MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY

Alluvial Valley Floor Determination

For Four Drainages intersected by Cloud Peak Energy's Proposed Amendment, AM5, to Spring Creek Mine

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Regulatory Framework

The Montana Strip and Underground Reclamation Act (MSUMRA) § 82-4-201 through 82-4-254, MCA, and its implementing rules, Administrative Rules of Montana (ARM) 17.24.301 through 17.24.1309, specifically § 82-4-227(3) (b) (i)-(ii) MCA, and ARM 17.24.301 and 17.24.325 set forth the process for identifying an alluvial valley floor (AVF) located in the arid and semi-arid lands of Montana. The "significance" of an AVF is determined based on the criteria set forth in ARM 17.24.325 and 17.24.805. Any mine proposal or mine related disturbance within a valley holding a stream, or adjacent to and connected to a valley holding a stream, must have an AVF determination. MSUMRA requires protection of identified AVFs from impacts of coal mining that are adverse to agricultural activities or farming.

An AVF determination consists of three separate evaluations. The first evaluation determines the presence and extent or absence of AVFs based on criteria defined in ARM 17.24.325(2). The second evaluation determines the significance of the AVF for adversely affected agricultural or farming operations, ARM 17.24.805. Included in this significance determination, DEQ consults with the affected landowner(s) or ranch operator(s). The third evaluation determines the essential hydrologic functions of each AVF, ARM 17.24.325 (3)(c)(i)(ii)and (e). If the first evaluation determines that no AVF is present, then further evaluation is not warranted. If an AVF is identified, then significance of the AVF must be determined, and the essential hydrologic functionality of that AVF must also be determined.

As explained in detail, below, both geologic and hydrologic criteria must be met to designate an AVF. The key to the existence of an AVF is the presence of both geomorphic characteristics and water availability for agricultural activities or farming.

I. Presence or Absence

Analysis of Presence or Absence

Section 82-4-203(3)(a), MCA, defines an AVF as: "the unconsolidated stream-laid deposits holding streams where water availability is sufficient for subirrigation or flood irrigation agricultural activities." Section 82-4-203(3)(b), MCA, distinguishes "upland areas that are generally overlain by a thin veneer of colluvial deposits composed chiefly of debris from sheet erosion and deposits by un-concentrated runoff or slope wash, together with talus, other mass movement accumulation, and windblown deposits" from AVFs. Uplands is further defined in ARM 17.24.301 (136) as "with respect to alluvial valley floors, those geomorphic features located outside the floodplain and terrace complex, such as isolated higher terraces, alluvial fans, pediment surfaces, landslide deposits, and surfaces covered with residuum, mud flows or debris flows, as well as highland areas underlain by bedrock and covered by residual weathered material or material deposited by sheetwash, rillwash, or wind."

Alluvium and colluvium are deposits of materials resulting from erosion and deposition. Alluvium is a general term for materials deposited by water, including gravel, sand, silt, clay, and all the variations and mixtures of these. Unless otherwise noted, alluvium is unconsolidated (Brady and Weil, 2010). Colluvium is a deposit of rock fragments and soil material accumulated at the base of steep slopes as a

result of gravitational action (Brady and Weil, 2010). Both of these transport processes result in unconsolidated material on the earth's surface.

According to the Dictionary of Geologic Terms, "colluvial" is defined as "consisting of alluvium in part and also containing angular fragments of the original rocks." Colluvium may be mixed with alluvium. Various processes may account for this. For example, alluvial stream channel deposits may slide down terrace banks resulting in new colluvial deposits.

The definition of AVF is further clarified as "unconsolidated streamlaid deposits holding streams" as "all flood plains and terraces located in the lower portions of valleys which contain perennial or other streams with channels." ARM 17.24.301(132). This definition of unconsolidated deposits allows for colluvium as defined above to be contained in a terrace or floodplain of an AVF. Therefore, the presence of surface colluvium does not exclude a stream from AVF status. The underlying geology rather than surface deposition dictates a determination of alluvial or colluvial character in a valley floor.

ARM 17.24.325(2)(b) sets forth the procedure for determining the presence or absence of an AVF:

> Based on the investigations conducted under [ARM 17.24.325(2)](a), the department shall make a written determination of the extent of any alluvial valley floors within the study area and whether any stream in the study area may be excluded from further consideration as lying within an alluvial valley floor. The department shall determine that an alluvial valley floor exists if it finds that:
> (i) unconsolidated streamlaid deposits holding streams are present; and
> (ii) there is sufficient water to support agricultural activities as evidenced by:
> (A) the existence of current flood irrigation in the area in question;
> (B) the capability of the area to be flood irrigated, based on typical regional agricultural practices, historical flood irrigation, stream-flow, water yield, soils, water quality, and topography; or
> (C) subirrigation of the lands in question, derived from the ground water system of the valley floor; and
> (iii) the valley does not meet the definition of upland areas in ARM 17.24.301.
> (c) If the department determines in writing that an alluvial valley does not exist pursuant to (b), no further consideration of this rule is necessary;

Finally stream valleys "adjacent" to proposed mining operations must be evaluated for the presence or absence of AVFs. "Adjacent" is also a defined term under MSUMRA and means in pertinent part, "the area outside the permit area where a resource or resources, determined in the context in which the term is used, are or could reasonably be expected to be adversely affected by proposed mining operations." § 82-4-203(2), MCA.

Introduction

Cloud Peak Energy's, Spring Creek Mine Amendment 5 (AM5), is a proposed transportation corridor connecting the existing Spring Creek Mine to an approved coal mine permit in Wyoming, Youngs Creek Mine (Map 1 Project Overview). The Spring Creek Mine is located in Big Horn County, roughly 8 miles north of the Montana and Wyoming border. The current permit area is approximately 9,126 acres, with an additional 4,334 acres proposed in AM5. The Spring Creek Mine is 3.5 miles west of the Tongue River

Reservoir, approximately 7 miles northwest of Decker, MT, and 21 miles north of Sheridan, WY. The Youngs Creek Mine permit area is located in Sheridan County, Wyoming and is roughly 6 miles southwest of Decker, MT and 12 miles north of Sheridan, WY. MT DEQ does not have regulatory authority over the Youngs Creek Mine in Wyoming.

The transportation corridor proposed in AM5 travels primarily south and slightly west, of the Spring Creek Mine, for a distance of roughly 8 miles. This area is entirely within the Tongue River Watershed and contains the following named tributaries to the Tongue River in order, north to south: Squirrel Creek, Dry Creek, Youngs Creek, and Little Youngs Creek. This document will evaluate the presence or absence of an AVF on each of the four drainages.

1. Unconsolidated Streamlaid Deposits

Geology and Soils

As explained above, the first step in determining the presence or absence of an alluvial valley floor is to identify valleys with streams holding unconsolidated streamlaid deposits. Unconsolidated stream laid deposits are alluvium.

Two geologic units, the more recent Wasatch and historic Fort Union Formations, are cut by the four creeks that cross the corridor of the proposed amendment. These formations erode eastward toward the Tongue River. Geology is dominated by sedimentary rock strata consistent throughout all four drainages.

Wasatch formation rock is present at higher elevations to the west of the proposed project area. The Wasatch formation is made up of light-colored massive sandstone; drab-colored shale and coal in southeastern Montana (study region); and variegated, dominantly red beds of clay and sandstone, in north-central Montana. The Wasatch formation holds a minor roll to the Fort Union formation in the proposed project area.

The four stream beds generally sit in the dominant Fort Union formation. Geology of the Fort Union formation consists of: Clay shale, siltstone, and sandstone; local lenses of impure limestone, numerous lignitic beds, including the Tongue River member, Lebo shale member, and Tullock member in its overall stratigraphy.

In these tributaries of the Tongue River drainage the parent materials for alluvium are derived from either of these geologic formations. Alluvial materials are formed in a setting where more erosion resistant sandstone and clinker capped buttes are underlain by softer strata (USDA 1980). Through time, erosion and deposition have eroded the parent materials depositing them in the drainages and lowlands as alluvium. The alluvium is sorted into finer silts and clays on floodplains that lie over clinker gravels and fine sands. Monitoring well logs may refer to alluvium using any of these material names. As defined above alluvium is unconsolidated material.

Soil types of these geologic units are expected to have similar characteristics. Soils of AM5 fall in the loam to clay soil texture classes. Coarse fragments when present are found further below ground

surface. Soil survey and drill log data indicate the finest particle sized soils, silty and clayey loam, are found in surface soil layers (horizons). These surface horizons rest on varying types of unconsolidated materials and loam in channel bottoms and on terraces. Many of these soil types have mixed layers consisting of scoria gravels which occur at the greatest depths in the soil column. This is a typical layering of soil horizons. When water transports earthen materials the largest particles, gravels and then sands, settle out first. As sediment rich water slows down, smaller and smaller particles settle out. The smallest and lightest particles, silty then clayey particles, settle out last generally to be found in the surface horizons.

Prime Farmland soil

Soils that meet requirements of prime farmland are investigated in the permitting process and indicate an enhanced ability to cultivate the land surface. As part of the permitting process, Spring Creek Mine (SCM) was tasked with determining if prime farmlands were present. The Natural Resources Conservation Service (NRCS) was consulted and concurred with portions of Youngs Creek and Little Youngs Creek soils being prime farmland soils when irrigated. An AVF determination is not dependent on Prime Farmlands. However, prime farmland soils do indicate areas favorable for cultivation in a valley floor. SCM has addressed permitting concerns regarding prime farmlands, which can be found in Sections 306 and 324 of the permit. (AM5)

Hydrology

Geomorphology of the tributaries to the Tongue River fit into two general categories. The first category includes streams where erosional and depositional zones have created meanders within a lower gradient valley consisting of alluvium. A second category includes erosional streams where the channel is held in an incision formed on a steeper gradient slope and lacks major depositional zones and meanders. The category two channels usually represent upland tributaries to larger streams of the first category. The streams of this AVF determination considered category one include the main stem channels of Squirrel, Youngs, and Little Youngs Creeks. A fourth stream, Dry Creek, demonstrates characteristics of both categories.

Category one low gradient valleys may support agricultural production adjacent to the active stream channels. In contrast, category two erosional channels flow through rangeland, where runoff could be directed to flood irrigation on a lower gradient valley, or used in stock watering ponds, but generally is not captured for use.

2. Sufficient Water to Support Agricultural Activities:

The presence of irrigation sufficient to support agricultural activities or farming must be determined. See Section 82-4-203(3)(a), MCA; 17.24.325(2)(b), ARM. The three criteria to determine if there is sufficient water to support agricultural activities or farming are discussed in ARM 17.24.325(2)(b)(ii)(A)-(C).

a. The Existence of Current or Historic Flood Irrigation

Flood irrigation is defined as “supplying water to plants by natural overflow or the diversion of flows, so that the irrigated surface is largely covered by a sheet of water,” ARM 17.24.301(44). Surface water management structures such as dams or spreader and containment dikes indicate the existence of current or historic flood irrigation. Of these water management structures, dams and

spreader dikes can be found in the proposed permit area and shown in Exhibits 04-1.1, 04-2.1, 04-3.1, and 04-4.1(AM5). These are the "Permitted Ditches and Water Rights" for each creeks' Irrigated Lands.

b. Capability of the Area to be Flood Irrigated

An area has the capacity to be flood irrigated if there is enough available water to support flood irrigation and there is an appropriate location on the landscape to irrigate with that water. As this transportation corridor crosses four drainages, they will be discussed separately.

c. The Existence of Subirrigation

Areas with unconsolidated streamlaid deposits that are sub-irrigated also qualify as AVF's. Subirrigation occurs when groundwater is close enough to the surface to support agricultural activities or farming. This happens when water reaches the root zone of the plants being grown. "Subirrigation means, with respect to alluvial valley floors, the supplying of water to plants from a sub-surface zone where water is available and suitable for use by vegetation." ARM17.24.301(118).

When evaluating the depth to useful groundwater, the thickness of the capillary fringe needs to be considered. However, the thickness of a capillary fringe is difficult to determine. Capillary fringe refers to the ability of water to rise in the soil column above the water table due to capillary action. Pore sizes of the material above the water table determine the thickness of the capillary fringe. Montana DEQ recently defined capillary fringe to be 10 feet (5 feet rooting depth, and 5 feet of capillary rise in the soil) for the Otter Creek Alluvial Valley Floor (Otter Creek AVF, 2016). This was determined using soil test pit data for both rooting depth and soil composition.

The Otter Creek AVF is also located in the Tongue River member of the Fort Union Formation described above. This previous investigation allowed Montana DEQ to target subirrigation influences to areas with water ten feet or less below the surface. The same values were used in this investigation due to the similar geology and fine grained soil types.

2.1 Squirrel Creek

Geology and Soils

Drill logs in the Squirrel Creek study area all indicate unconsolidated material. Unconsolidated material at the thinnest deposits measure 9.5 feet and the thickest deposits indicate approximately 30 feet. Data indicates most of these unconsolidated materials as fine sands, silt, and clay. Geology in the Squirrel Creek Drainage meets criteria of unconsolidated materials required for AVF determination.

Hydrology

Squirrel Creek is a perennial stream with a drainage area of nearly 50 square miles. The stream feeds irrigation canals at various locations along its length. Surface water data indicated a peak flow recorded on June 4, 2015 of 40 cubic feet per second (cfs). The streams base flow ranged from 1-3 cfs from July 2014 to September 2015 (AM5).

Groundwater levels of Squirrel Creek were measured at four alluvial wells and four shallow piezometers. Three of the piezometers had water levels ranging approximately one to ten feet below ground surface.

The water level in these piezometers varied above and below the stream surface elevations. Three of the four alluvial monitoring wells were dry with only one SQCAL-4 exhibiting a water level around one foot below the adjacent channel floor (AM5). Squirrel Creek demonstrates hydrologic conditions required of an AVF.

The Existence of Current or Historic Flood Irrigation

The irrigation ditches on Squirrel Creek are found downstream of the proposed transportation corridor. A previous AVF decision was completed for Squirrel Creek (Squirrel Creek 1981). This delineated an AVF between the two irrigation ditches on either side of Squirrel Creek and deemed that AVF to be significant to agriculture in Section 24 Township 9S, Range 39E and portions of Sections 19 and 30, Township 9S, Range 40E (inset on Map 2). This AVF is over 3.25 miles straight line, or over 5 river miles, from the transportation corridor. As surface flows will not be impacted by the transportation corridor, the functionality of the downstream AVF is not likely to be impacted. No active ponds or dams are located on the portion of Squirrel Creek impacted by the transportation corridor. The centerline goes through a breached dam. Trees growing in the breached portion are mature and there is no evidence of this dam being in use within the past 50 years. There are also no remnant ditches coming off the breached dam, implying that it was only utilized for livestock purposes and not for irrigating farmland.

Capability of the Area to be Flood Irrigated

Squirrel Creek is a perennial stream carrying consistent year-round flow. See ARM 17.24.301(84). There are also several small areas, within the proposed disturbance boundary, that are relatively flat and within five feet of the channel elevation. This is typical throughout much of the length of Squirrel Creek which is evidenced by irrigation structures and flood irrigation downstream of the proposed crossing. There may be limited water available as there is currently 2.03 cfs allocated through existing water rights and demonstrations of only 1 to 3 cfs in Squirrel Creek. However, it is beyond the scope of this analysis to determine water availability in regards to water rights. The aspects described above identify the capability of this area to be flood irrigated.

The Existence of Subirrigation

Squirrel Creek has had shallow piezometers and a monitoring well installed as part of the transportation corridor evaluation. These wells show shallow groundwater within five feet of the stream elevation. This would mean terraces within five feet of the channel bottom have the potential to be subirrigated along the length of Squirrel Creek. This generally fits with the T1 terrace and areas directly adjacent to it as delineated by the operator in the application. The subirrigation extent can be seen in Map 2 and is represented as the AVF Extent on that map as the geology required for an AVF is present where the subirrigation is also delineated. This area is a relatively narrow band directly adjacent to the stream channel and currently supports undeveloped rangeland as its land use.

2.2 Dry Creek

Unconsolidated deposits

In the proposed haul road corridor drill log OB-6 indicates an unconsolidated layer 9 feet thick in the main stem channel of Dry Creek. Other drill logs indicate unconsolidated materials from 3-11 feet thick. These drill logs indicate the presence of unconsolidated material in the main stem Dry Creek channel and

to a lesser degree the first terrace along the channel. Unconsolidated materials are limited to the main channel and first terrace. Evidence of unconsolidated materials in the Dry Creek valley indicates the presence of alluvium; however, the extent is very limited. Geology in the Dry Creek Drainage indicates unconsolidated materials are narrow in extent and generally confined to the stream channel. The geology does not indicate adequate alluvium for AVF determination.

Hydrology

Dry creek is an ephemeral stream with a drainage area of approximately 7 square miles. Geomorphology demonstrates an incised erosional upland stream trending toward a lower gradient valley stream. Generally Dry Creek is constricted by surrounding terraces and uplands with small deposition zones in lower gradient reaches. Stock dams in Dry Creek disrupt the channel causing altered flow velocities and intermittent stream characteristics.

Surface water flow measurements were recorded at monitoring stations DC-SW-1 upstream and DC-SW-2 downstream of the haul route between July 2014, and July 2015. Measurable runoff occurred once on June 4, 2015. At station DC-SW-1 peak flow averaged 31.3 cfs and station DC-SW-2 averaged 1.8 cfs. The precipitation response indicates the ephemeral qualities of Dry Creek. The large difference between the flow rates is suspected to be from the presence of a stock reservoir located in the stream channel between these monitoring stations.

Groundwater measurements in Dry Creek were measured at three monitoring wells. One well DCAL-1 approximately one half mile upstream of the haul route contained water, the other wells remained dry. Monitoring well DCAL-1 was drilled 8-25-2014, and was dry at the time of drilling. From May to July 2015 an increase of 6 inches of water was recorded in DCAL-1; however, the water level declines sharply in August and becomes nearly dry. Dry Creek does not support necessary hydraulic conditions required for an AVF determination.

The Existence of Current or Historic Flood Irrigation

There are two dams near the Dry Creek crossing for the proposed transportation corridor. One is upstream while the other is downstream. Both have water rights, but no irrigation ditches or dikes. These can only be utilized for livestock in early spring during snowmelt and spring runoff events. There are no spreader dikes or irrigation ditches on Dry Creek.

Capability of the Area to be Flood Irrigated

Dry Creek has only ephemeral characteristics and flows only in response to snowmelt or precipitation events. See ARM 17.24.301(39) and 82-4-301(17) MCA. Three flow events were observed from September 2014 to September 2015. This limited amount of available water greatly reduces the ability of Dry Creek to support flood irrigation. Given the lack of annual runoff, the height of stream bank terraces, and lack of farmable area, it is unlikely that this area has the capability to be flood irrigated. This was supported by comparing topographic mapping and available water quantity data. Even when significant runoff events do occur, they are of such a short duration and/or infrequent and unreliable return period, as to make flood irrigation unproductive.

The Existence of Subirrigation

Dry Creek has three monitoring wells installed. Only one, DCAL-1 upstream of the proposed transportation corridor, has shown evidence of water being present. This showed water as close as 7 feet below the surface in May of 2015, but lower outside of the primary runoff period. The topography adjacent to Dry Creek is very steep with narrow to non-existent terraces. These topographic constraints and the very limited water present indicate that Dry Creek is not capable of being subirrigated.

2.3 Youngs Creek

Geology and Soils

Drilling logs for Youngs Creek indicate unconsolidated materials. Wells established in the Youngs Creek drainage study area show unconsolidated materials up to 64 feet below ground surface. Piezometers which were drilled to 9.5 feet indicate unconsolidated material in their entire column. Geology in the Youngs Creek Drainage meets criteria of unconsolidated materials required for AVF determination.

Hydrology

Youngs Creek is a perennial stream with a drainage area of approximately 64 square miles. Surface water flow records are available from 2007 to 2015. During this period spring month mean peak flows ranged from 15 to 25 cfs (AM5). Although the mean flow is calculated for spring months, data was collected during the entire year in Youngs Creek. Flows decreased and occasionally stopped during winter months with a longer duration during dry warmer years. Monitoring indicated water is present a majority of the recorded period.

Groundwater levels of Youngs Creek were measured at three shallow piezometers and eight monitoring wells. Water levels recorded June through August 2015 indicated piezometer water levels from 1.5 to five feet below ground surface. All eight monitoring well records from September 2014 through August 2015 contained water for the entire year. Depths to water in the wells ranged from nine to approximately 20 feet below ground surface (AM5). Youngs Creek demonstrates hydrologic conditions required of an AVF.

The Existence of Current or Historic Flood Irrigation

Young's Creek has several dikes present in the application area. These stem primarily from the Jensen Ditch, upstream of the crossing, and the Anderson Ditch which originates within the proposed centerline for the transportation corridor. Water rights on these ditches date to 1894, 1910, and 1944. This irrigation currently supports improved hay pasture and barley hay which is actively managed on an annual basis. Young's Creek contains a pond downstream of the proposed crossing. There is no evidence that it has been used for anything beyond livestock watering. The pond is east of both the Young's Creek channel and an irrigation ditch, Demmon Ditch, with a head-gate just upstream of the pond. This prevents the ponded water from influencing flood irrigation.

Capability of the Area to be Flood Irrigated

Youngs Creek is a perennial stream carrying consistent year-round flow in the reach intersected by the proposed transportation corridor. There are also several areas currently being flood irrigated throughout the permit boundary on this valley. As evidenced by current irrigation, there is sufficient water available

for flood irrigation, and a landscape that allows for flood irrigation. The transportation corridor intersects lands on Youngs Creek that are capable of being flood irrigated delineated as AVF Extent on Map 3.

The Existence of Subirrigation

Youngs Creek has nine monitoring wells and three piezometers used for evaluating the depth to alluvial water. None of these show elevations of more than ten feet below the channels at their respective cross sections and most show levels within six feet of the surface. Wells YCMT-23-08 and YCMT-22-08 show water levels above the channel bottom and are situated in the second terraces adjacent to the channel. Youngs Creek has many areas with surface elevations within four to ten feet of the channel bottom that indicate potential subirrigation.

2.4 Little Youngs Creek

Geology and Soils

Drilling logs for Little Young's Creek indicate unconsolidated materials. Wells indicate extensive unconsolidated materials up to 50 feet below ground surface. Piezometers indicate fine grained unconsolidated materials that were moist or wet the entire 10 foot drilling column. Geology in the Little Youngs Creek Drainage meets criteria of unconsolidated materials required for AVF determination.

Hydrology

Little Youngs Creek is a perennial stream with a drainage area of 17 square miles. Surface water flow records collected from mid-2007 through 2015 indicates consistently fluctuating flows in the Little Youngs Creek drainage. Flow generally stops sometime during the winter months. There are some years where water flowed all year long and some years the stream flow stopped for a longer period during the winter. The streams base flow typically ranged from 0.1 to 1cfs from mid-2007 through 2015. During 2011 an exceptionally wet year the mean daily flow peaked at 30 cfs (AM5).

Groundwater levels of Little Youngs Creek were measured at two shallow piezometers and five monitoring wells. Water levels recorded June through August 2015 indicated piezometer water levels from nine to ten feet below ground surface. All five monitoring well records from September 2014 through August 2015 contained water for the entire year. Depths to water in the wells ranged from approximately 7 to 35 feet below ground surface (AM5). Little Youngs Creek demonstrates hydrologic conditions required of an AVF.

The Existence of Current or Historic Flood Irrigation

Little Young's Creek also has several dikes present. The Kimmel-Tidball ditch pulls water from a dam upstream of the crossing and the Roush ditch originates within the proposed centerline for the transportation corridor from a head-gate. These ditches primarily support grazed go-back pastureland and have water rights dating from 1898 to 1944. There are no dams within the disturbance boundary, adjacent to Little Young's Creek, which will be impacted by the transportation corridor.

Capability of the Area to be Flood Irrigated

Little Youngs Creek is a perennial stream carrying consistent year-round flow in the reach intersected by the proposed transportation corridor. There are also several areas currently being flood irrigated

throughout the permit boundary on this valley. As evidenced by current irrigation, there is sufficient water available for flood irrigation, and a landscape conducive to flood irrigation. The transportation corridor intersects lands on Little Youngs Creek that are capable of being flood irrigated delineated as AVF Extent on Map 3.

The Existence of Subirrigation

Little Youngs Creek has five monitoring wells and two piezometers used for evaluating the depth to alluvial water. These show elevations with a wide range of depths from 30 feet below the channel bottom to six feet above the channel bottom. Upstream of the crossing, water levels have huge fluctuations while the piezometers show very little fluctuation for the few months of data that they had collected. These show water above and below the channel bottom by two feet. The wells downstream of the crossing, at the Montana-Wyoming state line show levels within eight feet of the channel bottom. As the piezometers show levels at the channel bottom above and below the stream crossing, terraces within ten feet of the channel bottom would be supported by subirrigation. There are areas on both sides of Little Youngs Creek that are currently subirrigated based on this evidence.

Presence or Absence Conclusion

An AVF is defined by having unconsolidated streamlaid deposits which are either flood or subirrigated. As described above, there is evidence within the AM5 area, and on adjacent properties, of the presence of an AVF. Unconsolidated deposits are present in and adjacent to the active channels of each of the creeks discussed (Squirrel, Dry, Youngs, and Little Youngs). The unconsolidated deposits depict one half of the AVF potential, while the flood irrigation or subirrigation depicts the other half. Each creek has varying aspects of this flood and subirrigation based on the evidence below:

- Squirrel Creek has no flood irrigation but is subirrigated on very narrow terraces;
- Dry Creek has no flood irrigation or subirrigation;
- Youngs Creek has both flood irrigation and subirrigation. The subirrigation is confined to areas within four to ten feet of the channel bottom.
- Little Youngs Creek has both flood irrigation and subirrigation. The subirrigation is confined to areas within ten feet of the channel bottom.

The information above confirms that AVF's are present in the proposed amendment area. Squirrel Creek, Youngs Creek, and Little Youngs Creek all have unconsolidated deposits and either flood or subirrigation.

The following table is a visual representation showing which valleys have the tenets of an Alluvial Valley Floor and how that fits with the regulatory process.

Drainage	Unconsolidated Deposits	Flood Irrigated	Subirrigated	Alluvial Valley Floor
Squirrel Creek	X	X	X	Yes
Dry Creek	X			No
Youngs Creek	X	X	X	Yes
Little Youngs Creek	X	X	X	Yes

II. Significance

Once the presence of an AVF is confirmed a significance determination must be determined per ARM 17.24.805. The language in this rule states:

> (1) The significance of the impact of the proposed operations on farming is based on the relative importance of the vegetation and water of the grazed or hayed alluvial valley floor area to the farm's production, or any more stringent criteria established by the department as suitable for site-specific protection of agricultural activities in alluvial valley floors. The effect of the proposed operations on farming is "significant" if the operations would, over the life of the mine, have more than a negligible impact on the farm's agricultural production. In making the determination of "significance", the department shall consult with the affected landowner(s).

Accompanying the significance determination is an evaluation of the AVF in relation to statutory exclusions designated in ARM 17.24.325(3)(a)(ii), and explained in more detail below. Based on the results of the statutory exclusions evaluation of the need for complete “significance” determination is established.

Statutory Exclusions

If statutory exclusions apply, an AVF is deemed insignificant, and the operator is not required to provide information explaining whether the operation will avoid interrupting, discontinuing, or precluding farming on the AVF and whether the operation will cause material damage to the quality and quantity of water supplying the AVF.

ARM 17.24.325(3)(a)(ii)(A –C) define the statutory exclusions for significance. They are included below:

> (A) the premining land type is undeveloped rangeland that is not significant to farming;
> (B) any farming on the alluvial valley floor that would be affected by the coal mining operation is of such small acreage as to be of negligible impact on the farm's agricultural production. Negligible impact of the proposed operation on farming is based on the relative importance of the affected vegetation and water of the developed grazed or hayed alluvial valley floor area to the farm's production over the life of the mine; or
> (C) the circumstances set forth in ARM 17.24.802(3) exist (pertaining to AVF’s contained in an reclamation plan approved prior to August 3, 1977).

These statutory exclusions are applicable on the three AVF’s present in the amendment area. Where the transportation corridor crosses Squirrel Creek, the current land use is undeveloped rangeland which is insignificant to farming. This land has not been manipulated to utilize the very small area of subirrigation or potential flood irrigation.

The previous Squirrel Creek AVF significance determination was completed using an agricultural production demonstration (Squirrel Creek 1981). This area had been developed and utilized specifically for hay production. The proposed transportation corridor crosses four drainages and involves three separate lessees. Conducting the production demonstration for these operations would be time intensive and may require additional data collection as these areas are not utilized only for hay

production, but also grazing. These are reasons why significance is currently being determined based on lessee interviews.

DEQ will make a significance determination based on these original interviews which were conducted in June 2016, as required in ARM 17.24.805 (Appendix A). A follow up interview was conducted April of 2017, with affected lessees after the determination was made. The follow up interview is to establish whether the lessees concur with DEQ's determination. If DEQ and the lessee agree on the significance to agriculture of an AVF, then there is no need to further investigate the AVF for significance. If there is a disagreement, then DEQ will conduct the production demonstration to determine significance.

With Youngs and Little Youngs creeks, farming that would be affected is on relatively minimal acreage and lessee interviews confirm that the transportation corridor will be of negligible impact. A summary of those interviews is included below and interview questionnaires are attached (Appendix A). Leo Ankney has been using the area in the Youngs Creek valley for hay production. According to our records, Mr. Ankney's leases include approximately 136 acres of irrigated land in the permit boundary, of which only 13 are in the disturbance footprint of the transportation corridor on Youngs Creek. Leo's operation consists of nearly 9,000 acres so this 13 acre disturbance is considered a negligible impact on his operation. Brett and Darcy DeLapp have been using the area in the Little Youngs Creek valley for supplemental forage. According to our records, DeLapp's leases include approximately 35 acres of irrigated land in the permit boundary, of which only 6 are in the disturbance footprint of the transportation corridor on Little Youngs Creek. Their operation consists of nearly 12,000 acres so this 6 acre disturbance is a negligible impact on the operation. Interviews indicate exclusion B (above) applies to these alluvial valley floors. Landowner concurrence letters are included as Appendix B Ranch Operator Consultation. There are no significant AVF's present in the transportation corridor submitted in Amendment 5.

III. Hydrologic Function

Pursuant to ARM 17.24.325(3)(c)(i) "If land within the permit area or adjacent area is identified as an alluvial valley floor and the proposed coal mining and reclamation operation may affect an alluvial valley floor or waters supplied to an alluvial valley floor, the applicant shall submit a complete application for the proposed coal mining and reclamation operation to be used by the department together with other relevant information as a basis for approval or denial of the permit." According to ARM 17.24.325(3)(c)(ii) "the complete application must include detailed surveys and baseline data required by the department for a determination of:

(A) the characteristics of the alluvial valley floor that are necessary to preserve the essential hydrologic functions throughout the mining and reclamation process;
(B) whether the operation will avoid during mining and reclamation the interruption, discontinuance, or preclusion of farming on the alluvial valley floor;
(C) whether the operation will cause material damage to the quantity or quality of surface or ground waters that supply the alluvial valley floor;

(D) whether the reclamation plan is in compliance with requirements of the Act, this chapter, and regulatory program; and
(E) whether the proposed monitoring system will provide sufficient information to measure compliance with ARM 17.24.801, 17.24.802, and 17.24.804 through 17.24.806, during and after mining and reclamation operations."

However, if the department determines that the statutory exclusions specified in ARM 17.24.325(3)(a)(ii)(A) or (B) apply, then the applicant need not submit the information required in ARM 17.24.325(3)(c)(ii)(B) and (C) as listed above.

ARM 17.24.325(3)(e) provides framework for evaluating the essential hydrologic function of an AVF. Hydrologic function is categorized into multiple aspects: characteristics supporting the function of collecting water, characteristics supporting the function of storing water, characteristics supporting the function of regulating the flow of water, and characteristics which make water available. Characteristics supporting the function of collecting water include:

"(A) the amount and rate of runoff and a water balance analysis, with respect to rainfall, evapotranspiration, infiltration and ground water recharge;
(B) the relief, slope, and density of the network of drainage channels;
(C) the infiltration, permeability, porosity and transmissivity of unconsolidated deposits of the valley floor that either constitute the aquifer that is hydraulically connected to the stream or the unsaturated valley fill below the stream and above the alluvial aquifer; and
(D) other factors that affect the interchange of water between surface streams and ground water systems, including the depth to ground water, the direction of ground water flow, the extent to which the stream and associated alluvial ground water aquifers provide recharge to, or are recharged by bedrock aquifers" (ARM 17.24.325(3)(e)(i).

Characteristics supporting the function of storing water include:

"(A) slope, and vegetation of the channel, flood plain, and low terraces that retard the flow of surface waters;
(B) porosity, permeability, waterholding capacity, saturated thickness and volume of aquifers associated with streams, including alluvial aquifers, perched aquifers, and other water bearing zones found beneath the valley floor; and
(C) moisture held in soils or the plant growth medium within the alluvial valley floor, and the physical and chemical properties of the subsoil that provide for sustained vegetation growth or cover during extended periods of low precipitation" (ARM 17.24.325(3)(e)(ii).

Characteristics supporting the function of regulating the flow of water include:

"(A) the geometry and physical character of the valley, expressed in terms of the longitudinal profile and slope of the valley and the channel, the sinuosity of the channel, the cross-section, slopes and

proportions of the channels, flood plains and low terraces, the nature and stability of the streambanks and the vegetation established in the channels and along the streambanks and flood plains;
(B) the nature of surface flows as shown by the frequency and duration of flows of representative magnitude including low flows and floods; and
(C) the nature of interchange of water between streams, their associated alluvial aquifers and any bedrock aquifers as shown by the rate and amount of water supplied by the stream to associated alluvial and bedrock aquifers (i.e., recharge) and by the rates and amounts of water supplied by aquifers to the stream (i.e., baseflow)" (ARM 17.24.325(3)(e)(iii).

Lastly, characteristics which make water available include "the presence of land forms including flood plains and terraces suitable for agricultural activities" (ARM 17.24.325(3)(e)(vi).

Introduction

This document represents the third evaluation in the AVF process and determines the essential hydrologic function of the Squirrel Creek, Youngs Creek, and Little Youngs Creek AVFs.

The majority of the following discussion and analysis is based on baseline studies and data collected by SCM. Spring Creek established a baseline hydrologic monitoring system on Squirrel, Youngs, and Little Youngs Creeks consisting of streamflow monitoring stations and ground water wells. Monitoring locations are presented in AM5 Exhibit I Vol. 5-1. Baseline monitoring data results, analysis, and discussion is presented in AM5 Appendix I, Vol. 5 – Pre-mine Hydrology for Arrowhead Amendment. Additionally, AM5 Appendix O4 – Alluvial Valley Floor Assessment for Arrowhead Amendment Area contains the agricultural, geomorphic, and hydrologic information as required for an AVF determination.

Regional Hydrology

Alluvial aquifers are dynamic systems with the ground water recharge and discharge strongly influenced by seasonal conditions. The alluvial aquifers of Squirrel, Youngs, and Little Youngs Creeks are influenced by several water budget components including atmospheric water, surface water, and ground water. Each water budget component alternatively represents a source or loss of water, depending on local seasonal conditions. Recharge components include seasonal streamflow losses, infiltration of excess overland runoff, infiltration of excess direct precipitation, irrigation and ditch seepage, and some lateral flow from bedrock aquifers. Conversely, discharge components include down gradient ground water flow, seasonal streamflow gains (baseflow), atmospheric losses from evaporation and transpiration, and some leakage into bedrock aquifers. The dynamic quality of these aquifers is best demonstrated by ground water elevations, which rise and fall seasonally in response to variable recharge and discharge conditions. This seasonality is demonstrated generally in Figure 1, and specifically for each AVF in AM5 Figure I Vol. 5-6.

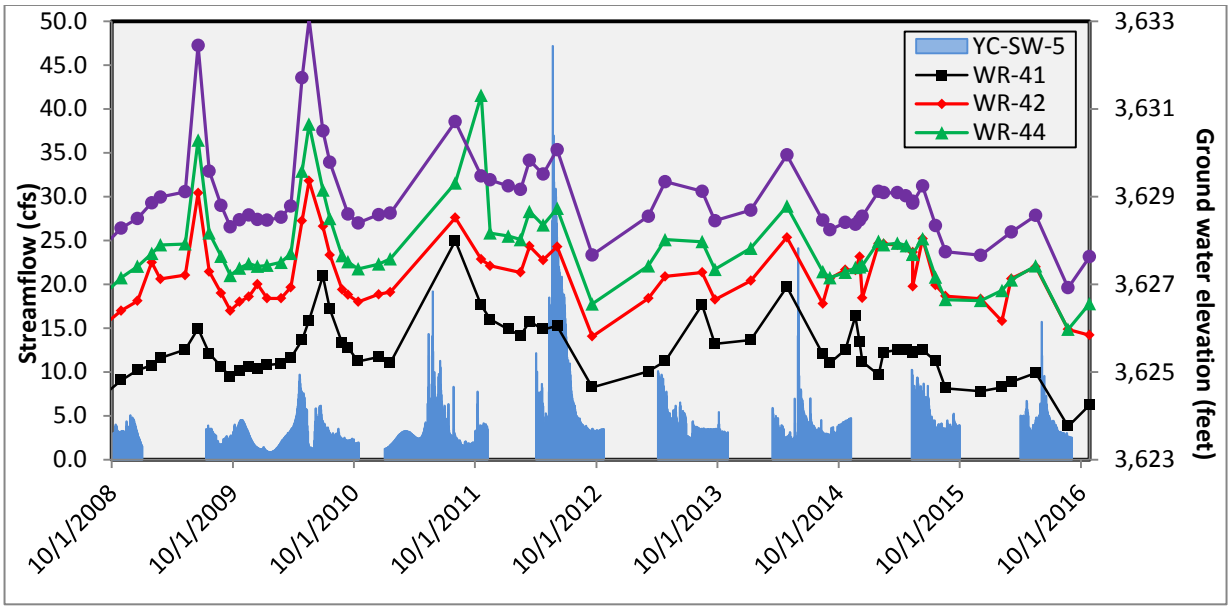

Figure 1. Comparison of streamflows and alluvial ground water elevations in the lower Youngs Creek AVF study area. Streamflows and ground water elevations are dynamic, interrelated, and vary seasonally.

Generally, recharge occurs during the spring, when excess streamflow and runoff is available from snowmelt and precipitation. During the following growing season, atmospheric conditions are dry, and alluvial water is discharged through evaporation, transpiration, and stream baseflow. However, locally discharge and recharge are variable. Irrigated areas may recharge the alluvium via infiltration and ditch seepage, while losing stream reaches will continue to recharge local alluvium. These processes, as indicated by monitoring data and reports, are discussed in detail below for each AVF.

1. Characteristics Supporting the Function of Collecting Water

Watershed Attributes

The drainages of Squirrel, Youngs, and Little Youngs Creeks are oriented southeast, with high elevation headwater areas in the northwest which progress down gradient to the southeast (Figure 2). Headwater areas are high gradient and erosional, conveying runoff and sediment downstream to low gradient, depositional areas.

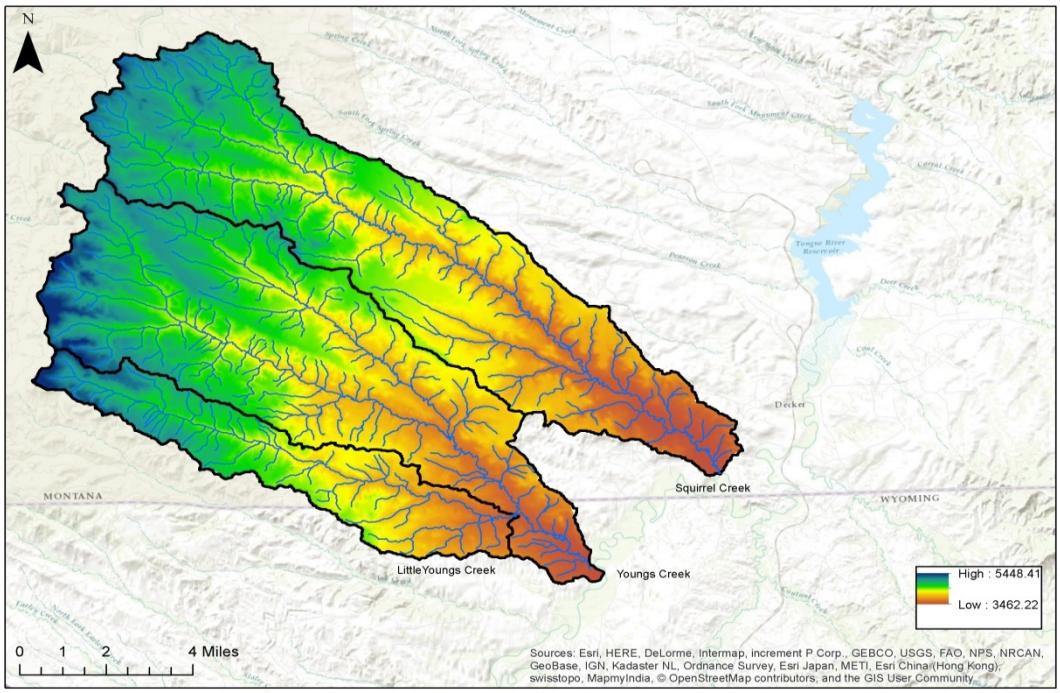

Figure 2

Mean basin slopes are similar at approximately 14%, as are channel densities at approximately 3.0 stream miles/watershed square miles (mi/mi², Table 1). In the Squirrel Creek watershed, elevation ranges from 3,462 to 5,135 feet (ft). In the Youngs Creek watershed, elevation ranges from 3,504 to 5,446 feet. Lastly, in the Little Youngs Creek watershed, elevation ranges from 3,622 to 5,446 ft.

Amendment 5 Exhibit O4-6.0 contains longitudinal profiles of the main stream channels in the vicinity of the AVF study area. This area is clearly a depositional area, with median channel slopes less than 1.0% (Table 1). The AVF study area is located downstream in the watershed, with elevations less than 4,000 ft.

		Squirrel Creek	Youngs Creek	Little Youngs Creek
Total Basin	Mean Basin Slope 30m DEM:	14.1%	14.7%	13.9%
	Elevation Range (ft):	3,462 – 5,135	3,504 – 5,446	3,622 – 5,446
	Channel Density (mi/mi²):	2.8	3.0	3.0
AM5 AVF Study Reach	Slope Median (%):	0.5%	0.48%	0.73%
	Slope Range (%):	0.35 - 1.1%	0.26 - 8.6%	0.71 - 12.0%
	Elevation Range (ft):	3,701 – 3,835	3,628 – 3,732	3,705 – 3,816
Note: Sources include Application Appendix O AVF Study and Streamstats reports accessed at https://water.usgs.gov/osw/streamstats/montana.html.				

Table 1. Geomorphic characteristics of the Squirrel, Youngs, and Little Youngs Creek drainages. Characteristics are provided for both basin wide and AVF Study reach scales.

The average annual precipitation in the area is approximately 14.0 inches (Table 2). Drainage area for Squirrel Creek is 49.8 mi ², while Youngs Creek and Little Youngs Creek have drainage areas of 64.1 and 17.0 mi ², respectively. For each watershed, average annual runoff is less than annual precipitation, with significant losses to infiltration or evapotranspiration (Table 2). However, perennial stream flows are generally sustained in each drainage with mean annual discharge at Squirrel Creek equaling 1.9 cubic feet per second (cfs). Mean annual discharge at Youngs Creek equals 9.2 cfs and mean annual discharge at Little Youngs Creek equals 1.8 cfs. Similar sized drainages in the region are ephemeral and the perennial nature of these watersheds is attributed to incision into ground water sources, numerous headwater springs, and an east facing aspect (Thompson and Van Voast, 1981). Lastly, Table 2 includes a summary of calculated peak discharges for each respective watershed.

	Youngs Creek at State Line	Youngs Creek at Mouth	Little Youngs at Mouth	Squirrel Creek at Mouth
Drainage Area (sq. mi.)	43.6	64.1	17.0	49.8
Average Annual Precip. (in.)	14.5	13.7	14.0	14.3
Average Annual Runoff (in.)	2.3	1.9	1.4	3.96
Mean Annual Discharge (cfs)	7.4	9.2	1.8	1.9
Mean Monthly ET Spring (Mar-June)	1.61	1.57	1.51	1.46
Mean Monthly ET Summer (Jul-Oct)	1.02	0.96	0.87	0.84
2-yr Peak Discharge (cfs)	39 - 198	42 - 208	18 - 88	185
5-yr Peak Discharge (cfs)	109 - 473	113 - 498	53 - 222	500
10-yr Peak Discharge (cfs)	173 - 756	184 - 791	85 - 364	740
25-yr Peak Discharge (cfs)	272 - 1232	286 - 1293	134 - 611	1270
Notes: Table adapted from Application AM5 Table I Vol. 5-1. Data sources include Hedges et al. 1980, Thompson and Van Voast, 1981, Ferreira 1981, and Sando et al. 2016. Peak discharge rate ranges represent flow rates expected to occur within 65% confidence probability. Peak discharge rates shown as single values represent mean values from prediction of 65% confidence interval. The mean annual discharge value shown for Squirrel Creek is that which is expected to be equaled or exceeded 50% of the time.				

Table 2. Drainage Basin Areas, Runoff Characteristics, and Evapotranspiration Rates for Squirrel, Youngs, and Little Youngs watersheds.

Alluvial Attributes

Amendment 5 Table I Vol. 5-6 provides a summary of aquifer testing analyses for the alluvium in Squirrel, Youngs, and Little Youngs Creeks. Calculated aquifer properties, specifically hydraulic conductivity and transmissivity, are high and consistent with alluvial materials. The extent of the alluvial deposits in the AVF study area is documented in geologic drill logs and cross sections contained in Appendix O of CPE AM5. In Squirrel Creek, hydraulic conductivity ranges from 80 feet/day (ft/day) to 160 ft/day, while transmissivity ranges from approximately 20,000 gallons per day/foot (gpd/ft) to approximately 40,000 gpd/ft. In Youngs Creek, hydraulic conductivity ranges from 42 to 270 ft/day, while transmissivity ranges from approximately 10,000 to 120,000 gpd/ft. In Little Youngs Creek, hydraulic conductivity ranges from approximately 150 to 300 ft/day, while transmissivity ranges from 24,000 to 53,000 gpd/ft. Aquifer parameters remain fairly consistent in Squirrel and Little Youngs Creeks, while hydraulic conductivity and transmissivity tend to increase moving downstream in Youngs Creek.

Ground Water Occurrence

Amendment 5 Figure I Vo. 5-6 presents a summary of ground water elevations at monitoring locations in Squirrel, Youngs, and Little Youngs Creeks. In general, ground water elevations fluctuate seasonally in response to recharge and discharge.

In Squirrel Creek, only monitoring well SQAL-4, located downstream in the valley, had recorded ground water levels. In SQAL-4, depth to water ranged from 14.3 to 22.6 feet while saturated thickness ranged from 38.2 to 53.2 feet. Additionally, shallow ground water elevations were monitored in piezometers PZ-SQ-1, PZ-SQ-2, and PZ-SQ-3. These piezometers are located in the upstream and middle portions of the Squirrel Creek AVF study reach (AM5 Exhibit I Vol. 5-1). Ground water levels in these piezometers were generally within 10 feet of the ground surface.

Upstream in Youngs Creek, depth to water in monitoring wells YCMT-27 and YCMT-28 ranged from 12.1 to 18.9 feet, while saturated thickness ranged from 38.2 to 53.2 feet. Further downstream at monitoring wells YCMT-22-08 and YCMT-23-08 depth to water ranged from 7.2 to 10.3 feet while saturated thickness ranged from 32.7 to 61.3 feet. At the lower most section of the AVF study reach, near the state border, water depths at monitoring wells WR-41, WR-42, WR-44, and WR-45 ranged from 8.7 to 22.6 feet while saturated thickness ranged from 21.1 to 61.3 feet.

In Little Youngs Creek, at upstream monitoring wells LYCMT-21-08 and LYCMT-22-08, depth to water ranged from 15.7 to 36.8 feet while saturated thickness ranged from 4.7 to 36.3 feet. Downstream at monitoring wells PWA-100, PWA-101, and PWA-102 depths to water range from 11.2 to 22.8 feet while saturated thickness ranges from 12.4 to 38.5 feet.

In addition to alluvial aquifers, Spring Creek Mine monitored regional sedimentary and coalbed aquifers. These aquifers are located laterally and below alluvial aquifers. Generally, ground water exchange between alluvial and sedimentary aquifers is limited because of dramatic differences in ground water elevations and hydraulic conductivity. However, one sedimentary ground water monitoring well, PM-OB-02, has some limited interaction with Little Youngs Creek alluvium. Ground water levels and water quality

in this well are similar to that in wells PWA-100, PWA-101, and PWA-102. This interaction is minor, and water quality in surface water is not similar to water quality in this sedimentary ground water well.

2. Characteristics Supporting the Function of Storing Water

Stream Channel Properties

Previous discussions have indicated stream channel slopes to average less than 1% for all three drainages within the study area. This physical aspect creates a depositional zone in the channel that allows for increased infiltration and water storing capacity. Smaller soil particles allow for additional water storage and these are endemic to depositional lengths of channels. As flow decreases in stream lengths dominated by fine grained materials, more water can be stored. This is demonstrated by terraces adjacent to the channels, especially evident on Youngs and Little Youngs creeks. Squirrel Creek has terraces also, but they are very narrow where the transportation corridor crosses the channel. This additional water also provides increased growth of riparian vegetation adjacent to these streams.

Aquifer Properties

As previously discussed, AM5 Table I Vol. 5-6 and Figure I Vo. 5-6 summarizes alluvial aquifer properties and occurrence within the AVF study area for the Squirrel, Youngs, and Little Youngs Creeks. The previous sections “Alluvial Attributes” and “Ground Water Occurrence” provide further discussion of the capacity of the alluvial aquifers to store water.

Soil Properties

Moisture holding capacity in a soil or plant growth media is a function of physical properties such as texture and structure, and chemical properties such as organic matter and soluble salts. The water molecule has a polar structure that results in electrostatic attraction of water to both soluble cations and soil solids. While the water molecule is affected by cations in the soil solution, fundamentally texture and structure influence soil processes including the growth of plant roots and water movement (Brady and Weil, 2010).

Physical properties of soil texture and structure can be used to understand how water will interact with the soil. Soil texture indicates the sizes of soil particles with the surface area capable of holding water. Soil textures are derived from three particles differentiated by the particles size. They are Sand (2.0-0.05mm), Silt (0.05-0.002mm), and Clay (<0.002mm). All mineral soils are a combination of these three particles.

Pure clay has a tremendous surface area and ability to pack together tightly resulting in a high water holding capacity and low infiltration. Clay soil will hold a lot of water which soaks in slowly. Even though the clay contains lots of water, it can be hard for a plant to use because the water is strongly adhered to that clay. Conversely sand, being opposite clay with the largest particles, lets water pass through quickly has a lower capacity to hold water, and therefore also leaves plants without water. Silt has some of the water holding capacity of clays, while also allowing water to move more freely than clay, but not as freely as sand. Since all soils are a combination of these components, they tend to be in the middle ground of the extremes.

Soil particles tend to clump together in aggregates with shapes like roundish granules, blocky cubes, flat plates, and other shapes referred to as structure (Brady and Weil, 2010). Pore space can be thought of as the space available to hold water between soil particles and aggregates. Imagine a pile of ball bearings in a box and think of the spaces between the bearings. The bearings are soil aggregated into a round structure and the voids are the pore spaces where water can fill up and move through the soil. Structural shapes are also associated with soil types. The example clay from above would have blocky clods as structure. In this blocky structure water will flow through the fissures in and between the blocks. While the water moves through the blocky structure, the clay particles absorb the liquid. Using these tools soils can be evaluated for moisture holding capacity.

Soils of Squirrel Creek, Youngs Creek, and Little Youngs Creek are of similar physical and chemical character. This is expected for the reason that the soils developed from similar parent materials of the Wasatch and Fort Union formations in which all three creeks reside. These parent materials consist of Clay shale, siltstone, and sandstone. Through soil forming processes these materials weathered into primarily silty clay loam, clay loam, and loam in the AVFs. Loam, being an even mix of sand, silt, and clay, is well balanced soil for plant water interactions. However, the silt and clay qualifiers indicate the soils contain a majority of smaller particles lending to slow water movement and restricted plant use, especially in the dry region where these creeks are found.

Due to the low frequency of precipitation, depth to groundwater, and the soil characteristics discussed above, the soils along the alluvial valleys of these three creeks will tend toward dry conditions most years. During a high water year it is expected that the soils would hold a useful amount of water for plants. Resulting in a longer growing season than adjacent uplands; however, water availability would be reduced throughout the dry season because of the higher clay content of the soils. Due to these characteristics cultivated plants require additional irrigation.

3. Characteristics Supporting the Function of Regulating the Flow of Water

Geomorphic Properties

Amendment 5 Exhibit O4-6.0 presents a detailed longitudinal profile and slope of Squirrel, Youngs, and Little Youngs Creeks in the vicinity of the AVF study area. Amendment 5 Appendix J – Attachment -5 contains detailed stream cross section data points. Lastly, AM5 Exhibits O4-1.1, O4-2.1, and O4-4.1 provide surface and geologic cross sections for each respective stream.

Streamflow Characteristics

Amendment 5 Figure I Vol. 5-3 provides a summary of monthly discharge in Squirrel, Youngs, and Little Youngs Creeks. Monthly discharge is variable seasonally and year to year. During above average precipitation years (e.g. 2011), total annual discharge is elevated compared to average or below average precipitation years. Spring runoff from snowmelt and precipitation results in high monthly flows, with the highest flows generally occurring during May and June. Following snowpack depletion and increased demands from evaporation and transpiration, streams decline to baseflow conditions through late summer and fall. Furthermore, streamflows in these drainages are further depleted by irrigation diversions, which may or may not return to the stream through alluvial infiltration. In Little Youngs and

Youngs Creek, flow data indicates gaining stream conditions moving downstream through the AVF study area, while in Squirrel Creek flow data indicates losing stream conditions moving downstream through the AVF study area.

Surface and Ground Water Interactions

Amendment 5 Figure I Vol. 5-6 presents a comparison of alluvial ground water elevations with adjacent streambed elevations. In alluvial systems surface water and ground water are highly interconnected. Surface water, e.g. streams, are generally either supplying or receiving water from shallow alluvial aquifers. A "losing" stream occurs when the streambed elevation is above the local ground water table, while a "gaining" stream occurs when the streambed elevation is below the local ground water table. This relationship may vary seasonally or by location.

In Squirrel Creek, gaining or losing stream reaches vary seasonally and physically. At monitoring well SQCAL-4, the alluvial water elevation is generally below the adjacent streambed, indicating losing stream conditions. However, in early spring, the water elevation in this well exceeds or approaches the streambed for a short period of time. At piezometer PZ-SQC-1, the shallow ground water level is below the adjacent streambed. In contrast, at PZ-SQC-2, the shallow ground water level is above the adjacent streambed. At PZ-SQC-4 the ground water levels fluctuate from above to below the streambed, indicating a seasonal shift from a gaining to losing reach. In general, streamflow records indicate that Squirrel Creek, moving downstream through the AVF study reach, is a losing stream.

In upper Youngs Creek, alluvial water levels in wells YCMT-27 and YCMT-28 fluctuate seasonally, approaching but never exceeding adjacent streambed elevations, indicating a losing stream reach. Downstream, alluvial water levels in wells YCMT-22-08 and YCMT-23-08 fluctuate seasonally, and are generally at or above the adjacent streambed elevation, indicating gaining stream conditions for the majority of the year. Further downstream near the state border, at well WR-45, alluvial water levels seasonally exceed the adjacent streambed elevation, indicating short periods of streamflow recharge from alluvium. However, in general, at this well and adjacent wells WR-41, WR-42, and WR-44, alluvial ground water elevations are below the adjacent streambed, indicating losing stream conditions. At piezometers PZ-YC -1 and PZ-YC-2, ground water elevations are below the streambed, while at PZ-YC-3 ground water elevations are above the streambed. In general, streamflow records indicate that Youngs Creek, moving downstream through the AVF study reach, is a gaining stream.

In Little Youngs Creek, alluvial water levels at LYCMT-21-08 and LYCMT-22-08 fluctuate seasonally and are periodically near or above the adjacent stream bed elevation. Short periods of gaining stream conditions in this area occur during the spring months. Downstream at wells PWA-100, PWA-101, and PWA-102, ground water elevations are always below the adjacent streambed, indicating losing stream conditions. At piezometer PZ-LYC-1, shallow ground water elevations are above the adjacent streambed, while at PZ-LYC-2 ground water elevations are below the adjacent streambed. Again, streamflow gains and losses are variable locally and seasonally. In general, streamflow records indicate that Little Youngs Creek is gaining moving downstream through the AVF study reach.

4. Characteristics which make Water Available

As part of the AVF investigation (AM5 Appendix O), Spring Creek Mine surveyed floodplains and terraces of the Squirrel, Youngs, and Little Youngs Creeks in the vicinity of the study area. These surveys are presented in AM5 Exhibits O4-1.0, O4-2.0, and O4-4.0. These surveys indicate the presence of historic and active floodplains, designated as different terrace levels. Historic and active floodplains are utilized for agricultural activities. Agriculture is supported by natural flooding of active floodplain or irrigation ditch systems which divert and spread streamflow onto upper terrace levels. Maps 2 & 3provide locations of agricultural lands and associated irrigation ditch systems for the Squirrel, Youngs, and Little Youngs Creek AVFs.

IV. Summary

In the transportation corridor the crossings of Squirrel, Dry, Youngs, and Little Youngs Creeks have been evaluated for the presence of an AVF. Dry Creek did not demonstrate the presence of an AVF and was excluded from the significance determination in step two of this process. Squirrel, Youngs, and Little Youngs Creeks each demonstrated AVF characteristics requiring a significance determination.

Pursuant to ARM 17.24.325(3)(a)(ii)(A–C), DEQ utilized existing scientific data and surface operator information to determine whether any statutory exclusions were applicable to the significance determination for each of these creeks. Under exclusion (A), an area cannot be deemed significant if the area is undeveloped rangeland. Under exclusion (B), if agricultural acreage is impacted but the acreage is negligible to the farm or ranch operation, the AVF is considered insignificant. Due to the undeveloped nature of Squirrel Creek and negligible size of impacted acreage in the Youngs Creek and Little Youngs Creek AVFs, the AVFs in each of the three creeks are considered insignificant to agriculture.

Since the AVFs meet the criteria for statutory exclusions, SCM is not obligated to "submit the information required in ARM 17.24.325(3)(c)(ii)(B) and (C), and the department is not required to make the findings of ARM 17.24.325(3)(f)(ii)(A) and (B)." as stated in ARM 17.24.325(3)(a)(ii).

To complete the AVF study the hydrologic function for the Squirrel, Youngs, and Little Youngs creeks was evaluated. All three creeks demonstrate intact hydrologic functionality. Alluvial and groundwater aquifers interact with stream flows showing characteristic water storage capacity and natural flow regulation are present. Squirrel Creek represents a losing stream through the study area and both Youngs and Little Youngs creeks are gaining streams through the study area. These functionalities will be maintained and monitored through the life of the transportation corridor.

Compaction is expected in the top few feet of the groundwater aquifer through construction and reclamation of the road and associated disturbance. The compaction is not expected to affect the water moving through the groundwater aquifer. These impacts are not expected due to water levels in the aquifer being below the zone of compaction a majority of the year. To ameliorate the compacted area, the compacted strata will be ripped to break up the massive structure during reclamation. The hydrologic function of the creeks is expected to support the farm and ranch operations they are associated with.

Appendix A

Landowner/Ranch operator Interviews

ARM 17.24.805 states, "[i]n making the determination of "significance", the department shall consult with the affected landowner(s)." making the determination of "significance", the department shall consult with the affected landowner(s)." Since the rule discusses both farm operations, and landowners, DEQ consulted with affected ranch operators leasing land impacted by the transportation corridor. The operators are Leo Ankney, Brett and Darcy DeLapp, and Kathy Larsen. DEQ conducted interviews with each of these operators on June 6, 2016. A follow-up concurrence interview was held with Leo Ankney April 26, 2017 and Brett DeLapp April 27, 2017 since the AVF's on their leases were excluded based on exemption B (above).

Leo Ankney

We met with Leo Ankney at his shop adjacent to fields he farms along the east side of the Tongue River. Leo informed us that he grazes approximately 2,800 acres and farms around 125 acres of Alfalfa, Orchard grass, and Hay Barley for feed on leased lands around the Youngs Creek drainage. In total Leo manages around 9,000 acres in the Tongue River basin, including the land around Youngs Creek and into Wyoming, as well as additional acres in the Powder River basin to the east. Most of the hay production is along the Tongue River; however, portions of his hay production are on Youngs Creek where the transportation corridor will be constructed. Around 20 acres of the fields at Youngs Creek are sub-irrigated with flood irrigation used when water is sufficient. The sub-irrigated acres are less productive than the irrigated portions. The water for these acres is critical to their production; however, the acreage is small when compared to total acres farmed. While Leo does run cattle he expressed that he generally produces feed and his sons who sublease some portions of the overall acres manage the cattle.

Brett and Darcy DeLapp

Brett DeLapp joined us in the evening at the Aqua Terra Consultants office in Sheridan Wyoming. Darcy was unavailable. Brett exclusively manages around 140 head of Longhorn cows grazing approximately 580 acres around Little Youngs Creek. This is a small area of the approximately 12,000 acres they lease between Montana and Wyoming. Brett indicated that they exclusively graze the land and do not hay the Little Youngs Creek acres. The flood irrigation does make a difference and would be critical if it were the only source of feed for his cattle; however, he only uses the flooding when water is available and the growth enhancement is for supplemental feed. The acres are not seeded and generally have Crested Wheat or Brome grass growing which was already on site. Over the past 20 years sub-irrigation has not shown a noticeable effect.

Kathy Larsen

Kathy Larsen, while waiting for a delivery of bulls, took time from her busy schedule to meet us at her home. Kathy utilizes leased land around Squirrel and Dry Creeks. Kathy manages approximately 22,000 to 27,000 acres in Montana and Wyoming for 300-500 cows. Alfalfa and grass hay is produced on roughly 300 acres. Flood irrigation along Squirrel creek is utilized when there is enough water available. Kathy

indicated that there is enough water to use the irrigation about one in ten years and it definitely enhances hay production. Sub-irrigation does not seem to be present. Kathy Larsen's lease that would be impacted by the transportation corridor has not been managed for hay production. This area is undeveloped rangeland. As long as surface flows are maintained, her hay production should not be impacted by the proposed action.

Appendix B

Ranch Operator Consultation

DEQ
Montana Department of Environmental Quality

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Overview: Alluvial Valley Floor Determination
Prior to approving an application for a strip or underground coal mining permit or major revision to a permit, the applicant must demonstrate that the proposed coal mining operation would not interrupt, discontinue, or preclude farming on alluvial valley floors (AVF) that are irrigated or naturally subirrigated, excluding undeveloped rangelands that are not significant to farming on alluvial valley floors and excluding lands that are of such small acreage that the impact on the farm's agricultural production are negligible. Section 82-4-227(3)(b)(i), MCA. The applicant must also demonstrate that the proposed coal mining operation would not materially damage the quantity of quality of water in surface water or underground water systems that supply alluvial valley floors. Section 82-4-227(3)(b)(ii).

If the Department determines that an AVF exists, coal mining operations must not interrupt, discontinue, or preclude farming on an AVF unless: 1) the premining land type is undeveloped rangeland that is not significant to farming, or 2) any farming on the AVF that would be affected by the proposed coal mining operation is of such small acreage as to be of negligible impact on the farms' agricultural production. ARM 17.24.325(3)(a)(ii)(A)-(B); ARM 17.24.802(1)(a)(i)-(ii).

In determining the significance of the impact of the proposed coal mining operation on farming, the department shall consult with the affected landowner/ranch operator. The effect of the proposed operation on farming is "significant" if the operations would, over the life of the mine, have more than a negligible impact on the farm's agricultural production. ARM 17.24.805.

Ranch Operator consultation:

1. Cloud Peak Energy is applying for an amendment to their Spring Creek Mine permit. Operations would be conducted in accordance with the Montana Strip and Underground Mine Reclamation Act (Title 82, chapter 4, part 2, MCA) and it's implementing administrative rules (ARM Title 17, chapter 24, subchapters 3-13) on an alluvial valley floor area which may impact the ranch operator's farming operation.

2. The Ranch Operator has been consulted by the Department concerning the existence of an alluvial valley floor and the significance of the impact of the proposed coal mining operations on farming based on the relative importance of the vegetation and water of the grazed or hayed alluvial valley floor area to the ranch operator's farm production.

3. I have reviewed the alluvial valley floor determination completed by the Department for the Arrowhead Amendment. I understand the extent of the alluvial valley floor identified by the Department (Map 3 from the 2017 AVF Determination). I also understand the Department has determined that the proposed mine operation would have an insignificant impact on my farm/ranch operation as the affected acreage within the AVF is of such small acreage as to be of neglible impact on my farm/ranch' agricultural production. I agree with the Department's determination that the impact of the proposed coal mining operation on the alluvial valley floor located in the area of Little Youngs Creek is insignificant to my farming operations.

Dated this 5 day of May, 2017

Brett DeLapp Darcy DeLapp (Signature)

Brett DeLapp Darcy DeLapp (Ranch Operator)
7 Youngs Creek Rd, Sheridan WY, 82801 (Address)

DEQ
Montana Department of Environmental Quality

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MAY 18 2017
DEQ/IEMB

Overview: Alluvial Valley Floor Determination
Prior to approving an application for a strip or underground coal mining permit or major revision to a permit, the applicant must demonstrate that the proposed coal mining operation would not interrupt, discontinue, or preclude farming on alluvial valley floors (AVF) that are irrigated or naturally subirrigated, excluding undeveloped rangelands that are not significant to farming on alluvial valley floors and excluding lands that are of such small acreage that the impact on the farm's agricultural production are negligible. Section 82-4-227(3)(b)(i), MCA. The applicant must also demonstrate that the proposed coal mining operation would not materially damage the quantity of quality of water in surface water or underground water systems that supply alluvial valley floors. Section 82-4-227(3)(b)(ii).

If the Department determines that an AVF exists, coal mining operations must not interrupt, discontinue, or preclude farming on an AVF unless: 1) the premining land type is undeveloped rangeland that is not significant to farming, or 2) any farming on the AVF that would be affected by the proposed coal mining operation is of such small acreage as to be of negligible impact on the farms' agricultural production. ARM 17.24.325(3)(a)(ii)(A)-(B); ARM 17.24.802(1)(a)(i)-(ii).

In determining the significance of the impact of the proposed coal mining operation on farming, the department shall consult with the affected landowner/ranch operator. The effect of the proposed operation on farming is "significant" if the operations would, over the life of the mine, have more than a negligible impact on the farm's agricultural production. ARM 17.24.805.

Ranch Operator consultation:

1. Cloud Peak Energy is applying for an amendment to their Spring Creek Mine permit. Operations would be conducted in accordance with the Montana Strip and Underground Mine Reclamation Act (Title 82, chapter 4, part 2, MCA) and it's implementing administrative rules (ARM Title 17, chapter 24, subchapters 3-13) on an alluvial valley floor area which may impact the ranch operator's farming operation.

2. The Ranch Operator has been consulted by the Department concerning the existence of an alluvial valley floor and the significance of the impact of the proposed coal mining operations on farming based on the relative importance of the vegetation and water of the grazed or hayed alluvial valley floor area to the ranch operator's farm production.

3. I have reviewed the alluvial valley floor determination completed by the Department for the Arrowhead Amendment. I understand the extent of the alluvial valley floor identified by the Department (Map 3 from the 2017 AVF Determination). I also understand the Department has determined that the proposed mine operation would have an insignificant impact on my farm/ranch operation as the affected acreage within the AVF is of such small acreage as to be of neglible impact on my farm/ranch' agricultural production. I agree with the Department's determination that the impact of the proposed coal mining operation on the alluvial valley floor located in the area of Youngs Creek and Little Youngs Creek is insignificant to my farming operations.

Dated this 4 day of May, 2017

Leo Ankney (Signature)

Leo Ankney (Ranch Operator)
PO Box 53, Decker MT, 59025 (Address)

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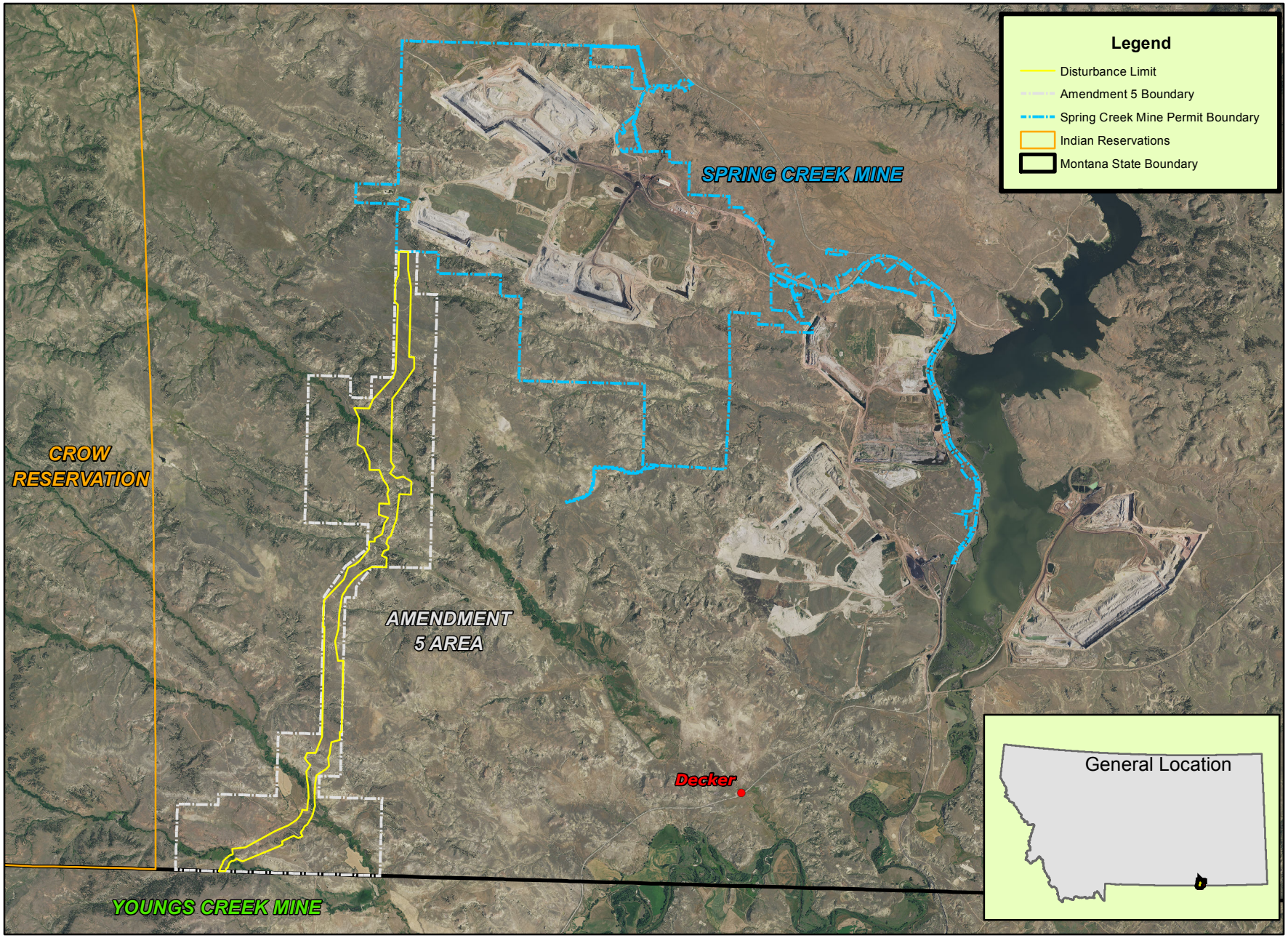
Map1 Project Overview



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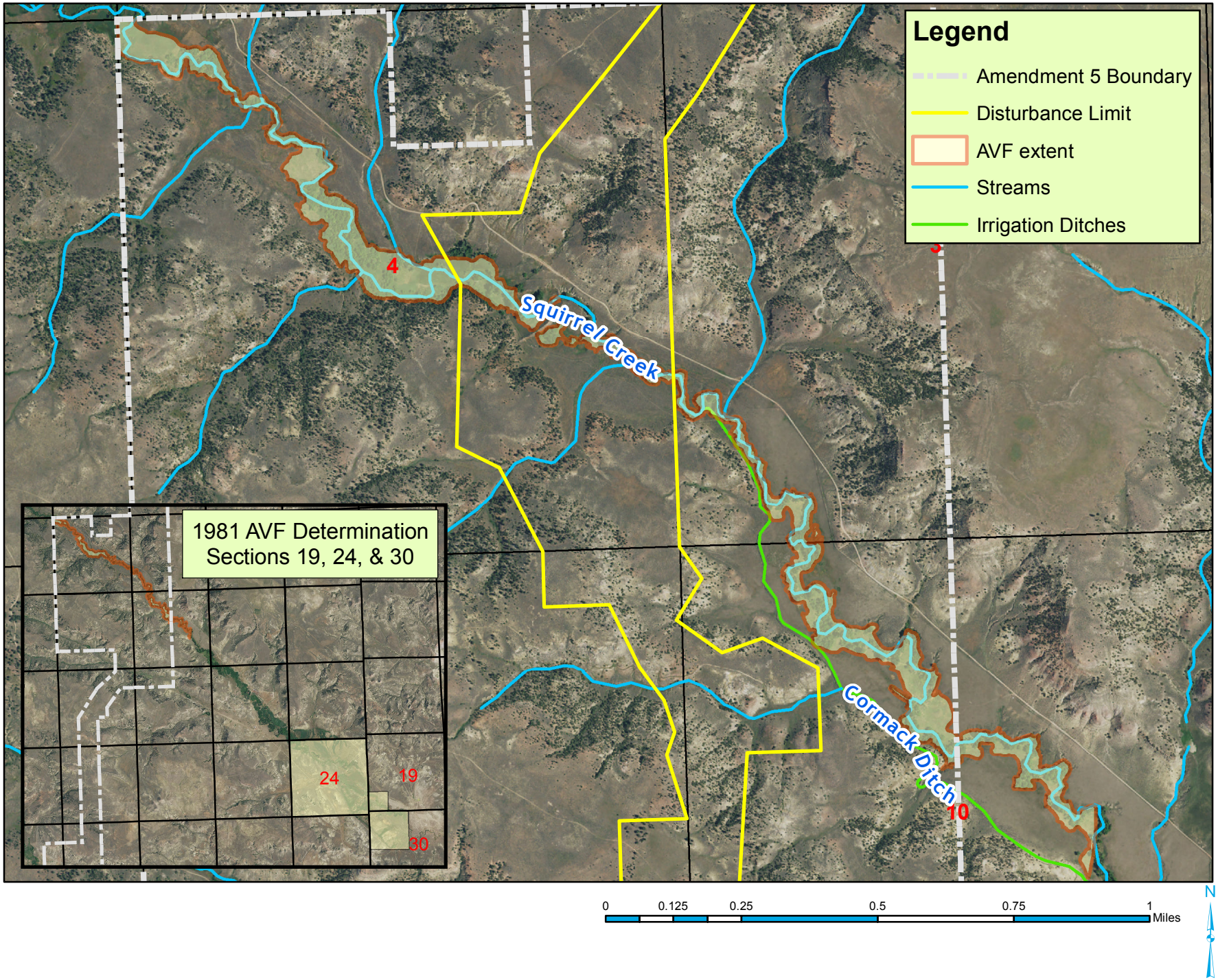
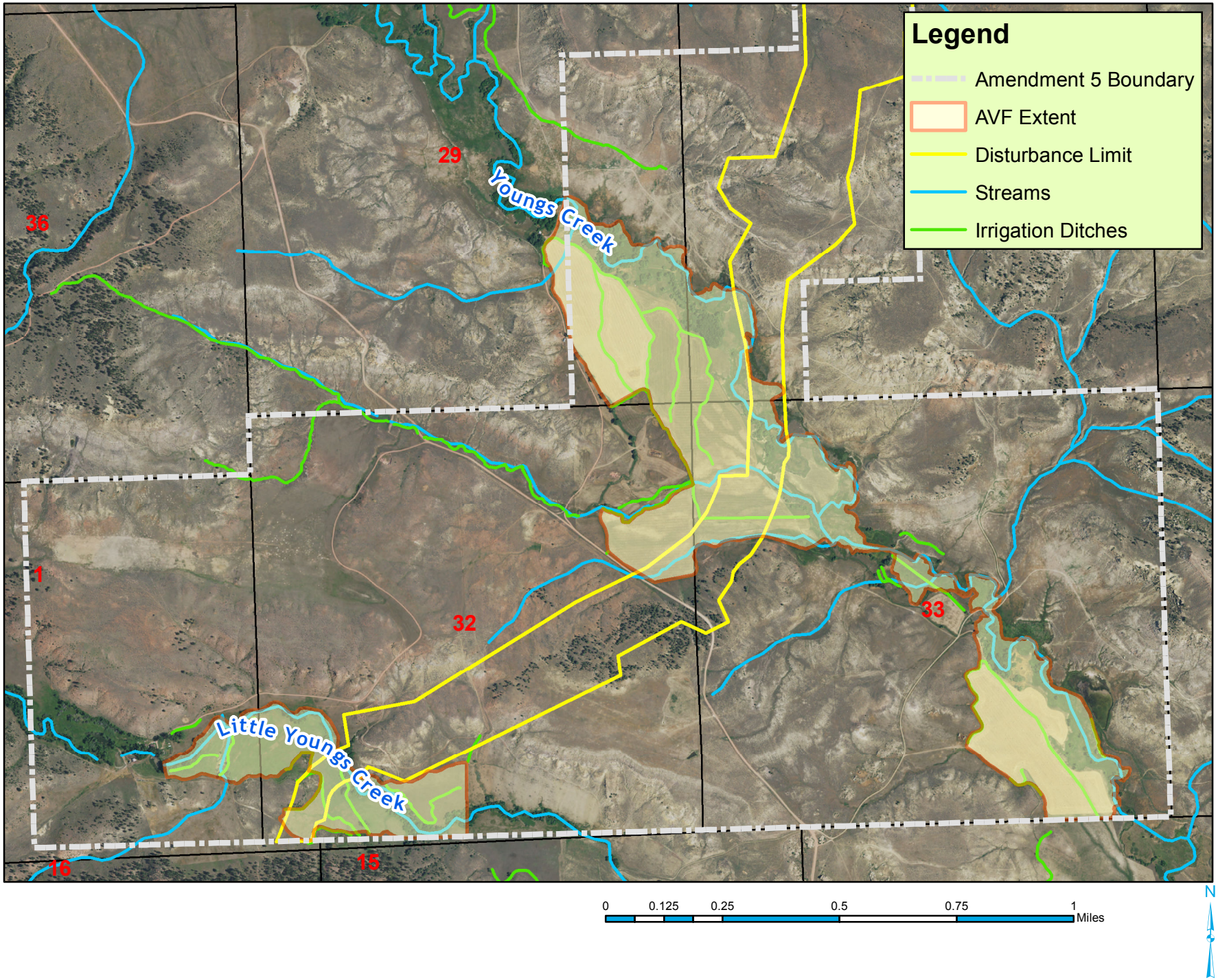
Map 2 Squirrel Creek AVF Exent



Map 3 Youngs and Little Youngs Creeks AVF Extent