PUBLIC SERVICE COMMISSION
Reclamation Division
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Memorandum

TO: Permit NACC-1302 Correspondence File

FROM: Bruce Beechie, Hydrologist – Reclamation Division BB
Randy Kowalski, Environmental Scientist – Reclamation Division RK

DATE: October 15, 2014

SUBJECT: **Cumulative Hydrologic Impact Assessment (CHIA) of Coyote Creek Mining Company - Permit NACC-1302, Mercer County, North Dakota**

SUMMARY

The Reclamation Division of the Public Service Commission has made an assessment of the probable cumulative hydrologic impacts of all anticipated mining in the area as required by NDCC 38-14.1-21-(3)(c) and the Commission finds that mining and reclamation operations proposed with Coyote Creek Mine Permit NACC-1302 have been designed to minimize disturbance to the hydrologic balance within the permit area and prevent material damage to the hydrologic balance outside the permit area.

As specified in NDCC 38-14.1-14(1)(o), this assessment was based in part, on review of the determination by the permit applicant of the probable hydrologic consequences (PHC) of the mining and reclamation operations, both on and off the mine site, with respect to the hydrologic regime, quantity and quality of water in surface and ground water systems and particularly upon water availability. This assessment incorporates the permit applicant's hydrologic reclamation plan (HRP) as required by NDAC 69-05.2-09-12(2), that specifically addresses any potential adverse impacts identified in the probable hydrologic consequences determination and contains the preventative and remedial measures for those impacts.

Coyote Creek Mine Permit NACC-1302 is located on 8091.51 acres within portions of Sections 6 and 7, T142N, R88W; Sections 1, 2, 3, 11, and 12, T142N, R89W; Sections 19, 30, and 31, T143N, R88W; Sections 23, 24, 25, 26, 27, 34, 35, and 36, T143N, R89W, of Mercer County. The permit area includes an 84.24 acre tract on the east side of Coyote Creek in Sections 30 and 31, T143N, R88W that was initially permitted as Permit NACC-1301 as a site to erect the dragline and contains the shop/office facilities that will be used in support of mining operations.

The Beulah Mine is operated by Dakota Westmoreland Corporation and is located on land just to the east of this permit. However, coal removal operations conducted at the Beulah Mine and Coyote Creek Mine are physically separated by Coyote Creek. The Coyote Creek Mine will replace most of the lignite coal production from the Beulah Mine beginning in 2016. Permit NACC-1302 is located adjacent to the southwest corner of Dakota Westmoreland's active mining Permit KRSB-8603 at the Beulah Mine. The Reclamation Division approved Revision No. 27 to Permit KRSB-8603 in 2014 that added approximately 900 acres contiguous with, and to the south of the Beulah Mine's active permit area. The planned mining and reclamation disturbance associated with the Beulah Mine along the west side of Permit KRSB-8603 is located within a subwatershed that enters the Coyote Creek Mine permit area and Coyote Creek proper in the SW1/4 of Section 19, T143N, R88W. Any potential impacts to this drainage are described in Permit KRSB-8603 and the accompanying CHIA for the permit area. No significant cumulative hydrologic impacts as a result of combined Beulah Mine and Coyote Creek Mine operations are foreseen.

As shown in **Figure 1**, the area of possible impact evaluated, defined as the Cumulative Impact Area and covered by this assessment includes that portion of Mercer County, North Dakota within the drainage basin of the Knife River from Coyote Creek downstream to the confluence with Antelope Creek east of Hazen. This area includes all existing and foreseeable operations at the Coyote Creek Mine and adjacent Beulah Mine, and all groundwater and surface water systems which may be logically impacted by those operations. Possible impacts are more reasonably limited to the Coyote Creek and Knife River drainages which include the permit and adjacent areas. Much of the assessment necessarily focuses on potential impacts within the permit and adjacent areas.

DISCUSSION

Material Damage by mining is here defined for the purpose of cumulative impact assessment as permanent and unmitigated degradation of the hydrologic environment outside permit areas, in excess of regulatory standards, which significantly affects beneficial economic uses of water resources, including maintenance of environmental and wildlife values.

The hydrologic standards used to assess the probable cumulative impacts of mining in this area and North Dakota coal producing areas in general are derived from four sources: 1) the baseline state as documented in all permit applications and in the county ground water study (the Mercer County Ground Water Study, N.D. Geol. Surv. Bull. 56, Parts I-III consisting of Geology, Ground Water Basic Data, and Ground Water Resources), 2) the probable hydrologic consequences and hydrologic reclamation plan in all relevant permits, 3) NDAC 69-05.2-16 Performance Standards - Hydrologic balance, and 4) NDAC 33-16-02.1 Standards of Quality for Waters of the State. These sources also provide the performance standards and environmental parameters which will be used to evaluate final bond release applications for individual tracts of permitted land.

The State Department of Health - Standards of Quality for Waters of the State establishes parameter-specific standards for water quality in surface and ground water, and NDAC 69-05.2-

16-04(1)(g) makes them part of the hydrologic protection performance standards for mining operations. These standards are consistent with the federal Safe Drinking Water Act of 1974 and the established North Dakota anti-degradation policy, and they accommodate situations where preexisting water quality exceeds established standards. The rules generally require that discharges into the waters of the state not cause concentrations of substances in the receiving water body to exceed the established or preexisting limits. Ground water classifications and standards are defined as well as aquifer exemption requirements under North Dakota's underground injection control program that was established under the Environmental Protection Agency's Safe Drinking Water Act and is now regulated in North Dakota by the State Health Department.

GENERAL HYDROGEOLOGY

The permit area is located within the Missouri Plateau Section of the Great Plains Physiographic Province which is characterized by glaciated terrain of moderate relief, stream dissected bedrock, ephemeral and intermittent streams, and the intermittent to perennial Coyote Creek that drains to the Knife River and ultimately, the Missouri River. Over much of this portion of the Knife River drainage, ground moraine is thin, usually less than 20 feet thick but up to about 45 feet thick in places, glacial features are few and bedrock topography controls landforms away from larger stream channels. Portions of the permit area are located within the valley and upland breaks of Coyote Creek. Coyote Creek enters the southeastern corner of the permit area in the NE1/4 of Section 7, T142N, R88W and flows north a distance of approximately 5 miles along the eastern edge of the permit area. The confluence of Coyote Creek and the perennial Knife River is located in the SE1/4 of Section 14, T143N, R89W, approximately 1.5 miles northwest of where Coyote Creek leaves the permit area. At its widest point within the permit area, the Coyote Creek valley is approximately 0.5 miles wide. Most of the permit area is an elevated upland that prominently rises more than 200 feet above the Coyote Creek floodplain elevation and in some areas rises to more than 260 feet above the flood plain.

The geologic formations of significance to the study area are the Quaternary, Coleharbor Group of Pleistocene age sediments which represent glacially constructed and modified landforms and the stratigraphically lower Sentinel Butte Formation, which constitutes the bedrock stratigraphic unit of the permit area. The overburden lithology of the Coleharbor Group includes unconsolidated glacial till/drift (pebble-loam) with occasional glacial erratics, gravel, sand and clay. Glacial outwash channels filled with variable depths of Pleistocene age till and Holocene age alluvium characterize the drainage channels of Coyote Creek and the Knife River. Alluvium in the Coyote Creek channel generally ranges between 20-25 feet thick in places and alluvium of the Knife River channel varies between 60 or 70 feet nearest the permit area up to about 240 feet east of Beulah. The developed flood plain and terrace system along Coyote Creek within the permit area will not be mined-through, although two crossings will be constructed over Coyote Creek by the operator to provide access to the mine on the east side of Coyote Creek with the shop/office facilities that are located on the west side of Coyote Creek.

The Sentinel Butte Formation is a terrestrial/non-marine deposit of Paleocene age sediments and consists of interbedded silts, clays, sands, as well as the lignites of the assessment area.

Overburden characteristics of the Fort Union Group sediments as well as the overlying glacial materials are variable throughout the Williston Basin sedimentary sequence and similar to those characteristics encountered within the permit area. However, in reviewing the data, some generalities can be made. Values of pH are fairly uniform ranging between 7 and 9 and pH tends to increase slightly with depth. Values of electrical conductivity vary considerably among samples spatially and with depth. Higher ratios of sodium adsorption ratio (SAR) were encountered frequently, although low SAR values were common in all depths to coal in several samples. As expected, overburden texture varied from relatively coarse loamy sands to fine textured clays. Generally, overburden properties varied with depth and are similar to overburden characteristics at other North Dakota coal mines. Underlying the bedrock Sentinel Butte Formation throughout the permit area is the Paleocene Bullion Creek Formation. There are three general hydrostratigraphic units of significance in the general mine plan area; Quaternary alluvium along Coyote Creek that is composed of silts, sands and gravels; the Upper Beulah lignite seam that will be mined by the Coyote Creek Mining Company; and a lower lignite seam which is termed the Lower Beulah 3 lignite. As described later, other thin lignite seams above the Upper Beulah serve as localized minor hydrostratigraphic units that serve as discharge zones as seeps and springs along major drainages within the permit.

The uppermost geohydrologic unit in the area is the Pleistocene, Coleharbor Group of Wisconsinan age consisting mostly of silty-clay glacial till, but with occasional lenses of sand and silty-sand that may locally contain nominal quantities of ground water as perched aquifers and is not significant to the hydrologic regime within the permit area. Pebble-sized to boulder-sized igneous and metamorphic rocks, typically granites and gneisses are frequently encountered in the glacial till overburden and the presence of Pleistocene age glacial erratics are common on the soil surface of rangeland throughout the permit area. Infrequent, hard cemented sedimentary sandstone ledges and/or concretions averaging about 2 feet thick have been identified in the Sentinel Butte strata below the Coleharbor Group sediments through Coyote Creek's drilling program within portions of the permit area. Cemented sandstone and sandstone/mudstone concretions up to 20 feet thick are typical in Sentinel Butte sediments; however, deposits of those thicknesses have not been encountered within the permit. The use of explosives is not planned at Coyote Creek Mine and heavy equipment will likely be used to break up any cemented sandstone deposits or concretions encountered during mining operations.

Coyote Creek Mining Company has identified a total of 27 separate and distinct, named coal seams within the permit area. Many of these attain thicknesses of only 1-2 feet and are insignificant in terms of water resources and insignificant in terms of coal production regarding the proposed mining operation. Thirteen of these coal seams have had their elevations correlated and the cropline locations (outcrops and subcrops) of these prominent seams are mapped and those locations are provided in the permit. Major coal seams identified within the permit area include in descending order; Harnisch, Twin Buttes, Schoolhouse, Upper and Lower Beulah, Jim Creek, Antelope Creek, and other significant rider and kicker seams associated with those named coal beds. The Upper Beulah Lignite is the only coal seam planned for extraction within the permit area although Coyote Creek Mine has not ruled out potentially removing localized thicker lignites higher in the stratigraphic column (Twin Buttes or Schoolhouse) when encountered and deemed economically feasible to mine. The Upper Beulah generally ranges between 9 to 12 feet

in thickness and averages about 11 feet thick within the permit area. The NACC-1302 permit area encompasses approximately 8,100 acres and the estimated coal production rate is expected to average 2.3 million tons/year, and the life of mine coal production from the permit area is estimated at 58.7 million tons through 2040. Overburden thickness to the top of the Upper Beulah averages about 100 feet in most areas of the permit except near outcrop areas, and increases to about 160 feet thick in some areas within the central and southern portions of the permit area. Strike and dip of the Upper Beulah is variable with a general dip from northwest to southeast in northern portions of the permit area and away from central portions of the permit area toward the croplines. The Upper Beulah reserve outcrops within the permit area along the northern and eastern portions of the permit and both outcrops and subcrops in southern portions of the permit area. Small scale structural features are observable on the Upper Beulah Structural Contour Map as provided in the permit and may produce localized grade reversal to the dip and strike. The Upper Beulah is classified as Lignite-A, with an average in-place heat value rating of 6,950 BTU/lb., an average of 36% moisture content, 7.5% sodium, 1% sulfur, and 7.6% ash content. Quality of the weathered coal along croplines (Leonardite) is considered poor and will not be mined.

Coal seams above the Upper Beulah include the Harnisch, Twin Buttes, and Schoolhouse. Harnisch and Twin Buttes lignites are present as localized deposits in higher elevation areas of the permit and range in thickness from 1 foot to about 6 feet thick. The Schoolhouse lignite is prominent throughout much of the permit area and ranges in thickness from 1 foot to about 3.5 feet. In places, all of these higher elevation coal seams may serve as local ground water sources with discharge zones as seeps and springs along croplines and where mined, those seeps and springs will be destroyed.

Several named coal seams and splits of those coal seams are located below the Upper Beulah. The Lower Beulah 3 seam averages about 20-25 feet below the Upper Beulah and is generally about 1-2 feet thick. The Lower Beulah 3 is a confined aquifer and in most areas of the permit is deemed the next viable water-bearing unit below depth of mining, and numerous ground water monitoring wells have been screened into this zone. Major lignite beds below the Lower Beulah 3 in descending order are major splits of the Lower Beulah 3 followed by the Jim Creek, Antelope Creek, Kinneman Creek, Hagel, and Tavis Creek beds. Correlation and seam naming convention for the Coyote Creek Mine general follows the seam correlation and names of Groenewold, et al. (1979) *"Geology and Geohydrology of the Knife River Basin and Adjacent Areas of West-Central North Dakota"*; however, one notable exception is that the Lower Beulah 3 bed and its splits are correlative with the Spaer bed in *Groenewold, et al. (1979).* The nearby Beulah Mine uses the Spaer bed nomenclature for this coal seam as provided by Groenewold, et al and the Coyote Creek Mine refers to this seam as the Lower Beulah 3.

The assessment area is an established lignite mining district that includes abandoned surface and underground mines as well as active, large scale surface mines including the nearby Beulah Mine operated by Dakota Westmoreland Corporation. The western portion of the Beulah Mine drains to a tributary that empties into Coyote Creek at the northeast end of Permit NACC-1302 on the east side of Coyote Creek in the SE1/4 of Section 30, T143N, R88W. The Beulah Mine represents the only active mining within the assessment area south of Knife River at this time.

The Freedom Mine operated by the North American Coal Corporation, is the only active surface mining operation located north of the Knife River and is located about 8 miles north of the permit area. The PSC Abandoned Mine Lands Division lists 24 inactive lignite mines in the assessment area. All but 5 of these were very small mines that operated for local use prior to 1950 and had maximum production of less than 1,000 tons per year. At the larger old sites with underground workings, collapse has caused localized safety problems. The Dakota Collieries Mine was wholly a surface mine started in 1922 and the predecessor to the Indian Head Mine. The Dakota Star, later Truax-Traer, Mine operated entirely as a strip mine from 1940 to 1967, and this old mine is included in or adjacent to the area under permit for the Freedom Mine. Evidence from over 30 years of hydrologic analysis and monitoring by mines and power plants in the assessment area indicates that effects of these old mine sites on surface and ground water systems are localized and not significant factors in the hydrologic regime. The only abandoned coal mine identified within Permit NACC-1302 is a small .5-acre surface cut located at the base of the western breaks to Coyote Creek within the SE1/4SW1/4 of Section 30, T143N, R88W and the presence of this feature will have no impact to surface or ground water systems within the permit area or the assessment area.

Agriculture is a significant activity in the assessment area in terms of economic importance and hydrologic impact, but it is a historically established cultural activity and its environmental effects are considered part of the baseline state of the area. The majority of agricultural activity within the NACC-1302 permit area is livestock production on native range; however, crop and hay production make up a minor, yet important component to the total land utilization. The Major Land Resource Area 54 in which Mercer and Oliver Counties are grouped within the 2002 USDA-NRCS inventory system has water erosion of soil from cropland averaging 3.6 tons/acre/year while statewide losses average 2.1 tons/acre/year; however, losses to wind erosion are less than the statewide average. In 1977-1980, the U.S. Geological Survey gaging stations on Spring Creek at Zap and Knife River at Hazen reported mean Total Suspended Solids values of 90.87 and 144.05 mg/l and average sediment discharge loads of .26 and .19 tons/acre/year, reflecting the acreage under cultivation in the contributing drainages. Extensive soil conservation and water quality preservation practices are permit requirements, and all surface water leaving the Coyote Creek Mine and other mining permits in the assessment area must meet NDPDES daily average and maximum total suspended solids values of 35 mg/l and 70 mg/1, respectively.

GROUNDWATER ASSESSMENT

The ground water database for Permit NACC-1302 has been acquired from a total of 83 ground water monitoring wells as depicted in **Figure 2** and these have been monitored for water levels and sampled for water quality since August, 2012. Details of acquiring water level and water quality data in the premine, mining, and postmine setting are outlined in Coyote Creek Mining Company's ground water monitoring plan and are provided in the permit. Previous scientific investigations, ranging from the study of fundamental ground water questions to landowner complaints about specific water wells, surface water bodies, and springs and seeps has served to verify the geologic and hydrologic data which have been acquired by mine operators in North Dakota since the mid-1970's, including the North American Coal Corporation. These data have

been compared and used in analysis along with data which have been acquired by diverse, independent sources such as the U.S. Geological Survey, North Dakota Geological Survey, State Water Commission, State Health Department, private well drilling contractors, and consultants performing spring and water well certifications. Close scrutiny of the data and information has found no inconsistencies attributable to careless or improper data acquisition. In addition to technical use, data are periodically audited by the Reclamation Division and Office of Surface Mining, Casper Field Office, for completeness of acquisition and monitoring sites are frequently checked during mine inspections. The Coyote Creek Mine and adjacent area is considered in hydrologic terms to be data rich, attributable to the fact that substantially more ground water monitoring points have been installed than required by regulation.

Mining operations within the general mine plan area will remove the Harnisch, Twin Buttes, and Schoolhouse seams/lignite beds where present, the Upper Beulah seam and all coal stringers and minor water-bearing sand units in the overburden that may contain nominal quantities of ground water as a perched aquifer or saturated zone. In mined-through areas, these lignite seams and all overburden will be replaced with a single pit-bottom spoils saturated zone. Historic data shows that water quality in this saturated zone will show some degree of increased mineralization with total dissolved solids (TDS) concentrations generally 1.5 to 2 times higher than those of waters in the lignites that were mined. The increase will depend on the degree of vertical infiltration and lateral recharge into the spoils. Saturated zones at the base of spoils are not considered groundwater resources because of their uncertain productivity, reduced transmissivity in the short term, and expected lower water quality due to increased soluble salt content, characterized as electrical conductivity or TDS. Geochemical reactions of oxygen with fresh, regraded spoil matrix results in spoil water ionic composition comparable to undisturbed units, but at higher initial concentrations. Over time, water quality in the base of spoils saturated zone will show improvement; however, this process may take years or decades, particularly in areas of low hydraulic heads and transmissivity and is considered an expected consequence of coal removal and reclamation processes in western North Dakota.

Recharge of ground water resources in western North Dakota is infrequent and only occurs during spring runoff or intense precipitation events since potential evaporation exceeds precipitation over most of the year. Plant uptake is a significant consumer of precipitation during the growing season which limits the amount of water that infiltrates to greater depths. However, low-gradient ephemeral and intermittent drainages and wetlands tend to be effective groundwater recharge areas because of snowmelt concentration and retention, while well-drained uplands are less effective recharge sites. Tracts of reclaimed spoil will likely have increased porosity and infiltration capacity compared with the soils and parent materials they replace due to the destruction of orderly, fine-grained and semi-lithified sediment encountered in the stratigraphic column, normally considered to be aquitards. The Center Mine, which is operated by BNI Coal, Ltd., and is located less than 30 miles east of Coyote Creek Mine, was one of several research sites in the 1980's that confirmed these observations on mined areas. Ground water level rebound and maintenance of saturated zones at the base of reclaimed spoils and within water levels in units below mining is further evidence of adequate recharge occurring in the post-mining landscape. Groundwater recharge after mining should approximate the pre-mining recharge rate since land use, runoff, retention and infiltration on the post-mining topography will

approximate that of the pre-mine topography. The planned construction and reconstruction of post-mining stock ponds, wetlands, drainage channels, linear catchments and other developed water resources will enhance ground water recharge to the base of spoils. Plans and design details regarding wetlands and other developed water resources, along with all surface water management reclamation plans, are incorporated into the permit. Plans are in the permit for placement and construction of base of spoils post-mining ground water monitoring wells to properly monitor recharge in the mined spoils block as well as in the Lower Beulah 3 hydrostratigraphic unit, and several other deeper units.

The Upper Beulah coal seam and all of the lignite hydrostratigraphic units within the permit area, under natural conditions, typically contains sodium-sulfate to sodium-bicarbonate type waters with total dissolved solids ranging from about 700 mg/l to over 3200 mg/l. Values of pH are predominantly alkaline, but generally range from 6.5 to 8.5 and sodium adsorption ratios (SAR) tends to be high. Sodium adsorption ratios of the Lower Beulah 3 Lignite, Upper Beulah Lignite, and higher lignite hydrostratigraphic units have a median SAR value of about 40. Below the Lower Beulah 3, the Lower Jim Creek, Antelope Creek, Kinneman Creek and Hagel lignites have SAR values ranging from low to high. Data collected from monitoring wells installed in alluvium adjacent to Coyote Creek typically contain sodium-sulfate type waters with TDS ranging from 1880 mg/l to 2870 mg/l and a median value of 2025 mg/l.

The shallow ground water flow systems in the permit area which includes the Upper Beulah seam and Lower Beulah 3 seam can best be described as sluggish. Groundwater movement in the Coyote Creek Mine area is generally downward through fine grained silts and clays which recharge the lignites and deeper sands. Ground water movement and hydraulic gradient within the lignites in the permit area is variable, but generally laterally toward discharge zones. Hydraulic head data indicate recharge to the Upper Beulah hydrostratigraphic unit is from interior portions of the permit, but data also indicate significant contributions from off-permit upland areas to the southwest in Sections 11 and 12, T142N, R88W. Ground water of the Upper Beulah is under confined conditions in southern portions of the permit area nearest the recharge areas with hydraulic heads exceeding 25 feet in places, and transitions to unconfined or water table conditions along the west and east sides of the permit toward discharge zones associated with major drainages in the area. Continuing to the north, head values further decline to nearly dry or dry conditions within the Upper Beulah.

Potentiometric contours of the Lower Beulah 3 lignite show similar hydraulic gradients to the Upper Beulah lignite. The Lower Beulah 3 lignite is considered the next viable hydrostratigraphic unit below depth of mining and recharge areas are concentrated in central and southern portions of the permit area and discharges are toward major drainages to the north, west, and east. Movement of ground water within the topographically higher Schoolhouse bed is generally from east to west across the permit area. Hydraulic gradient of ground water within the stratigraphically lower Jim Creek and Antelope Creek lignites is similar to head gradients of ground water in the Upper Beulah with prominent recharge areas being located in upland areas to the south of the permit area. The Harnisch lignite, where it occurs within the permit, is generally dry and not considered a hydrostratigraphic unit in the area. Several monitoring wells are screened within the Twin Buttes lignite and monitoring data indicate ground water to be under

confined conditions in those areas monitored. Other hydrostratigraphic units monitored include the Upper and Lower Kinneman Creek lignites and the Hagel Lignite. Both of these hydrostratigraphic units are located substantially deeper than the Upper Beulah and all other monitored units; however, several wells are monitoring these units at locations near the Knife River and Coyote Creek as these lignites occur below the elevation of those alluvial aquifers.

Significant alluvial hydrostratigraphic units within the permit and adjacent area include the alluvial aquifers of the Knife River and Coyote Creek. Ground water monitoring wells near the Knife River indicate about 70 feet of alluvium with about 40 feet of hydraulic head. Nested wells screened in differing elevations of the alluvial column indicate unconfined or water table conditions of the alluvial aquifers. Potentiometric gradient of the Knife River alluvial aquifer which is located a significant distance from the permit, has not been measured and is logically assumed to flow downstream. Alluvial ground water along the valley of Coyote Creek is also under unconfined conditions with hydraulic heads in the range of only 6 to 8 feet. Multiple monitoring wells along the course of Coyote Creek confirm that potentiometric gradient of the alluvial aquifer follows the stream gradient to the north, as could be expected. Baseline static water level data collected in 2012 and 2013 from Coyote Creek alluvial ground water monitoring wells CM12-08B, CM12-20B & 20C compared with Coyote Creek surface water elevation indicates Coyote Creek to be a losing stream. Static water levels in Coyote Creek alluvium average 8-9 feet below the surface water elevation of Coyote Creek, meaning that surface water flow recharges, or supplies the alluvial aquifer with water. Throughout the reach of Coyote Creek within the permit, the Antelope Creek lignite is a buried subcrop and through much of the course rides directly below or nearly so, of the Coyote Creek alluvial aquifer. Elevation of the Upper Beulah lignite to be removed by mining is above the Coyote Creek flood plain and contributes minimal quantities of water in support of base flow.

Slug test analyses of permit and adjacent ground water monitoring wells were attempted on 77 of the 83 monitoring wells in determination of aquifer hydraulic properties. Of those 77 wells tested, only 52 had sufficient water levels in which to conduct the single well response tests. Hydraulic conductivities of the Coyote Creek and Knife River alluvial aquifers ranged from .4 feet/day to 1.2 feet per day and transmissivity ranged from 4.6 square feet/day to 20.5 square feet/day, with the highest transmissivity value coming from the Knife River alluvial aquifer due to increased saturated thickness of Knife River alluvial deposits. Hydraulic conductivities and transmissivity of Twin Buttes and Schoolhouse lignites were highly variable. Hydraulic conductivity values ranged from .001 to 11.93 feet/day and transmissivity ranged from .001 to 47.7 square feet/day.

Hydraulic conductivity of the Upper Beulah was highly variable ranging several orders of magnitude from .001 to 4.37 feet/day with a median value of .027 feet/day. Transmissivity of the Upper Beulah ranged from .007 to 48 square feet /day with a median value of .293. The next lowest hydrostratigraphic unit below the Upper Beulah is the Lower Beulah 3 lignite and both hydraulic conductivity and transmissivity values were much less variable than all other higher stratigraphic units. Hydraulic conductivity ranged from .0004 to .874 with a median value of .005 feet/day. Transmissivity ranged from .001 to 1.75 with a median value of .010 square feet/day. Well response/aquifer testing was also conducted on wells monitoring the Lower Jim

Creek Lignite, Antelope Creek Lignite, Upper and Lower Kinneman Creek Lignites and the Hagel Lignite. Hydraulic testing results for those and all of the units are available in the permit.

Hydraulic conductivity values of the target Upper Beulah coal seam and hydraulic conductivity values of most lignite coal seams in North Dakota are highly variable due to secondary permeability caused by fracture flow. Variable fractures, joints and cleating distribution in North Dakota lignite is generally attributed to coalification processes at the time of deposition, sediment loading and unloading after deposition; and in some cases depending on the specific location-glacial loading and unloading. Shallower coal seams generally trend toward having increased fracture flow development and hydraulic conductivity lending to increased well production or yield, while deeper coal seams generally trend toward reduced fracture development and more sluggish hydraulic conductivity values resulting in reduced yields or production to a well.

Loss of ground water contributions in the form of base flow to Coyote Creek to the east and other ephemeral drainages to Knife River west of the permit is expected to be minimal during the mining process. Ground water produced from active pits will make a small addition to the volume of surface water flows to Coyote Creek and Knife River. The base of the Upper Beulah seam is above Coyote Creek alluvial aquifer grade in all areas with the exception of the extreme southeast portion of the permit area in the E1/2 of Section 6, T142N, R88W, most of which will not be disturbed by mining. Coyote Creek Mine has calculated that the springs along Coyote Creek contribute a total of 0.045 cfs to the flow of Coyote Creek. Adequate ground water monitoring systems in place at all mine permits in North Dakota since the mid-1970's has typically documented an average aquifer drawdown radius of influence from the cone of depression to be about 1000 feet. In those instances where private, in-use water wells are predominantly located down-gradient of coal removal operations and are screened in the target coal seam or a stratigraphically higher water-producing zone, effects of aquifer drawdown may be experienced up to about 1000 feet away and are addressed with replacement options as described in the permit.

Due to inadequate quantity and quality of shallow ground water resources within the permit area and the lack of reliable wetlands and properly-sized stockponds in other areas, an elaborate system composed of wells and pipelines used to deliver water to several stock tanks across the permit and adjacent area has been installed by major landowners Unruh and Voigt to support their livestock operations.

The S. Unruh system is supplied by a nest of three alluvial wells (#1, #2, #3) located ½ mile to the west of the permit in the SW1/4 of Section 22, T143N, R89W. A pipeline system from those wells supplies 12 stock tanks located in portions of 6 sections within the permit area, all located west of County Road 13. Those wells have been certified by Coyote Creek Mining Company and the alluvial aquifer which supplies the wells will not be affected by mining. Depth of the Unruh alluvial wells #1, #2, and #3 are 55, 53, and 44 feet, respectively.

The C. Voigt system is separated into North and South distribution systems. These systems are supplied by water from two separate wells in the deep Cretaceous, Fox Hills aquifer. The North

system is supplied by water from the C. Voigt Well #1 that is located in the NW1/4 of Section 25, T143N, R89W, within the permit area and will be mined through. Plans in the permit indicate the well will either be salvaged or replaced. Pipelines from the North system deliver water to 7 stock tanks all located within the permit. The South system is supplied by water from the C. Voigt Well #7 that is located in the SE1/4 of Section 31, T143N, R89W, just south of the Voigt farmstead. This well and pipeline system also supplies seven stock tanks and combined, the North and South systems supply water to portions of 6 sections within the permit area, all located east of County Road 13. This well has also been certified by Coyote Creek Mining Company and the well will not be disturbed. Depth to these Fox Hills wells and the other two Fox Hills wells on Voigt property average about 1300 feet below surface. Coyote Creek Mine is committed to partial and/or ongoing replacement of water resources as mining progresses to allow the landowners and individual producers to maintain full usage of available pasture in support of grazing plans for their livestock operations.

Two center pivot sprinkler irrigation systems owned by the same producer are located ½ mile to the north of the permit boundary in portions of Sections 7 and 18, T143N, R88W, and within portions of Sections 12 and 13, T143N, R89W. It has been observed over the years that the irrigated cropland has generally been planted to row crops, usually corn. The north irrigation system is sized to provide water to an 80-acre circle tract and is located within the floodplain of the Knife River. The south irrigation system is sized to provide water to a 100-acre circle tract and is located along a gentle gradient that is sloping up to the south and away from the Knife River floodplain. One well provides the water supply for both systems and the well is screened in shallow alluvium adjacent to the Knife River and is located within the NW1/4SW1/4 of Section 7, T143N, R88W, approximately 250 feet west of the Knife River. Mining and reclamation operations proposed at Coyote Creek Mine will not affect the producers' cropland, irrigation operation or the quantity or quality of the shallow Knife River alluvial ground water that supplies the irrigation system.

Coyote Creek Mining Company has an established groundwater monitoring plan for Permit NACC-1302, and its parent company the North American Coal Corporation, has a policy of certifying and periodically re-certifying private wells and springs in its North Dakota mining operations that, together, should detect any changes in groundwater quality or quantity which may occur as the result of mining. A total of 13 private production water wells and 8 springs have been certified within the permit area or within a distance of about 1/2 mile of the permit boundary. Of the 13 wells certified, one is expected to be replaced, two have been previously abandoned, and the remaining nine wells are not expected to be affected. Wells within the permit and adjacent area typically yield 1 to 10 GPM and the only exception to that is one of the S. Unruh alluvial wells having a measured production rate of 18.8 GPM. Wells in the Fox Hills aquifer may produce flows up to 50 GPM, but most well owners throughout the assessment maintain flows of 10-25 GPM or less, much of that depending on the pump size and rating.

A total of 8 springs have been certified within the permit area. Of those 8 certified springs, seven will either be mined through or experience noticeable drawdown and the water supply will be replaced or reestablished after mining. The other remaining certified spring is not expected to be affected. Water quality of the certified springs ranged from fair to poor. Total dissolved

solids concentrations of the certified springs ranged from 800 mg/l to over 6000 mg/l, with a median value of 1430 mg/l. Most agricultural publications provide warning statements to producers of livestock usage of water with TDS concentrations of 2000 mg/l or more, and some publications provide the same cattle consumption warning statements for TDS concentrations of 1000 mg/l or more. Mine-wide, well over a hundred spring/seep areas have been identified. Of those, well over 50% emanate as discharge from the Harnisch, Twin Buttes, and Schoolhouse lignites positioned above the Upper Beulah lignite. Only 15 of the springs identified within the permit were documented with a flow rate greater than 1 GPM, and are best described as seeps. Those springs and seeps whose source is from a hydrostratigraphic unit above the base of the Upper Beulah will be destroyed and will likely not be restored, with the exception of those located along unmined croplines. As could be expected, locations of the spring/seep zones are along unit source outcrop areas of major drainages to Coyote Creek, Mud Creek, and Knife River. The remaining spring/seep source units include the Upper Beulah, Lower Beulah, Antelope Creek, and Lower Jim Creek lignites. Measured spring flow rates at the point source from all identified spring and seeps in both the Knife River and Coyote Creek Watershed drainages, including about a dozen located on the east side of Coyote Creek that will not be disturbed, conservatively range from less than about 50 GPM to a high of 178 GPM, equal to a flow rate that ranges from 0.11 to about 0.4 cfs. However, much of the described spring/seep flow does not reach either Knife River or Coyote Creek and is retained in stock ponds and wetlands, lost to soil retention, provides some contribution to ground water recharge and most is lost to evapotranspiration. Location information, water quality sampling, seasonality, flow rate and possible source unit information data from the springs and seeps were collected, compiled, analyzed, and that information is incorporated into the permit.

The probable hydrologic consequences sections of the Coyote Creek Mine Permit, as well as the nearby Beulah Mine, discuss the specific locations and owners/operators of the wells and developed springs that may be affected by mining. Should any in-use water supply be contaminated, diminished or destroyed, Coyote Creek Mining Company has committed in the permit to replacement of water supplies as required by North Dakota's reclamation law and rules. Replacement wells are of better construction and generally significantly more productive than the pre-mining wells they replace. Commonly, a single replacement well can produce more water than several older pre-mine wells on the same tract. Mining and reclamation is not expected to negatively affect availability of post-mining groundwater resources at Coyote Creek Mine.

In general, the Lower Beulah 3 lignite, which is situated below and hydraulically separated from the Upper Beulah lignite, is a minor source of shallow ground water that should not be affected by mining and is not used by producers in the permit area. The ability of the Lower Beulah 3 to supply water quantities suitable for modern uses is variable over the area and unlikely, in particular because of the low transmissivity of the Lower Beulah 3 and the availability of more transmissive, productive aquifers in the area. The alluvial aquifers associated with Coyote Creek and the nearby Knife River, in addition to nearby well-documented deeper sand units in the Lower Hell Creek/Upper Fox Hills Formations are proven replacement sources for destroyed wells near them. A water supply well, or well system that will produce water from the deep Fox Hills Formation regional aquifer is planned for installation in the permit area to supply a low

volume of water to the Coyote Creek Mine shop/office complex to provide non-potable and equipment washing water needs of the facility. Depth to the Fox Hills aquifer ranges from about 1270-1300 feet below surface in the permit area and water facility requirements are expected to be on the order of approximately 3 million gallons per year. The well system will be designed to yield approximately 30 GPM and this nominal production rate, drawdown, and estimated water usage from the Fox Hills aquifer should not adversely affect other producing wells in the area.

A piped rural water system that has been available to rural Mercer County and surrounding areas for many years is a viable water replacement alternative for homeowners and producers. On-site surface and ground water resources, rather than the rural water system, will likely remain the appropriate post-mining water replacement supply for most livestock and similar agricultural uses in established water system areas because of their more favorable cost and accessibility. However, necessary water supply replacement by mining companies in North Dakota has typically entailed diligent response by the mining company and consultation in close relationship with the affected user. Water supply replacement options are discussed between mine operators and affected users, and replacement generally proceeds after concurrence with both parties regarding the water supply source, required quantity, quality, and delivery method.

North American Coal Corporation has responded quickly and positively to landowner concerns about water supply problems and has cooperated fully with PSC investigations of water supply complaints in the past. Complaints and inquiries relative to the effects of mining on wells increased throughout North Dakota's coal mining areas in the late 1980's and early 1990's during a drought period but declined with wetter conditions of the mid 1990's. Complaints are typically few in number and usually concern water quantity. Most complaints, after investigation, have been found to be unrelated to mining, but operators have responded quickly with appropriate remedies in instances where diminution of in-use supplies or any water-related issues by mining was evident. In the assessment area, there has been no evidence to date of improperly designed or executed mining operations, reclamation activities or hydrologic monitoring causing permanent damage to the hydrologic regime not addressed in probable hydrologic consequences assessments and hydrologic reclamation plans of approved permits.

The relative scarcity of water in western North Dakota, the reclamation rules taken collectively, and the very limited degradation of water quality by surface coal mining in the coal-bearing strata of North Dakota impart special emphasis on water quantity, more properly the conservation of flow systems and hydrostatic heads, in adjacent areas of permits. Lowering of potentiometric surfaces near mine pits by ground water flow into pits is generally recognized in mining permits as a probably hydrologic consequence of mining. Where hydrostatic head loss is due only to mine pit inflows, nearly full recovery of shallow aquifers after its closure and reclamation has been documented at several North Dakota mines and can be logically expected in the normal North Dakota surface mine setting. Recovery to approximate pre-mining conditions is a reasonable standard for water quantity in undisturbed strata near reclaimed mine pits and is expected at Coyote Creek Mine.

Coyote Creek Mining Company is fully committed to restoration and replacement of any in-use ground water supply that may be adversely affected by its operations and has committed to the

water supply replacement requirements of the North Dakota reclamation law and rules. The mine plan incorporates modern best management practices to control and minimize water pollution. In addition to the Reclamation Division's permit review, all aspects of the operator's ground water and surface water management plans and systems were allowed to be reviewed by the State Water Commission and State Health Department as members of the Reclamation Division's advisory review committee and no issues or concerns were brought forward regarding water management operations from either of those reviewing agencies. Utilizing the best technology currently available and as required by NDAC 69-05.2-16-01(a), the Coyote Creek Mine has been designed to minimize disturbance of the hydrologic balance within the permit and adjacent areas and prevent material damage outside the permit area.

SURFACE WATER

The Coyote Creek Mine is located on a topographic divide between the Knife River and Coyote Creek. The eastern half of the mine drains to Coyote Creek and the western half drains to the Knife River via ephemeral drainage ways. Coyote Creek flows along the east side of the permit area and eventually drains into the Knife River at a location approximately 1.5 miles northwest of the permit area. The Knife River has its headwaters in west-central North Dakota near Fairfield and drains predominantly agricultural lands throughout its length over a drainage basin of 2,240 square miles, as measured at Hazen, ND. Spring Creek is a substantial tributary that empties into the Knife River just to the west of Beulah North Dakota. Seasonal variations in flow for the Knife River and its tributaries are primarily influenced by snowmelt runoff and summer thunderstorms. Base flows are generally very low and periods of no flow occur on most streams in the area, including the Knife River.

The only perennial or intermittent stream in the permit area is a portion of Coyote Creek. Several ephemeral drainages are cut into the upland breaks and flow to Coyote Creek or to the Knife River within the study area. Baseline information for surface water features was provided in the permit to support the stream flow classifications. Mining will begin on the upland west of Coyote Creek and progress in a westward direction. The upland (coal producing area) is bound on the northwest by the Knife River valley. The office/shop site is located east of Coyote Creek necessitating a stream crossing over Coyote Creek. Another crossing is planned for the coal haulage route. The Commission consulted with the State Health Department and the State Water Commission in regard to these disturbances planned within 100 feet of a perennial stream in accordance with NDAC 69-5.2-16-20. Coyote Creek Mining Company plans to remove the road and crossings once mining is complete and restore the stream crossing areas to the approximate original contour and vegetative ground cover.

There are no large bodies of standing water in the assessment area, and surface water use is largely ponds or stock dams on smaller drainages for livestock watering. There are 17 stock ponds located in the permit area considered to be reliable. Five additional stock ponds were inventoried that do not hold water for extended periods of time due to erosion, siltation or small size. Water for livestock is also provided by a pipe system supplying water to stock tanks from wells within the permit. Coyote Creek Mining Company will be required to replace or supplement any supplies that are diminished by mining on the adjacent permit areas.

A summary of the available data for Coyote Creek has been included in, and reviewed as part of the application for this permit. Coyote Creek has also been monitored by the Beulah Mine as part of their surface water monitoring program. A USGS gaging station (06339550) located on Coyote Creek near the confluence with the Knife River was operated from October 1, 1977 through December 21, 1983. Extensive ambient monitoring records are available for the Knife River at Hazen and Golden Valley, USGS gaging stations 06340500 and 06339500 respectively. Coyote Creek Mine intends to monitor eight surface water sampling sites as part of their surface water monitoring program. The monitoring sites are located on the Knife River and Coyote Creek both upstream and downstream of the mine area and four ephemeral drainages in the mine area. Pre-mining baseline monitoring information for the years 2012 and 2013 is included in the permit application. Data collection at the monitoring sites has continued with data provided to the Commission in quarterly surface water monitoring reports.

The applicant conducted sampling for heavy metals as part of their baseline surface water monitoring program and all of the samples results were below the respective acute water quality standard as provided in NDCC 33-16-02.1. Coyote Creek and nearby tributaries to the Knife River are subject to a Total Maximum Daily Load (TMDL) for fecal coliform bacteria, finalized in September 2010 *(Fecal Coliform Bacteria TMDLs for the Knife River Tributaries in Mercer County, North Dakota; September 2010; North Dakota Department of Health).* The Knife River from its confluence with the Branch Knife River (upstream of the permit area) to the Missouri River is identified as a water body requiring a TMDL to address fecal coliform/Escherichia coli bacteria impairments in the 2012 Section 303(d) TMDL list for North Dakota. Coal mining activity and runoff is not a significant source of bacteria to the TMDL water bodies. The septic system planned for the facility is subject to approval by local authorities and requirements specified in a NDPDES permit for any wastewater discharge.

The permit area will have several sedimentation ponds and associated diversions that will control runoff from the permit area. The designs for the surface water management structures are included in the permit application. The proposed facility plans indicate a waste stabilization pond system will be built to store and treat wastewater from the shop and office facilities. The design for the wastewater treatment system must be approved by the State Health Department and/or local health unit. The operation of the ponds and more specifically the quality of the water released from the ponds is subject to NDPDES permit requirements. The surface water leaving the Coyote Creek Mine and other mining permits in the assessment area must meet NDPDES daily average and maximum total suspended solids values of 35 mg/l and 70 mg/1, respectively. The sediment concentration in water released from the mining operations in the state is typically less than suspended sediment levels found in streams in the area.

The ephemeral drainages within the permit area commonly contain linear wetlands. The wetland drainages are often times enhanced by flow from springs or seeps. The flow from the springs is described as typically being less than 1 gpm. The mining disturbance will remove the springs and they will be absent in the reclaimed setting. The design for replacement wetlands and stock ponds will be based on surface flow volumes. While the reclaimed wetlands will be in a different form than the linear wetlands the acreage and function will be replaced.

The permit application adequately evaluates the probable consequences of mining and the post-mining environment on the surface hydrologic regime. The land included in Permit NACC-1302 is primarily located on a topographic ridge with well-defined pre-mine drainages in close proximity to the Knife River and Coyote Creek. Surface water management during mining will primarily be achieved with sedimentation ponds. Interception of storm runoff and ground water discharged from all mining pits by the total surface water management system will result in a net reduction in peak flows from controlled drainage areas. Changes in peak flows in the Knife River and Coyote Creek immediately below the Coyote Creek Mine (downgradient) will be insignificant. Ground water produced from active pits will make a very small addition to the volume of surface water flows. Thus, the operations will produce no significant diversion of water from the surface or ground water flow systems of the Knife River and Coyote Creek. Reclamation to approximate original contours minimizes diversion of water from surface or ground water flow from pre-mining drainages. The post-mining watershed divides will be situated near pre-mining divides between the Knife River and Coyote Creek, including the respective tributaries, so no significant change in the proportions of watershed yield to these streams is anticipated.

ALLUVIAL VALLEY FLOOR

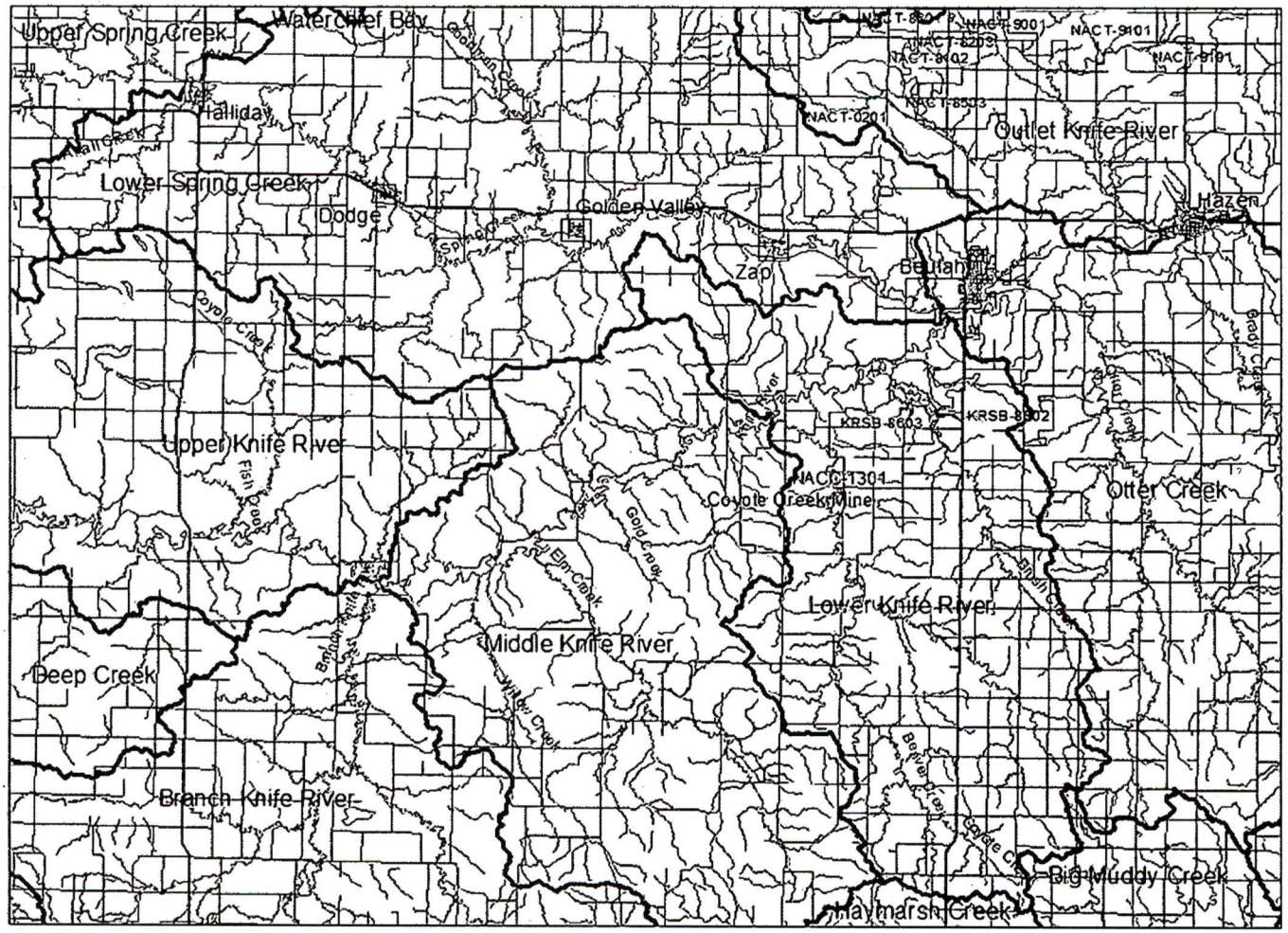
As required by NDAC 69-05.2-08-13(2) the Reclamation Division provided a written determination detailing the absence of alluvial valley floors within and adjacent to the proposed Coyote Creek Mine permit area associated with Permit NACC-1302 that now incorporates previously approved Coyote Creek Mine Permit NACC-1301. Based on review of the *Alluvial Valley Floor Evaluation Report – Coyote Creek Mining Company, L.L.C. – Coyote Creek Mine* prepared by Bickel Consulting, LLC, for the Coyote Creek Mining Company, the Alluvial Valley Floor Evaluation Report was approved by the Reclamation Division on August 26, 2013, affirming the non-existence of AVF within the study area.

A previously approved Alluvial Valley Floor report and negative determination is applicable to a portion of the Coyote Creek Mine area. The determination made for Dakota Westmoreland Company's Revision No. 22 to Permit KRSB-8603 for the Beulah Mine encompasses the area included in Coyote Creek Mining Company's Permit NACC-1301, which has now been absorbed into Permit NACC-1302. The PSC issued a determination on October 26, 2009 that the valley of Coyote Creek within the Revision No. 22 to Permit KRSB-8603 study area is not an AVF. A discussion of the 2009 determination and maps depicting the study area are included with the Alluvial Valley Floor Evaluation Report approved for the Coyote Creek Mine.

The Coyote Creek AVF report information was based on existing information available in published work, approved mining permits and related data in the public domain from the surface mining reclamation and regulatory process, and observations of professionals involved in the acquisition of baseline data for application of Permits NACC-1301 and NACC-1302. Based on the geologic, hydrologic, soils, vegetation and landuse data and information provided in the *Alluvial Valley Floor Evaluation Report – Coyote Creek Mining Company, L.L.C.* and observations made during a field investigation conducted by the Reclamation Division in April,

2013, it was determined that the Knife River floodplain adjacent to the Knife River channel, Coyote Creek and its associated floodplain, Brush Creek, Beaver Creek, Mud Creek and the remaining stream channels and drainage areas included within the 33,000 acre AVF Study Area do not constitute an alluvial valley floor as defined in NDCC 38-14.1-02 and described in NDAC 69-05.2-08-13.

Figure 1: Hydrologic Map depicting the Cumulative Impact Area



Pink – Freedom Mine
Blue – Beulah Mine
Tan – Coyote Creek Mine

Figure 2: NACC-1302 Ground Water Monitoring Sites Location Map
As provided in Permit NACC-1302