Salinity Condition Report-2017	WQPB Ebrary			common ions, pH, conductivity, miscellaneous; quantitative physical data
Sada de Suplee, Rosie ; Suplee, Michael W. (2018), Memo-Comparison of Reference Stream Data to East Fork Armells Creek	WQPB Ebrary			common ions, pH, conductivity, miscellaneous
Montana Bureau of Mines and Geology (nnnn), GWIC Data from http://mbmggwic.mtech.edu/	Assessment Record	algae	Land use; riparian &/or instream surveys & physical features	benthic sediment data; common ions, pH, conductivity, miscellaneous; major nutrients; metals; quantitative physical

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Citation	Location	Biological Data	Habitat Data	Chemistry Data
				data
Montana Department of Environmental Quality, Planning, Prevention and Assistance Division, Water Quality Planning Bureau (nnnn), Montana Water Quality EQuIS	WEB	General; algae; chlorophyll; e-coli; macroinvertebrates	riparian &/or instream surveys & physical features	General; General; benthic sediment data; common ions, pH, conductivity, miscellaneous; major nutrients; metals; organics; quantitative physical data

Comments:

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DATA MATRIX
Biological Data

Comments: Pre-2018: Not enough data available to conclude anything about the fishery. Macroinvertebrates sampled at 3 sites in 2005. Very few animals were collected at the lower site, indicating thermal extremes or periodic dewatering. The dominant taxon was a tolerant dragonfly. Emergent macrophytes probably provided a significant portion of the habitat space. Nutrient enrichment was suggested at the middle and upper sites. Periodic dewatering may have influenced the biology at the middle site. Blackfly larvae made up 52% of the sample at the middle site, while midges made up 44% of the upper site. Filamentous algae may have been prevalent at the upper site. At least 2 sites suggested poor biotic communities. The chlorophyll a value at all 3 sites was below criteria.

2018:
Periphyton, 2017: Of the periphyton samples collected (n = 4), one sample exceeded the probability of impairment threshold for nutrients: 55.5%, Site Y17AREFC50, Armells Creek East Fork downstream of golf course.

Macroinvertebrates: No recent available data for this AU

Upper

Data Type	Comments	Ref Num	Citation
chlorophyll	Upper: 0.30 mg/m^2.	4652	(2005), DEQ Field Assessment Form
macroinvertebrates	Macroinvertebrate taxa list and organism counts for four sites on EF Armells Creek sampled in 1976. Sites are above and below the Colstrip sewage lagoon, and below the mine siltation pond.	15741	Western Energy Company (1976), Invertebrate and Water Quality: Studies of Four Armells Creek Stations, Two Rosebud Creek Stations, and One Reclamation Pond.1976
macroinvertebrates	Upper: Midges (44%) dominated the sample. Orthocladius sp. was also among the taxa here; together, these midges suggest that filamentous algae may have been prevalent. Nutrient enrichment is implied. Overall taxa richness (28) was marginal; instream habitat diversity may have been limited. 4 specimens of Dubiraphia sp. were collected, making it less likely that dewatering or thermal extremes affected the biota. Bramlett's IBI score = 33.75%, indicating poor water quality.	4652	(2005), DEQ Field Assessment Form

Entire AU

Data Type	Comments	Ref Num	Citation
algae	PERIPHYTON: Periphyton samples were collected in 2017 following DEQ sampling protocols during the index period when nutrient standards apply for the Northwestern Great Plains level III ecoregion (July 1 - Sept 30). Four sites were each sampled. Three sites were sampled twice, and the site upstream of the golf course was sampled once (dry channel the second time). Individual site samples were composited by site,yielding four periphyton samples for identification. For each sample, diatoms were identified to the lowest taxonomic level possible and nutrient increaser taxa metrics were calculated. These metrics were developed to indicate the likelihood of nutrient impairments in a waterbody. A diatom sample suggests nutrient impairment when the probability of impairment is > 51%. Of the periphyton samples collected (n = 4), one sample exceeded the probability of impairment threshold for nutrients:55.5%, Site Y17AREFC50, Armells Creek East Fork downstream of golf course.	15288	Montana Department of Environmental Quality, Planning, Prevention and Assistance Division, Water Quality Planning Bureau (nnnn), Montana Water Quality EQuIS

From vicinity of outfall 020 (45.85887 N, -106.6621 W) to mouth (Armells Creek)

Data Type	Comments	Ref Num	Citation
fish	No fishery data.	11349	Montana Department of Fish, Wildlife, and Parks (1999), Montana Rivers Information System (MRIS)
fish	2005: 2 sites visited in 2003 were dry (RM 7.2 and 42.8). RM 24.8 to 24.9 sampled in 2003, no fish captured. RM 19.2 to 19.3 sampled in 2001, 2 Plains Killifish captured.	11355	Montana Department of Fish, Wildlife, and Parks (2006), Montana Rivers Information System (MRIS): Montana Fisheries Information System (MFISH) - http://maps2.nris.mt.gov/scripts/esrimap.dll?nam

Data Type	Comments	Ref Num	Citation
			e=MFISH&Cmd=INST
macroinvertebrates	Two EFAC sites adjacent to the Rosebud Mine permit areas (Areas A, B, and C) sampled on October 9, 2014. Site EFAC1 is located on MT42K002_110, while site EFAC2 is located on MT42K002_170. Community diversity and abundance was similar between the two locations, with a total of 25 and 26 taxa identified at EFAC1 and EFAC2, respectively. Communities were represented by eight orders of aquatic organisms, including aquatic worms, snails, amphipods, mayflies, damselflies, caddisflies, beetles, midges, and fly larvae. For both locations, mainly tolerant Dipteran taxa comprised over 50% of the community, with Hyalella following closely at nearly 25% and above within the community. Based on the MDEQ protocols, a community indicator metric (Hilsenhoff Biotic Index [HBI]) was calculated using Montana-specific tolerance values for identified taxa. HBIs for both locations: 6.98, 7.90	15742	Arcadis U.S., Inc (2014), Aquatic Survey Assessment
macroinvertebrates	Macroinvertebrate monitoring sites for this study were located on both MT42K002_170 and MT42K002_110. Sampling locations were limited to areas of the wetlands accessible with hip boots. The locations surveyed in 2014 were dry and were therefore not surveyed. A third location contained enough water to conduct a benthic macroinvertebrates survey, and this location was divided into 2 survey sites, one survey site on each side of an access road. Two sites along EFAC were surveyed for benthic macroinvertebrates on 24 Sept 2015. Survey protocols and taxonomic identification of the benthic community organisms followed MDEQ sampling and analysis protocols. Seventeen and twenty-one genera were identified	15743	Environmental Resources Management (2016), 2015 East Fork Armells Creek Benthic Macroinvertebrate Survey

Data Type	Comments	Ref Num	Citation
	at the east and west survey sites, respectively. Species abundance was dominated by sandflies (Ceratopogonidae) at both locations. The HBI scores were 6.63 and 7.64		

Lower and Middle

Data Type	Comments	Ref Num	Citation
chlorophyll	Lower: 0.50 mg/m^2. Middle: 0.50 mg/m^2.	4652	(2005), DEQ Field Assessment Form
macroinvertebrates	Lower: Very few animals collected here. Low abundance of invertebrates can be an indication of severe habitat disturbance, toxic pollutants, frequent dewatering, or thermal extremes. While metrics may not be used, a few observations about the composition can be ventured. The dominant taxon was the dragonfly Lestes sp., considered a tolerant ordinate. The mayfly Callibaetis sp. was present at the site, suggesting that emergent macrophytes probably provided a significant proportion of instream habitat space. Middle: Blackfly larvae (Simulium sp.) were the dominant taxon collected, accounting for 52% of the animals. The abundance of these animals suggests lotic conditions. Another tolerant taxon, Physa sp., was also present in significant numbers. These taxa suggest that nutrient-rich particulates and algal films were a major energy source in the reach; nutrient enrichment may be indicated. Periodic dewatering may influence the biology, since no less-mobile semivoltine taxa were collected. Bramlett's IBI score = 24.71%, indicating poor water quality.	4652	(2005), DEQ Field Assessment Form

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DATA MATRIX

Habitat Data

Comments: Pre-2017: Site visits in 1979 reported stable banks and a channel covered with macrophytes (cattails). 3 sites visited in 2005. The banks were stable vertically and horizontally, and were well vegetated with deep-rooted grasses. The stream had access to a floodplain, and active erosion was minimal. Long, deep glides were prevalent, and the substrate was mostly silt. Macrophyte growth (cattails) is common. Where cattails are not present, sediment moves during major storm events. A lack of trees was noted, but they probably are not required for sustainability. Some rip rap, culverts, and garbage was noted through town. One pond created by a road crossing is located in the lower reach and there is continuous flow at a site about 300 yds above hwy 39 crossing. The effect upon flow from the open cut mine is unknown. The overall habitat is least or slightly impaired.

2017- Habitat assessments were performed to update the 2018 303(d) list.

Upper

Data Type	Comments	Ref Num	Citation
riparian &/or instream surveys & physical features	Upper: Site fairly pristine and appealing. Site is basically a wetland, with a small discernable channel. Water is flowing through cattails. Heavy macrophyte growth, sparse filamentous algae. Substrate 100% silt. No "pools", but channel is deep. No alteration present. Sediment does not move, but covers bottom. Bank stability optimal, only eroded at cow paths, then very little. Bank vegetation protection optimal on RB, sub-optimal on LB (lacking age classes of trees).	4652	(2005), DEQ Field Assessment Form

Entire AU

Data Type	Comments	Ref Num	Citation
riparian &/or instream surveys & physical features	Four sites were evaluated using DEQ's pilot qualitative habitat assessment process. Indicators for riparian degradation assessment totaled 3 marginal, 7 Poor, 11 Sub-Optimal, and 3 Optimal as compared to potential condition. Alteration of Stream Geomorphology: The AU failed 3 geomorphology tests. 7 indicators were rated Optimal, 4 Sub-Optimal, 5 Marginal, and 4 Poor.	15657	Montana Department of Environmental Quality, Planning, Prevention and Assistance Division, Water Quality Planning Bureau (2017), Habitat Assessment Template

Data Type	Comments	Ref Num	Citation
riparian &/or instream surveys & physical features	This document describes the project design, including the habitat monitoring and assessment plan.	15656	Nixon, Al (2017), Armells Creek Water Quality Monitoring Project 2017: Nutrients, Metals, Salinity, and Habitat Sampling and Analysis Plan, Y17MASSAP-01

From vicinity of outfall 020 (45.85887 N, -106.6621 W) to mouth (Armells Creek)

Data Type	Comments	Ref Num	Citation
General	According to The Addendum to the Comprehensive Evaluation of Probable Hydrologic Consequences Areas A, B and C Western Energy Rosebud Mine, the East Fork of Armells Creek transitions from ephemeral to intermittent 15 to 20 yards downstream of outfall 020. Therefore, the break point between the upper segment of East Fork Armells Creek and the lower segment of East Fork Armells Creek has been moved approximately 2 stream miles upstream from the mine shops area to the vicinity of outfall 020 during the 2020 cycle. The new upstream endpoint is located at 45.85887N, -106.6621W.	15763	Nicklin Earth and Water (2015), Addendum to the Comprehensive Evaluation of Probable Hydrologic Consequences Areas A, B and C Western Energy Rosebud Mine.
photo points	19 reach photos.	4652	(2005), DEQ Field Assessment Form
riparian &/or instream surveys & physical features	Visited twice in 1979, below Colstrip. 7/79: Banks vegetated and stable. Substrate 40% detritus, 30% muck, 10% gravel, 20% sand/silt. 99% pools. Substrate 90% covered with macrophytes. 3/70: Banks vegetated and stable. Substrate 30% detritus, 30% muck, 40% sand/silt. Substrate 0% covered with macrophytes, mostly bare shifting silt and muck. Lots of cattails.	1151	(1981), Field Notes and Data Collected for "Biological Water Quality Monitoring Eastern Montana 1979"
riparian &/or instream surveys & physical features	Some channelization through the town of Colstrip.	10472	(1997), Pre 1997 Field Assessments

Data Type	Comments	Ref Num	Citation
riparian &/or instream surveys & physical features	Stream Reach Assessment: Assessment includes the town of Colstrip. Water first starts "flowing" in the vicinity of East Rosebud Mine outfall 020. The stream appears intermittent through town. No land disturbances were observed from Colstrip to the mouth. In town there were several road crossing, culverts, rip-rap, and bank encroachment. The stream runs through a golf course below town. Stream bottom all silt/clay, abundant submerged vegetation. Long deep glides are prevalent. The lack of trees probably contributes slightly to elevated water temps. There were no noticeable alterations to flow. Aquatic plants consist of rush, sedge, cattails. Some algae growing on submerged veg. Banks appear to be grazed seasonally. Riparian Assessment: Stream appears stable vertically and horizontally. The amount of riparian vegetation is optimal, although the kind of vegetation is sub-optimal (lacks trees and brush). Only a few mature trees are present, although they are probably not required for sustainability. Little erosion observed, the stream has adequate characteristics to dissipate energy. Overall the habitat is in good shape.	4652	(2005), DEQ Field Assessment Form

Lower and Middle

Data Type	Comments	Ref Num	Citation
riparian &/or instream surveys & physical features	Lower: Site fairly pristine and appealing. Many minnows observed. Macroinvertebrate Habitat Assessment: Substrate mostly silt, some woody debris, grass, rush. Site is 1 long, deep glide or pool. Channel alteration absent. Banks stable, but sediment moves w/in channel during major storm events. Bank stability and vegetation protection optimal; grass, brush, scattered adult and young adult trees, forbs. Little evidence of erosion except for a few cow paths. Stream appears to be recovering and a new riparian zone is establishing. Middle: Site somewhat disturbed. Moderate filamentous algae and	4652	(2005), DEQ Field Assessment Form

Data Type	Comments	Ref Num	Citation
	macrophyte growth. Heavy sedge growth and lots of submerged veg. Macroinvertebrate Habitat Assessment: Substrate mostly silt, some small pebbles; lots of sedge, grass. No "pools" present, reach is a long, narrow, deep glide. Channel alteration absent. Little sediment movement, though the bottom is silt. Bank stability and vegetation protection optimal; no trees or woody vegetation, but good grass cover. With the exception of trees, "as good as it gets" on a prairie stream.		

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DATA MATRIX
Chemistry Data

Comments:

Pre-2018: East Fork Armells is typical of most streams in this region. The water is very hard, saline, and high in sulfates. Where TSS data was available (2005), concentrations were low. Mining activities (including water pumped from the Yellowstone River to seeping ponds) likely have contributed to increased TDS concentrations and "water logging" below Colstrip. Water logging may not currently be occurring. The elevated SC concentrations make this water unsuitable for irrigation under ordinary circumstances. The soils must be permeable, drainage must be adequate, water must be applied in excess, and very salt-tolerant crops should be selected. This water is acceptable for use with livestock accustomed to its use, but is not recommended for pregnant or lactating cows. Data from the 1970s show that NO2+NO3 regularly exceeded the guidance threshold of 0.10mg/L although this was not the case in 2005. In 2005, TKN at the lower site moderately exceeded the contact recreation guidance, and slightly exceeded the aquatic life guidance. At the middle site, contact recreation and aquatic life guidance thresholds were slightly exceeded. The most reliable metals data is from the 2005 assessment, which showed no exceedences.

2018:
NUTRIENTS: 29 nutrient samples were collected following DEQ sampling protocols during the index period when numeric nutrient standards apply for the Northwestern Great Plains level III ecoregion. Data were evaluated against numeric nutrient standards for TN and TP and to recommended NO2+3 nutrient guidance threshold for the Northwestern Great Plains ecoregion (TN = 1.30 mg/L; TP = 0.15 mg/L; NO2+3 = 0.10 mg/L).

METALS: Dissolved Al: 3 samples are greater than 2 times the Acute Standard, and 14 exceed the Chronic Std. Fe: 8 samples exceed the chronic aquatic life standard. Cd, Cr, Cu, Se, Ag, Hg, and Zn: no samples exceed acute or chronic aquatic life or human health standards. Pb: one chronic aquatic life exceedance, and one human health exceedance. As: One sample exceeds the human health standard. This stream is classified as a C-3 water. The quality of these waters is naturally marginal for drinking, culinary, and food processing purposes.

SEDIMENT METALS: One sample was collected at each of seven monitoring sites and analyzed for As, Cd, Cr, Cu, Fe, Pb, Hg and Zn. Benthic sediment metals data was considered separately from water column metals data and is not explicitly included in the assessment decision-making process. Data was evaluated using NOAAs Screening Quick Reference Tables for Inorganics in Soil (Probable Effect Level). All concentrations are below the NOAA screening criteria used (17ug/g As, 3.53 ug/g Cd, 90 ug/g Cr, 197 ug/g Cu, 91.3 ug/g Pb, 0.486 ug/g Hg and 315 ug/g Zn).

SALINITY: EF Armells Creek was monitored to assess salinity (Specific Conductance, Total Dissolved Solids). Using analyses of base chemistry data for identifying potential reference streams, we were unable to obtain reliable reference sites for comparison to the study stream.

Entire AU-Salinity

Data Type	Comments	Ref Num	Citation
common ions, pH, conductivity, miscellaneous	WF Armells Creek was examined and monitored for water chemistry as a potential local reference stream to test the hypothesis that EF Armells Creek salinity levels are increased beyond reference condition due to the land and water uses in the watershed. The 2017 study results show that salinity levels in EF Armells Creek are lower than that of WF Armells Creek in all site comparisons. The two compared streams lie within the Fort Union geological formation. However, many of the project monitoring sites for the EF Armells Cr are in the Tongue River member of the Fort Union formation, whereas the primary WF Armells Cr reference site is in the Lebo member of the Fort Union formation. The geology of WFAC and EFAC differs in their salinity-influencing formations in that the Lebo Shale in the WFAC has outcrops higher in the watershed and has sodium values that are higher than the Tongue River member. The upper WFAC site was located near the upper extent of the stream where perennial flow could be located. That location is about 1-1/2 miles downstream of the Tongue River member of the Fort Union formation, in the Lebo member. Base water chemistry data analysis suggests that the EFAC and WFAC have differing geochemical origins that influence salinity. For this reason, WF Armells Cr will not be used as a reference stream for comparisons to EF Armells Cr.	15665	Nixon, Alan ; Kron, Darrin (2017), East Fork Armells Creek Salinity Assessment and Armells Salinity Condition Report-2017
common ions, pH, conductivity, miscellaneous	The native soils in the Armells Creek drainage, and in this region of Montana are naturally high. This results in stream conditions that are high in salinity. Natural salinity levels can easily be generally well above the tolerances of livestock and poultry, and above the levels suitable for irrigated crops. The	15288	Montana Department of Environmental Quality, Planning, Prevention and Assistance Division, Water Quality Planning Bureau (nnnn), Montana Water Quality EQuIS

Data Type	Comments	Ref Num	Citation
	quality of C-3 classified waters is naturally marginal for drinking, culinary, and food processing purposes, agriculture, and industrial water supply (ARM 17.30.629. C-3 Classification Standards (1)). WF Armells Creek is used as a local reference stream to test the hypothesis that EF Armells Creek salinity levels are increased beyond reference condition due to the land uses in the watershed. The 2017 study results show that salinity levels in EF Armells Creek are lower than that of WF Armells Creek in all site comparisons and therefore within the range of reference levels.		

Upper

Data Type	Comments	Ref Num	Citation
common ions, pH, conductivity, miscellaneous	Upper: pH=7.98; Calcium=313 mg/L; Sodium=296 mg/L; Chloride=68.1 mg/L; Magnesium=425 mg/L; Bicarbonate=484 mg/L; Carbonate=<2.0 mg/L; Sulfate=2360 mg/L; Alkalinity=484 mg/L; Total Hardness as CaCO3=2530 mg/L; SAR=2.6.	4652	(2005), DEQ Field Assessment Form
major nutrients	Upper: NO2+NO3= 0.011 mg/L; TKN=0.70 mg/L; TP=0.251 mg/L.	4652	(2005), DEQ Field Assessment Form
metals	No standards exceedences.	4652	(2005), DEQ Field Assessment Form
quantitative physical data	Upper: 6/5/05: Flow= 5 (est.) cfs; Temp=20.76°C; SC=3376 µmho/cm; DO=7.80 mg/L; turbidity=clear; TSS=2.50 mg/L; Substrate: 100% silt.	4652	(2005), DEQ Field Assessment Form

Entire AU

Data Type	Comments	Ref Num	Citation
benthic sediment data	SEDIMENT METALS: One sample was collected at each of seven monitoring sites and analyzed for As, Cd, Cr, Cu, Fe, Pb, Hg and Zn. Benthic sediment metals data was considered separately from water column metals data and is not explicitly included in the assessment decision-making process. Data was evaluated using NOAAs Screening Quick Reference Tables for Inorganics in Soil (Probable Effect Level). All concentrations are below the screening criteria used (17ug/g As, 3.53 ug/g Cd, 90 ug/g Cr, 197 ug/g Cu, 91.3 ug/g Pb, 0.486 ug/g Hg and 315 ug/g Zn).	15288	Montana Department of Environmental Quality, Planning, Prevention and Assistance Division, Water Quality Planning Bureau (nnnn), Montana Water Quality EQuIS
common ions, pH, conductivity, miscellaneous	SEDIMENT METALS: One sample was collected at each of seven monitoring sites and analyzed for As, Cd, Cr, Cu, Fe, Pb, Hg and Zn. Benthic sediment metals data was considered separately from water column metals data and is not explicitly included in the assessment decision-making process. Data was evaluated using NOAAs Screening Quick Reference Tables for Inorganics in Soil (Probable Effect Level). All concentrations are below the screening criteria used (17ug/g As, 3.53 ug/g Cd, 90 ug/g Cr, 197 ug/g Cu, 91.3 ug/g Pb, 0.486 ug/g Hg and 315 ug/g Zn).	10255	Montana Department of Environmental Quality, Planning, Prevention and Assistance Division, Water Quality Planning Bureau (2006), STORET/Storease Data Archive [Electronic Resource]
common ions, pH, conductivity, miscellaneous	DO DELTA: DO delta values (daily maximum DO minus the daily minimum DO) were measured following DEQ sampling protocols during the index period when nutrient standards apply for the Northwestern Great Plains level III ecoregion (July 1 - Sept 30). Elevated DO delta values indicate high productivity and the potential for DO standards exceedances that would impact fish and aquatic life. Daily DO delta values were compared to the recommended DO delta threshold (less than or equal to 5.3 mg/L). Of the seven sites where DO delta values were measured, 6 sites had greater than 10% of the	15288	Montana Department of Environmental Quality, Planning, Prevention and Assistance Division, Water Quality Planning Bureau (nnnn), Montana Water Quality EQuIS

Data Type	Comments	Ref Num	Citation
	DO measurements that exceeded the recommended DO delta threshold.		
major nutrients	NUTRIENTS: 29 nutrient samples were collected following DEQ sampling protocols during the index period when numeric nutrient standards apply for the Northwestern Great Plains level III ecoregion (July 1 - Sept 30). Data were evaluated against numeric nutrient standards for TN and TP and to recommended NO2+3 nutrient guidance threshold for the Northwestern Great Plains ecoregion (TN = 1.30 mg/L; TP = 0.15 mg/L; NO2+3 = 0.10 mg/L). Of all the nutrient samples collected (n = 29 for TN, TP and NO2+3), 10 samples exceeded the TN standard (range = 0.33 to 14.2 mg/L), 9 samples exceeded the TP standard (range = 0.007 to 2.0 mg/L) and 13 samples exceeded the NO2+3 recommended threshold (range < 0.03 to 1.9 mg/L). Data were analyzed following the DEQ nutrient assessment method for the plains region of Montana.	15288	Montana Department of Environmental Quality, Planning, Prevention and Assistance Division, Water Quality Planning Bureau (nnnn), Montana Water Quality EQuIS
metals	METALS: All water column metals samples (n = 54 for Al, As, Cd, Cu, Fe, Pb, Hg, and Zn, 58 for Se, and n = 27 for Ag and Cr) were collected according to DEQ sampling protocols. Total recoverable fractions were analyzed for all metals except aluminum for which the dissolved fraction was analyzed. 44 to 48 percent of the metals samples were collected during a period of high flow conditions. The remaining samples were collected during baseflow. Water column data for each metal was evaluated against numeric water quality standards (acute and chronic aquatic life, and human health) according to the DEQ assessment method for metals. Al: 3 samples are greater than 2 times the Acute Standard, and 14 exceed the Chronic Std. Fe: 8 samples exceed the chronic aquatic life	15288	Montana Department of Environmental Quality, Planning, Prevention and Assistance Division, Water Quality Planning Bureau (nnnn), Montana Water Quality EQuIS

Data Type	Comments	Ref Num	Citation
	standard. Cd, Cr, Cu, Se, Ag, Hg, and Zn: no samples exceed acute or chronic aquatic life or human health standards. Pb: one chronic aquatic life exceedance, and one human health exceedance. As: One sample exceeds the human health standard.		

Lower and Middle

Data Type	Comments	Ref Num	Citation
common ions, pH, conductivity, miscellaneous	Lower: pH=7.68; Calcium=303 mg/L; Sodium=756 mg/L; Chloride=76.8 mg/L; Magnesium=542 mg/L; Bicarbonate=480 mg/L; Carbonate=<2.0 mg/L; Sulfate=3920 mg/L; Alkalinity=480 mg/L; Total Hardness as CaCO3=2990 mg/L; SAR=6.0. Middle: pH=7.97; Calcium=315 mg/L; Sodium=543 mg/L; Chloride=69.4 mg/L; Magnesium=543 mg/L; Bicarbonate=536 mg/L; Carbonate=<2.0 mg/L; Sulfate=3440 mg/L; Alkalinity=536 mg/L; Total Hardness as CaCO3=3020 mg/L; SAR=4.3.	4652	(2005), DEQ Field Assessment Form
major nutrients	Lower: NO2+NO3= 0.009 mg/L; TKN=1.06 mg/L; TP=0.029 mg/L. Middle: NO2+NO3= 0.012 mg/L; TKN=0.97 mg/L; TP=0.018 mg/L.	4652	(2005), DEQ Field Assessment Form
metals	No standards exceedences at either site.	4652	(2005), DEQ Field Assessment Form
quantitative physical data	Lower, 6/5/05: Flow=1.25 cfs; Temp=18.43°C; SC=4757 µmho/cm; DO=4.15 mg/L; turbidity=turbid; TSS=10.3 mg/L; Substrate: 100% silt. Middle, 6/7/05: Flow= 2.44 cfs; Temp=18.54°C; SC=4594 µmho/cm; DO=9.20 mg/L; turbidity=clear; TSS=11.5 mg/L; Substrate: 100% silt.	4652	(2005), DEQ Field Assessment Form

From vicinity of outfall 020 (45.85887 N, -106.6621 W) to mouth (Armells Creek)

Data Type	Comments	Ref Num	Citation
common ions, pH, conductivity, miscellaneous	1980, 1985: Pond approx. 2 mi. above hwy 39 sampled twice in 1980: Calcium=547 and 132 mg/L; Sodium=160 and 66.7 mg/L; Chloride=15.6 and 15.2 mg/L; Magnesium=345 and 185 mg/L; Bicarbonate=547 and 370 mg/L; Carbonate=<1.0 mg/L; Sulfate=1600 and 921 mg/L; Alkalinity=448 and 303 mg/L; Total Hardness as CaCO3=1841 and 1094 mg/L.	10255	Montana Department of Environmental Quality, Planning, Prevention and Assistance Division, Water Quality Planning Bureau (2006), STORET/Storease Data Archive [Electronic Resource]
common ions, pH, conductivity, miscellaneous	1973: Water hole approx. 2 mi. above town: Calcium=106 mg/L; Sodium=0 mg/L; Chloride=7 mg/L; Magnesium=35 mg/L; Bicarbonate=497 mg/L; Carbonate=<1.0 mg/L; Sulfate=295 mg/L; Alkalinity=408 mg/L; Total Hardness as CaCO3=409 mg/L.	10121	Montana Bureau of Mines and Geology (nnnn), GWIC Data from http://mbmggwic.mtech.edu/
major nutrients	1 973: Water hole approx. 2 mi. above town: Nitrate as N= 0 mg/L.	10121	Montana Bureau of Mines and Geology (nnnn), GWIC Data from http://mbmggwic.mtech.edu/
quantitative physical data	1980, 1985: Pond approx. 2 mi. above hwy 39 sampled twice in 1980: Calculated TDS = 2866 and 1725 mg/L.	10255	Montana Department of Environmental Quality, Planning, Prevention and Assistance Division, Water Quality Planning Bureau (2006), STORET/Storease Data Archive [Electronic Resource]
quantitative physical data	1973: Water hole approx. 2 mi. above town: TDS= 962 mg/L.	10121	Montana Bureau of Mines and Geology (nnnn), GWIC Data from http://mbmggwic.mtech.edu/

General

Data Type	Comments	Ref Num	Citation
benthic sediment data	This document contains the numeric water quality standards used to evaluate metals concentrations for beneficial use support in waters in the Armells Creek drainage.	15288	Montana Department of Environmental Quality, Planning, Prevention and Assistance Division, Water Quality Planning Bureau (nnnn), Montana Water Quality EQuIS

Data Type	Comments	Ref Num	Citation
common ions, pH, conductivity, miscellaneous	The position of the split between the two EF Armells Creek AUs has been changed to correspond better with the ephemeral flow regime of the upstream AU (MT42K002_170), and the intermittent/perennial flow regime of the downstream AU (MT42K002_110). Having small portions of assessment units that contain water poses problems when trying to fulfill a minimum sample size for Montana's assessment methods. As a result of the relocation of the AU split, there is no salinity data for the upper EF Armells Creek AU, since it was a dry channel for the duration of the project.	15665	Nixon, Alan ; Kron, Darrin (2017), East Fork Armells Creek Salinity Assessment and Armells Salinity Condition Report-2017

From 1/2 mile above highway 39 to mouth (Armells Creek)

Data Type	Comments	Ref Num	Citation
common ions, pH, conductivity, miscellaneous	Water in the creek is less mineralized upstream from Colstrip than it is downstream from the town. The water downstream from the town chemically resembles water from ponds in the former Rosebud mine pits. Pre mining data are not adequate for specific comparisons between the past and the present, but statistical tests of variances and means indicate that no significant changes in water quality have occurred since 1923.	1404	Van Voast, Wayne A. ; Hedges, Robert B. ; McDermott, John J. (1977), Hydrogeologic Conditions and Projections Related to Mining Near Colstrip, Southeastern Montana, Bulletin 102
common ions, pH, conductivity, miscellaneous	Water in the East Fork Armells Creek is very hard, alkaline, magnesium sulfate type and has a high concentration of dissolved minerals. Water quality in this stream is poor and is not suited for irrigation, water supply, or most uses. The stream, in its natural state, does not meet States requirement for B-D3 streams to be suitable for growth and propagation of non-salmonid fishes. If the Colstrip flyash pond leaked, it would eventually reach the East Fork of Armells. No measurable impacts are expected due to the stream's poor quality and high flow relative to expected groundwater seepage.	673	Botz, Maxwell K. (1978), Characteristics and Potential Impact of Wastewaters from a Coal-Fired Power Plant at Colstrip, Montana

Data Type	Comments	Ref Num	Citation
	Calcium=377 mg/L; Sodium=295 mg/L; Chloride=61 mg/L; Magnesium=381 mg/L; Bicarbonate=449 mg/L; Carbonate=<1.0 mg/L; Sulfate=2362 mg/L; Alkalinity=368 mg/L.		
common ions, pH, conductivity, miscellaneous	1974-1977: Sulfates exceeded recommended levels in 29 out of 30 samples.	398	Melancon, Susan ; Hess, Bryant C. ; Thomas, Robert B. (1979), Assessment of Energy Resource Development Impact on Water Quality: The Tongue and Powder River Basins, EPA-600/7-79-249
common ions, pH, conductivity, miscellaneous	1978, 1979: One site in lower segment sampled each year. 1978: Calcium=330 mg/L; Sodium=665 mg/L; Chloride=54.6 mg/L; Magnesium=605 mg/L; Bicarbonate=594 mg/L; Carbonate=<1.0 mg/L; Sulfate=4038 mg/L; Alkalinity=487 mg/L; Total Hardness as CaCO3=3316 mg/L. 1979: Calcium=236 mg/L; Sodium=385 mg/L; Chloride=36 mg/L; Magnesium=416 mg/L; Bicarbonate=427 mg/L; Carbonate=<1.0 mg/L; Sulfate=2590 mg/L; Alkalinity=350 mg/L.	911	Klarich, Duane A. ; Regele, Stephen M. ; Bahls, Loren L. (1980), Data Report for the Benthic Macroinvertebrate and Periphyton Community Inventory of Streams Draining the Southern Fort Union Coalfield Region of Southeastern Montana, USGS Research grant #14-08-0001-G-503
common ions, pH, conductivity, miscellaneous	1978, 1979: SC (µmho/cm) measured 3 times. Min= 4200, Max= 6400, Mean= 5080.	2389	Klarich, Duane A. ; Regele, Stephen M. (1980), Structure, General Characteristics, and Salinity Relationships of Benthic Macroinvertebrate Associations in Streams Draining the Southern Fort Union Coalfield Region of Southeastern Montana, USGS Grant #14-08-0001-G-503
common ions, pH, conductivity, miscellaneous	One site approx. 1.5 mi. below Colstrip. 3/22/79: pH= 8; Alkalinity= 380 mg/L; TSS= 7.8 mg/L. 10/7/79: Stream dry, no sample.	1151	(1981), Field Notes and Data Collected for "Biological Water Quality Monitoring Eastern Montana 1979"
common ions, pH,	Water and pollutants are reportedly seeping from sludge	11566	Montana Standard (1981), Order Issued on

Data Type	Comments	Ref Num	Citation
conductivity, miscellaneous	ponds, most significantly the fly ash evaporation pond.		Colstrip Seep: Montana Standard Newspaper Article 6/06/1981
major nutrients	1979: NO2+NO3= 0.37 mg/L; TP= .07 mg/L; TKN= 1.1 mg/L. One site approx. 1.5 mi. below Colstrip. 3/22/79: Ammonia (mg/L as N)= .57;	1151	(1981), Field Notes and Data Collected for "Biological Water Quality Monitoring Eastern Montana 1979"
major nutrients	The criteria used for these sites (with the exception of TKN) are from the level lV Central Grassland ecoregion, growing season. All values in mg/L. Contact recreation (80th percentile of reference): NO2+ NO3 = 0.16; TP = 0.13; TN = 1.04; TKN = Unavailable. Aquatic life uses the 90th percentile of reference condition: NO2+ NO3 = 0.19; TP = 0.15; TN = 1.29; TKN = Unavailable. The criteria used for TKN is from the level lll Northwestern Great Plains ecoregion, growing season. All values in mg/L. Contact recreation (80th percentile of reference): TKN = 0.82. Aquatic life uses the 90th percentile of reference condition: TKN = 0.93.	10811	Suplee, Michael W. (2005), Best Use of the June 2005 Nutrient Data Statistical Summaries
major nutrients	Several sites were sampled between 1974 and 1979. Near colstrip, NO2+NO3 (mg/L), 1975: 9 samples, max= .13, min= .02, mean= .07. 1976, 10 samples, max= .88, min= .02, mean= .28. 1977, 10 samples, max= .64, min= .01, mean= .13. 1978, 9 samples, max= .85, min= .01, mean= .18. 1979, 6 samples, max= .87, min= .00, mean= .23. NO2+NO3, 11 samples, separate from those above: Mean= 0.19 mg/L. TP, 6 samples. Mean=0.11 mg/L. TKN, 3 samples. Mean= 1.0 mg/L.	10255	Montana Department of Environmental Quality, Planning, Prevention and Assistance Division, Water Quality Planning Bureau (2006), STORET/Storease Data Archive [Electronic Resource]
metals	10 samples between 1974-1977. Cd exceeded aquatic life and drinking water criteria 10 times. Fe exceeded aquatic life criteria once and drinking water criteria 7 times. Pb exceeded both criteria 10 times, and Hg exceeded aquatic life criteria 5 times. This data is from well water.	398	Melancon, Susan ; Hess, Bryant C. ; Thomas, Robert B. (1979), Assessment of Energy Resource Development Impact on Water Quality: The Tongue and Powder River Basins, EPA-600/7-79-249

Data Type	Comments	Ref Num	Citation
metals	1973-1979: Most of data is over 30 years old and detection limits too high. Cannot use data.	10255	Montana Department of Environmental Quality, Planning, Prevention and Assistance Division, Water Quality Planning Bureau (2006), STORET/Storease Data Archive [Electronic Resource]
metals	1973, 1999, 2000: Detection level too high to use data.	10121	Montana Bureau of Mines and Geology (nnnn), GWIC Data from http://mbmggwic.mtech.edu/
quantitative physical data	One sample = 3510 µmho/cm.	673	Botz, Maxwell K. (1978), Characteristics and Potential Impact of Wastewaters from a Coal-Fired Power Plant at Colstrip, Montana
quantitative physical data	1978-1979: 3 SC samples taken, expressed as µmho/cm. Min = 4200, Max = 6400, Mean = 5080.	2389	Klarich, Duane A. ; Regele, Stephen M. (1980), Structure, General Characteristics, and Salinity Relationships of Benthic Macroinvertebrate Associations in Streams Draining the Southern Fort Union Coalfield Region of Southeastern Montana, USGS Grant #14-08-0001-G-503
quantitative physical data	More than 8,000 acre-feet per year of Yellowstone river water is pumped to the MPC storage pond to supply the MPC power plant and Colstrip municipal uses. It is evident that a 70% increase in discharges from the Colstrip area have likely resulted in "water logging" problems downstream along EFAC over the past 20 years. Mining activities at this time do not appear to be a contributor to the problem of inundation because mine dewatering has resulted in a reduction of inflow. TDS samples from alluvium wells in the EFAC alluvium increased 50% from 1977 to 1997, since the advent of significant mining disturbance, and seepage and discharges from facility and municipal sources.	11628	Erbes, Dan (1998), Montana Dept. of Environmental Quality Letter to Office of Surface Mining and Reclaimation
quantitative physical	Permit data from 2014-2015 indicates year round flow at site	15481	Montana Department of Environmental Quality

Data Type	Comments	Ref Num	Citation
data	SW-55 wier a couple hundred yds above hwy 39 crossing, even though it is low volume at certain times of the year.		(2015), Montana DEQ IEMB Permit Data

Watershed-General

Data Type	Comments	Ref Num	Citation
common ions, pH, conductivity, miscellaneous	The native soils and geology in the Armells Creek drainage are naturally high in salinity because this area was once a shallow seabed. This results in highly saline runoff and groundwater conditions that influence surface water quality. Natural salinity levels are often well above the tolerances of livestock and poultry, and above the levels suitable for irrigated crops. The quality of C-3 classified waters is naturally marginal for drinking, culinary, and food processing purposes, agriculture, and industrial water supply (ARM 17.30.629. (1)). In the Armells Creek watershed, the highest quality (lowest salinity) water is found upstream and in the vicinity of Colstrip, while the lowest quality (highest salinity) water is found near the confluence of the East and West Forks of Armells Creek.	15665	Nixon, Alan ; Kron, Darrin (2017), East Fork Armells Creek Salinity Assessment and Armells Salinity Condition Report-2017

Reporting Cycle: 2020 **Assessment Record:** MT42K002_110.pdf **Status:** Completed

DQA SUMMARY

Aquatic Life & Fishes

Nutrients	PASS
Metals	PASS
Sediment	NOT ASSESSED
Temperature	NOT ASSESSED
Other	NOT ASSESSED

Drinking Water

Metals	PASS
Other	NOT ASSESSED

Recreation

Nutrients	NOT ASSESSED
E.coli	NOT ASSESSED
Other	NOT ASSESSED

Agriculture

Common	NOT ASSESSED
Other	NOT ASSESSED

Reporting Cycle: 2020 **Assessment Record:** MT42K002_110.pdf **Status:** Completed

ASSESSMENT HISTORY

Cycle 2006

1996- 19 miles listed as partially supporting agriculture, aquatic life, swimmable, and warm water fishery. The causes were nutrients, salinity/TDS/chlorides, and suspended solids. The sources were agriculture, natural sources, and range land. Listed for assessment in 2004 due to insufficient credible data.

Cycle 2008

Not assessed this cycle

Cycle 2010

Not assessed this cycle

Cycle 2012

TKN listing is being changed to a TN listing

Cycle 2014

Not assessed this cycle

Cycle 2016

Not assessed this cycle

Cycle

2018

2018 Cycle:

Nutrients: A nutrient assessment was performed following the DEQ nutrient assessment method to update the 2018 303(d) list. Total Phosphorus is a new listing as a cause of impairment to the Aquatic Life beneficial uses. Total Nitrogen will remain listed, and Nitrate plus Nitrite will also remain listed as a cause of impairment to the Aquatic Life beneficial uses.

Metals: Assessments for aluminum, arsenic, cadmium, chromium, copper, iron, lead, selenium, silver, mercury and zinc were performed according the DEQ metals assessment method to update the 2018 303(d) list. This Integrated Report cycle will have new listings for Aluminum and Iron as causes of impairment to the Aquatic Life beneficial uses.

Salinity: No changes to listings of Specific Conductance and Total Dissolved Solids as causes of impairment to Aquatic Life beneficial uses.

Habitat assessment was performed to update the 2018 303(d) list. New listings for Habitat Alterations and Alteration of Stream-Side or Littoral Vegetation Covers affecting Aquatic Life beneficial uses.

Cycle 2020

According to The Addendum to the Comprehensive Evaluation of Probable Hydrologic Consequences Areas A, B and C Western Energy Rosebud Mine, the East Fork of Armells Creek transitions from ephemeral to intermittent 15 to 20 yards downstream of outfall 020. Therefore, the break point between the upper segment of East Fork Armells Creek and the lower segment of East Fork Armells Creek has been moved approximately 2 stream miles upstream from the mine shops area to the vicinity of outfall 020 during the 2020 cycle. The new upstream endpoint is located at 45.85887N, -106.6621W.

Overall Condition of Segment

2018 IR Cycle:
Channel discharge: East Fork Armells Creek has an intermittent flow regime. It had very little flow during the 2017 study period. Where surface flow existed in the AU, discharge ranged from a trace to 1 cfs, the highest occurring at the site located downstream of the golf course. The flow there diminished to 0.1 cfs by early October. No diversions are present on the AU.

Water Chemistry:

NUTRIENTS: Listing decisions: TN and NO2+3 will remain listed as impairing Aquatic Life uses, and TP will be a new impairment listing for Aquatic Life uses.

METALS: This stream is classified as a C-3 water. The quality of these waters is naturally marginal for drinking, culinary, and food processing purposes, so this stream will not be listed for the human health standards exceedances of Pb and As. There was one out of 41 samples that fell above the standards for each of these metals . Aquatic Life uses will be listed as impaired by Al and Fe due to the high exceedance rates of these two metals sampling results.

SALINITY:
In the 2017 study, the highest salinity in the Armells Creek watershed occurs in the vicinity of the confluence of EF Armells and WF Armells Creeks. Near the town of Colstrip, groundwater from Castle Rock Lake may influence a reduction of the salinity in EF Armells Creek. The water in Castle Rock Lake is pumped from the Yellowstone River six miles west of Forsyth. The lake provides water for the City of Colstrip municipal water supply and for power generation facilities and has an average SC of 411 uS/cm. Specific conductance data show that the median SC drops in the vicinity of Castle Rock Lake, at the two EF Armells Creek sites downstream of Colstrip. From there, SC gradually increases toward the mouth. EF Armells Creek was monitored to assess salinity. However, using analyses of ionic base chemistry data for identifying potential reference streams, we were unable to obtain reliable reference sites for comparison to the study stream, and the original salinity related listings of SC and TDS from 2016 will remain as impairments.

HABITAT: Four sites were evaluated using DEQ's habitat assessment process. The habitat assessment decision is to list as impaired: Alteration of Stream-Side or Littoral Vegetation Covers, and for Habitat Alterations (LOSS OF INSTREAM HABITAT - geomorphology). Grazing impacts were evident in the upper reaches of this AU.

BIOLOGY:
Fish: Observations of plains killifish were common in reaches with perennial flow or stranded pools.

SOURCES: Formal pollutant source assessments are outside of the scope of the 2017 project. Based on identified land uses in the area of the study stream, several potential sources are present. However, we do not know the contribution of any of these or if they contribute at all. Besides sources that are natural in origin, some existing activities in the watershed that may influence pollutant loading include: crop production, coal mining, golf courses, grazing along streams, septic systems, land application of wastes, urban areas and power generation facilities.

Reporting Cycle: 2020 **Assessment Record:** MT42K002_110.pdf **Status:** Completed

Reporting Cycle: 2020 **Assessment Record:** MT42K002_110.pdf **Status:** Completed

USE SUPPORT DECISION

Use Class C-3

Trophic Status: **Trophic Trend:**

Uses	DQA	Method, Data, and Information Used	Assessment Type and Confidence	Use Support	Partial Flag	Use Support Certainty	Threatened
Aquatic Life	Pass			Not Fully Supporting	No	Medium	No
Primary Contact Recreation				Fully Supporting	No	High	No

Method Number and Description

Reporting Cycle: 2020 **Assessment Record:** MT42K002_110.pdf **Status:** Completed

IMPAIRMENT INFORMATION

Uses	Cause (Confidence): Source(Confirmed)	Observed Effects
Aquatic Life	84 (High): 46 (Y) 87 (Medium): 140 (N), 155 (N) 260 (High): 140 (N), 155 (N) 379 (Low): 152 (N), 165 (N) 399 (Low): 152 (N), 165 (N) 456 (Medium): 140 (N), 156 (N) 458 (High): 140 (N), 156 (N) 462 (High): 46 (N), 140 (N) 527 (Medium): 46 (Y)	
Primary Contact Recreation		

Cause Number and Description	Source Number and Description	Observed Effect Number and Description
84-Alteration in stream-side or littoral vegetative covers 87-Aluminum 260-Iron 379-Specific Conductivity 399-Total Dissolved Solids (TDS) 456-Nitrate/Nitrite (Nitrite + Nitrate as N) 458-Nitrogen, Total 462-Phosphorus, Total 527-Habitat Alterations	46-Grazing in Riparian or Shoreline Zones 140-Source Unknown 152-Transfer of Water from an Outside Watershed 155-Natural Sources 156-Agriculture 165-Coal Mining	

Reporting Cycle: 2020 **Assessment Record:** MT42K002_110.pdf **Status:** Completed

DELISTING / STATUS CHANGES

Cause	Reason for Change	Date of Change
Total Kjehldahl Nitrogen (TKN)	Data and/or information lacking to determine WQ status; original basis for listing was incorrect	11/10/2011

CATEGORY INFORMATION

Previous Cycle

Cycle 2018

Category 5 - Waters where one or more applicable beneficial uses have been assessed as being impaired or threatened, and a TMDL is required to address the factors causing the impairment or threat.

User Defined Category N/A

Current Cycle

Cycle 2020

Category 5 - Waters where one or more applicable beneficial uses have been assessed as being impaired or threatened, and a TMDL is required to address the factors causing the impairment or threat.

User Defined Category N/A