2.04.7(2) Surface Water Information

This section describes the surface water resources located in or near the permit area. A more detailed discussion of the surface water resources in the permit area is presented in Exhibit 71 and 71A. The surface water in the permit area is expressed in four ways:

1. Streams
2. Springs
3. Reservoirs and Stock Ponds
4. Wetlands

Surface Water Resources

Streams

Several drainage systems have their headwaters on or flow through the West Elk Mine permit area. All of the streams draining the area are tributary to the North Fork of the Gunnison River (North Fork). Sylvester Gulch, Lone Pine Gulch, Gribble Gulch, Box Canyon, and unnamed tributaries are ephemeral streams draining the northern portion of the coal lease area directly into the North Fork. Additionally, a portion of Deep Creek, which joins Raven Gulch before entering the North Fork, overlies the permit area. Minnesota Creek and its tributaries drain the southern portion of the coal lease area, which has been designated as the South of Divide area in reference to the drainage divide separating Minnesota Creek from the North Fork tributaries. Although all watersheds in the permit area are tributary to the North Fork, in this document, a distinction is made between those that drain directly into the North Fork and those which enter Minnesota Creek before reaching the North Fork. A summary of drainage basin characteristics is found in Table 8, which identifies basic physical characteristics of the lease area watersheds. Map 34 and Map 1 of Exhibit 71 delineate the gaged basins within the West Elk Mine coal lease areas.

North Fork Drainage Basin

The North Fork is the ultimate receiving stream for all drainages on the West Elk Mine permit area. The North Fork watershed encompasses significant high-mountain drainages to the east of the mine, which generate the majority of the streamflow measured at the USGS gage near Somerset. The ephemeral streams within the permit area provide incidental contributions to the flow in the North Fork.

The majority of streams in the permit area are ephemeral, flowing only in response to snowmelt or intense rainfall, with the exception of Deep Creek, a perennial stream which crosses the southeast part of the permit area. Physical properties of these drainage basins are summarized in Table 8.

Minnesota Creek Drainage Basin

The Minnesota Creek watershed drains most of the southern portion of the coal lease area (see Map 34). The majority of the flow in Minnesota Creek originates from the perennial tributaries with their headwaters near the peak of Mount Gunnison. Although several tributaries flow through the lease area, including South Prong, Horse Creek, and East Fork, the only tributary watersheds of Minnesota Creek that are partially located within the permit area are the Dry Fork of Minnesota Creek (Dry Fork) and Lick Creek, and the north fork of the South Prong Creek which drains the extreme southern portion of the permit area.

Table 8
Characteristics of Lease Area Watersheds

Watershed[1]	Drainage Area (mi^2)	Maximum Elevation (ft)	Minimum Elevation (ft)	Channel Length (mi)	Channel Slope (%)
Dry Fork (lower)	7.49	8,720	6,70	5.6	6.0
Minnesota Creek (lower)	41.3	12,700	6,200	11.5	6.9
Lick Creek	1.85	9,730	7,630	2.8	12
South Prong	3.27	12,390	7,380	2.2	18
Horse Creek[2]	1.75	12,390	7,830	3.5	19
Deep Creek (lower)	4.68	12,180	7,200	4.4	11
Box Canyon[3]	0.88	8,480	6,120	1.2	16
Sylvester Gulch (middle)	4.25	8,480	6,220	3.6	8.4
Gribble Gulch (lower)[3]	1.20	8,170	6,640	1.1	17

Notes:
1. Watershed names refer to gaged basins as shown on Map 34.
2. Permanent gages are no longer installed on Horse Creek.
3. Permanent gages were not installed on Box Canyon and Gribble Gulch.

The Dry Fork receives much of its flow from the Deep Creek Ditch, an inter-basin diversion that enters the eastern boundary of the Dry Fork drainage basin where the flows are measured by the Upper Dry Fork gage. This additional flow allows the Dry Fork to flow several months after the end of snowmelt runoff. Based on available data, the average annual diversions from Deep Creek Ditch are approximately 1,000 acre-feet per year. The Deep Creek Ditch diverts flow from Little Gunnison Creek, a tributary to Coal Creek and ultimately the North Fork. As the ditch traverses across the upper portion of the Deep Creek watershed, it collects runoff from Deep Creek tributaries then enters at the headwaters of the Dry Fork.

Generally, there are transit losses that are experienced as Deep Creek Ditch transbasin diversion flow from the upper Dry Fork watershed into the lower Dry Fork watershed. Transit losses are commonly experienced in irrigation ditches and natural drainage channels. They are attributable to: bank storage, infiltration losses, channel storage, and evapotranspiration. Due to the characteristics of the Dry Fork channel in the upper watershed (e.g., dry channel for much of the year, cracked channel bottom, significant channel erosion, wide channel with steep banks, no evidence of groundwater inflows to channel and others), transit losses will be experienced.

Lick Creek, the drainage basin south of Dry Fork, generally flows east to west across the southern portion of the permit area. Like most of the permit area basins, Lick Creek is an ephemeral drainage.

MCC believes that without these supplemental flows the Dry Fork would be strictly ephemeral. However, because the currently available data does not specifically indicate whether the majority of

Dry Fork is ephemeral, intermittent, or perennial, MCC will continue to monitor the flows through the Dry Fork flumes, the interbasin diversion operational data, and visually check the flows in the fall after water is no longer being diverted to Dry Fork.

Springs

There are three different types of springs within the permit area:
Springs in Surficial Sediments - Groundwater that moves through sediments that have a limited thickness and are generally considered to be unconsolidated (i.e., alluvial, colluvium, and landslide deposits). Subsurface water moving through the alluvium emerges as a spring, and discharges into the drainage channel. Colluvial groundwater moving down-gradient emerges from the colluvium as a spring. The source of the groundwater in the colluvium can be snowmelt infiltration, rainfall infiltration, discharge from a surface channel or upgradient bedrock spring flows that infiltrate into the colluvium.

Bedrock Springs - Springs can be encountered where subsurface formations outcrop. Groundwater moves along the surface of the formation and eventually daylights.

Starting in 1978, discharge rate data were collected from more than 80 springs. Available data indicated that approximately two-thirds originated from surficial sediments and one-third had bedrock formations as their source. The locations of all springs are shown on Map 37. The currently monitored springs are shown on Map 34. The monitoring plan for the permit area is shown in Exhibit 71 and 71A. Spring flow data are presented in Annual Hydrology Reports.

Although discharge data from alluvial springs are limited, it is apparent that they are highly sensitive to seasonal variations. There is also a wide variation in flow from alluvial springs during the year. This large variation suggests that: 1) The capability of the alluvial sediments to transmit water is great, 2) The storage volume of the alluvial sediments is small relative to the recharge and discharge rates, and 3) The alluvial sediments are in good connection with surface water flows. The overall storage capacities of alluvial spring groundwater systems are large.

Colluvial cover springs also display large seasonal discharge variations. These springs have very high springtime flow discharge rates, but commonly cease flowing entirely during the fall and winter months. This suggests that, like the alluvial groundwater system, the groundwater systems have an appreciable capacity to transmit water, but that the storage volumes of these systems are small relative to the recharge and discharge rates.

The combined total volume of water discharged from the landslide springs is nearly twice that of any rock units in the mine area. Landslide deposit springs are highly influenced by seasonal variations in precipitation. Thus, the travel times from the recharge area to spring discharge locations are less than one year. Groundwater systems that sustain these springs have small storage volumes relative to the recharge and discharge rates. Many of the springs also have discharge variability that responds to climatic cycles.

Almost all bedrock springs issue from the Barren Member and all exhibit seasonal fluctuations. Most Barren Member springs either dry up or nearly dry up during the fall and winter months.

The effect of wet and dry climatic cycles also affects the discharge rates of Barren Member springs. Spring discharge rates from most Barren Member springs are less than 10 gpm during the high-flow season, suggesting that these springs do not have the same high level of hydraulic communication with snowmelt and surface water as do many springs issuing from unconsolidated deposits. The general shape and the seasonal and climatic responses of Barren Member spring hydrographs are similar to hydrographs of springs issuing from unconsolidated sediments. These facts suggest that the groundwater storage capacities of groundwater systems supporting Barren Member springs are commonly less than the storage capacities of groundwater systems supporting unconsolidated sediment springs.

See Exhibit 18 for further spring discussions in a 1999 study completed by Mayo and Associates.

Reservoirs and Stock Ponds

Minnesota Reservoir is located within the permit area, but the area of the reservoir itself is excluded from the Federal coal lease and permit area. Beaver Reservoir is located outside of and to the west of the permit area. Minnesota Reservoir is located on the Dry Fork of Minnesota Creek. Beaver Reservoir is on the East Fork of Minnesota Creek. Map 34 illustrates the locations of the two reservoirs.

The Monument Dam of Minnesota Reservoir is located on the Dry Fork of Minnesota Creek approximately eight miles upstream of Paonia, Colorado. It is owned by the Minnesota Canal and Reservoir Company, and is used for storage of irrigation water. Monument Dam is an earth-fill structure that was originally constructed around 1900. The dam height was raised in approximately 1910 and again in approximately 1933. MCC completed reconstruction of the dam to its current configuration in 2008 as approved in Technical Revision TR-108. The reservoir has a surface area of approximately 20 acres at the storage capacity of 467 acre-feet. The drainage area contributing to the reservoir is approximately 5 square miles. The reservoir generally fills during the runoff season (May through July) and is drained to a nearly empty condition by autumn. Exhibit 74 contains the information regarding Monument Dam and Minnesota Reservoir.

Beaver Reservoir is located on the East Fork of Minnesota Creek approximately 3.3 miles upstream from its confluence with Minnesota Creek and more than a half mile from planned mining. It is owned and operated by the Beaver Reservoir Company. Records of the SEO show that the reservoir has a decreed capacity of 1,620.20 acre-feet of which 551.70 acre-feet is a conditional decree. The source of water for the reservoir is runoff from Mount Gunnison. Leakage from Beaver Reservoir has caused the SEO to restrict its storage capacity. This leakage causes minor springs to occur in the outcropping bedrock along the downstream banks of East Fork and below the toe of the dam. Leakage is most noticeable in the spring when the reservoir is at its maximum storage capacity. The yield of Beaver Reservoir has been tabulated by the SEO (1978) for the 28-year period from 1950 through 1977. During this period, the average reservoir yield was approximately 680 acre-feet per year.

In addition to the two storage reservoirs in the area of the West Elk Mine, a total of 61 stock water impoundments have been identified in or adjacent to the permit area. Map 37 illustrates the locations of the known stock water ponds. Stock water ponds are typically found in drainages or below identified springs where surface water can be collected. These ponds, for the most part, do not represent adjudicated water rights or perennial flows. Within the Gunnison National Forest, the ponds are managed for seasonal use only by the U.S. Forest Service.

Wetlands

Based upon inspection of conventional and infrared aerial photographs and reconnaissance-level field investigation, there are approximately 7 acres of wetlands (as defined by the U.S. Army Corps of Engineers (USACE) in the permit area. Field surveys conducted in August 1995 verified this estimate. Most of the wetlands are found in drainage channels, although there are small, isolated wetlands on the hillsides where springs and seeps occasionally emerge as a result of landslides/slumps.

WWE conducted inventories of wetlands and riparian zones within the permit area in the fall of 1996 and again in the fall of 2004, and identified approximately 42 acres of wetlands in the South of Divide permit area. Wetlands occur in four types of locations: (1) Along the channel bottoms, (2) In association with beaver activity, (3) At seeps or springs, and (4) Along the margins of stock ponds. The vast majority of the wetland acreage is located along the Dry Fork and Lick Creek riparian corridors.

For additional information regarding wetlands, refer to Section 2.05.6 and Exhibit 32B.

Baseline Monitoring Program

This section discusses the program that MCC has implemented to monitor the water resources in the permit area. Many of the monitoring stations have been gaged for years and, consequently, have established the baseline hydrologic regime of the resource in accordance with CDRMS regulations.

The monitoring program for the permit area is presented in Exhibits 71 and 71A. At least one year of baseline data will be provided to CDRMS prior to longwall mining under or within the angle-of-draw of a monitored water resource in the permit area. Monitoring data are presented in the Annual Hydrology Reports.

Streamflow Monitoring

Stream Quantity

Starting in 1977, MCC installed a network of continuous recording stream gaging stations to establish the baseline surface water hydrology for the permit and adjacent areas of the West Elk Mine and to provide a method of assessing the impacts of mining during the life of the West Elk Mine. Five of these gaging stations are located within the Minnesota Creek drainage basin, on Horse Creek, Lick Creek, South Prong, Upper Dry Fork, and Lower Dry Fork. Another gaging station is located on Sylvester Gulch, a tributary of the North Fork, adjacent to the surface facilities. Data are also obtained from a U.S. Geological Survey (USGS) gage in the North Fork located in the river just upstream of the mouth of Sylvester Gulch.

MCC also operates gaging stations on the main stem of Minnesota Creek below the Dry Fork confluence (Minnesota Creek Lower Gage) and on Minnesota Creek just upstream of the confluence of Minnesota Creek and the Dry Fork (Minnesota Creek Upper Gage).

Additional baseline data were obtained in Horse Gulch, the west gulch located east of Horse Gulch, the east gulch located east of Horse Gulch and in the Deep Creek drainage above and below the coal lease boundary. Instantaneous flows, along with monthly peak flows, are measured with a crest stage gage. After baseline data were collected, West Gulch was eliminated from the monitoring program because the drainage was dry.

A second Sylvester Gulch gaging station (Upper Sylvester Gulch) was added to the monitoring program in 1996. All stream gage locations are shown on Map 34. The monitoring program for the permit area is presented in Exhibits 71 and 71A.

In addition to providing baseline data, a portion of the Minnesota Creek gaging station network will be relied on to quantify stream depletions to Minnesota Creek (if any) from MCC's mining operations to provide the necessary augmentation water in accordance with MCC's adjudicated water augmentation plan. The extent of depletion, if any, is quantified by correlating the streamflows of Minnesota Creek at the lower gaging station, approximately six miles upstream from its confluence with the North Fork, with sub-basins that could potentially be affected (Dry Fork and Lick Creek). A complete description of the streamflow correlation procedures is provided in the *Application for Approval of Plan for Augmentation Concerning the Application of Water Rights of MCC in Gunnison and Delta Counties* (WWE 1986) (Exhibit 52) and *Engineering report, Water Augmentation Plan for MCC in Minnesota Creek Basin near Paonia* (WWE 1985).

MCC closed the Horse Creek flume and the East Fork upper station. Should mining advance to the point where these basins might be impacted, MCC will install new gaging stations, or reinstall the old stations, at least one monitoring season before any potential exists for streams to be impacted.

MCC began collecting baseline monitoring data (flow and water quality) at the existing rectangular weir on Deep Creek Ditch located at the Deep Creek water conveyance flume in 2006. The weir is equipped with a continuous recorder that operates during the irrigation season when the ditch carries water from Little Gunnison Creek.

Annual reports for the stream gaging stations are furnished to the CDRMS in Annual Hydrology Reports. These reports include monthly measurements of streamflows for each gaging station with maximum, minimum and mean flows reported. Representative streamflow records are contained in Exhibit 18A.

Stream Quality

As a result of Technical Revisions, including TR-54, TR-85, TR-85, TR-88 and TR-139, the water monitoring program was revised, including water quality monitoring. The current stream water quality monitoring program is presented in Exhibits 71 and 71A and locations are shown on Map 34. The Baseline monitoring parameters and schedule are provided in those exhibits.

Analyses are completed as outlined in the *Guidelines for Collection of Baseline Water Quality and Overburden Geochemistry Data* (CDMG 1982). Results are reported in the Annual Hydrology Reports. If not already provided in the AHRs, baseline data will be provided to CDRMS prior to longwall mining under or within the angle-of-draw of a monitored resource.

Spring Monitoring

Spring Quantity

In 1977, MCC began a spring water monitoring program that incorporated monthly, quarterly and semi-annual monitoring of flow and/or water quality. Map 37 shows the springs identified within the coal lease area and the locations of the decreed springs. Springs that are included in the monitoring program are presented in Exhibit 71 and 71A. Annual Hydrology Reports provide a graphic representation of the flow data available for the springs monitored from 1984 to date.

Spring Quality

The springs included in the current monitoring plan are presented in Exhibit 71 and 71A. Seasonal baseline measurements are obtained to characterize the water. As with stream water quality, mining-related changes in water quality that are known to mobilize metals would cause iron or manganese to be released in readily detectable quantities, and changes in conductivity and TDS will indicate changes in water quality. If not already provided in AHRs, baseline data will be provided to CDRMS prior to longwall mining under or within the angle-of-draw of a monitored water resource.

Spring water quality samples (Exhibit 19 and Exhibit 19A) were obtained from selected locations. These springs were chosen for water sampling on the basis of geographic distribution, generally reliable flow, availability of previous water quality data, and ease of access. Springs were selected to provide sampling points in each of the major watersheds in the project area, and to provide coverage throughout the lease area. In addition, Mayo and Associates conducted a hydrogeologic analysis of the permit and adjacent area in 1999. The complete report is included in Exhibit 18. To summarize Dr. Mayo's findings: the groundwater systems are localized, are not areally extensive, and tend to form discrete groundwater bodies that are not in hydrodynamic communication with each other. Therefore, impacts to the water quality of a spring due to underground mining are highly unlikely.

Monitoring of Reservoirs and Stock Ponds

Although water level measurements are not taken on Minnesota Reservoir, the Upper and Lower Dry Fork flumes provide an estimate of the reservoir inflows and outflows. The addition of the ditch company's flume (Middle Dry Fork) upstream of the reservoir has improved the accuracy of the reservoir inflow measurement.

In addition, MCC, in cooperation with the U.S. Forest Service (USFS), Paonia Ranger District, informally monitors the USFS surface water resources (stock ponds), as depicted on Map 37, that are located directly over longwall panels to be mined or within the angle-of-draw per the agreement letter in Exhibit 19C. MCC also annually photographs stock ponds that are located over longwall panels to be mined or within the angle of draw. The results of this monitoring are provided in the AHRs. Table 12 lists the USFS water resources within or adjacent to the West Elk Mine permit area.

Table 12 Summary of U.S. Forest Service Water Resources Near the West Elk Mine			
Resource Number	**Name**	**Source**	**Current Amount of Use[1]**
131	Dry Fork 44	Gribble Gulch	0.5 AF
132	Dry Fork 42	Minnesota Creek	0.5 AF
133	Dry Fork 43	Minnesota Creek	0.5 AF
134	Dry Fork 41	Minnesota Creek	0.5 AF
135	Dry Fork 26	Minnesota Creek	0.5 AF
136	Dry Fork 40	Minnesota Creek	0.5 AF
137	Dry Fork 13	Minnesota Creek	0.5 AF
138	Dry Fork 17	Minnesota Creek	0.5 AF
139	Dry Fork 37	Minnesota Creek	0.5 AF
140	Dry Fork 16	Minnesota Creek	0.5 AF
141	Dry Fork 38	Minnesota Creek	0.5 AF
142	Dry Fork 4	Minnesota Creek	0.5 AF
143	Dry Fork 39	Minnesota Creek	0.5 AF
144	Dry Fork 7	Minnesota Creek	0.5 AF
145	Dry Fork 32	Minnesota Creek	0.5 AF
146	Dry Fork 8	Sylvester Gulch	0.5 AF
147	Dry Fork 49	Sylvester Gulch	0.5 AF
148	Dry Fork 36	Minnesota Creek	0.5 AF
149	Dry Fork 9	Minnesota Creek	0.5 AF
150	Dry Fork 22	Minnesota Creek	0.5 AF
151	Dry Fork 23	Minnesota Creek	0.5 AF
152	Dry Fork 18	Minnesota Creek	0.5 AF
153	Dry Fork 28	Minnesota Creek	0.5 AF
154	Dry Fork 48	Sylvester Gulch	0.5 AF
155	Dry Fork 47	Deep Creek	0.5 AF
156	Dry Fork 45	Minnesota Creek	0.5 AF
157	Dry Fork 46	Deep Creek	0.5 AF
158	Dry Fork 27	Deep Creek	0.5 AF
159	Dry Fork 24	Deep Creek	0.5 AF
179	Cow Camp	Spring	0.001 CFS
180	Dry Fork	Raven Gulch	0.1 AF
181	Dry Fork	Raven Gulch	0.5 AF
182	Dry Fork	Deep Creek	0.5 AF
183	West Flatiron	West Flatiron	1.0 AF
185	Dry Fork	Sylvester Gulch	0.5 AF
186	Dry Fork	Sylvester Gulch	0.5 AF
187	Dry Fork	Sylvester Gulch	0.5 AF
188	Dry Fork	Sylvester Gulch	0.5 AF
200[(2)]	Cowboy	Sylvester Gulch	1.0 AF
201[(2)]	Indian	Sylvester Gulch	1.0 AF
260	Dry Fork	Long Draw	0.3 AF
261	Dry Fork	Sylvester Gulch	0.3 AF
265	NA[(3)]	Sylvester Gulch	NA
266	NA	Sylvester Gulch	NA
279	NA	Minnesota Creek	NA
280	NA	Minnesota Creek	NA
281	NA	NA	NA
282	NA	Sylvester Gulch	NA
[1]AF=Acre Feet (Storage) and CFS=Cubic Feet per Second (Flow)		[2]Future foreseeable use.	
[3]NA – Information has not been provided by the U.S. Forest Service		[4]Resources, except No. 185 and 186 have a June through October season of use. Resources 185 and 186 have a May through October season of use.	

Surface Water Quantity

Streams

Most of the streams in the permit area are ephemeral, flowing only in response to snowmelt or significant rainfall events. Using Sylvester Gulch as an example, "significant" rainfall (based on the conceptual-level application of the U.S. Soil Conservation Service curve number (CN) approach), means that a precipitation amount or snowmelt equivalent of about one inch in 24-hours is required to generate runoff.

The distribution of flows for the North Fork and Minnesota Creek is shown on Figure 8 and Figure 9, respectively. These figures indicate the similarities in the monthly distribution of the annual flows for the North Fork and Minnesota Creek. For both watersheds, over 80 percent of the annual yield occurs from April through July which demonstrates the influence of snowmelt on these streams.

While snowmelt provides the greatest yields, summer rainfall can cause large peak flows. These storms typically occur during late summer months when many of the ephemeral streams have diminished flows. The peak flows resulting from significant storm events are the primary mechanism for sediment transport and defining the channel geometry.

Within the permit area, the watersheds appear to yield smaller amounts of streamflow than do any of the gaged basins that are tributary to the North Fork upstream from Somerset. As shown in Exhibit 18A, the drainage areas of these watersheds ranged from 1.3 to 63 square miles. Only the two perennial streams, upper South Prong and Horse Creek, can be properly included in such a comparison. Exhibit 18A shows that these two coal lease area watersheds fall well below the driest annual runoff values of the regional watersheds. Indications are that these watersheds typically have less runoff per square mile than most watersheds in the region. The gage records support the conclusion that the watersheds in the permit area have very little flow and typically yield less per square mile than other regional basins.

There are a number of factors potentially responsible for the low annual flows occurring in these streams. The combination of low precipitation and heavy vegetation is important. The dense vegetation leads to a high evapotranspiration rate. The permit area watersheds receive low precipitation compared to much of the North Fork basin. Within the North Fork basin, annual precipitation varies from up to 50 inches in the high mountains to 20 inches at Somerset. Drainages within the permit area receive about 24 to 50 inches of precipitation per year. The combination of these factors results in a diminution of excess precipitation available for runoff.

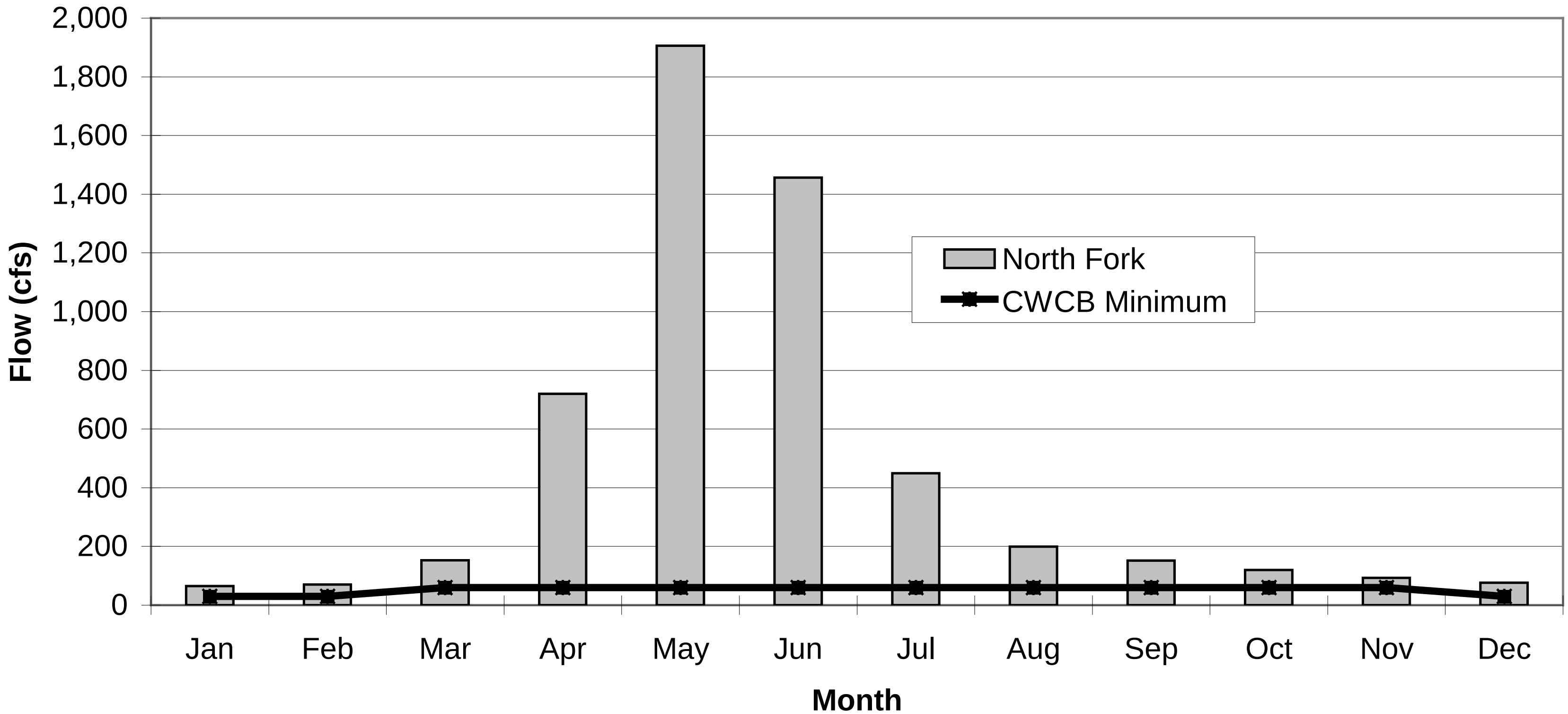

Figure 8
Average Monthly Flow – North Fork Gunnison River Near Somerset 1934-2002

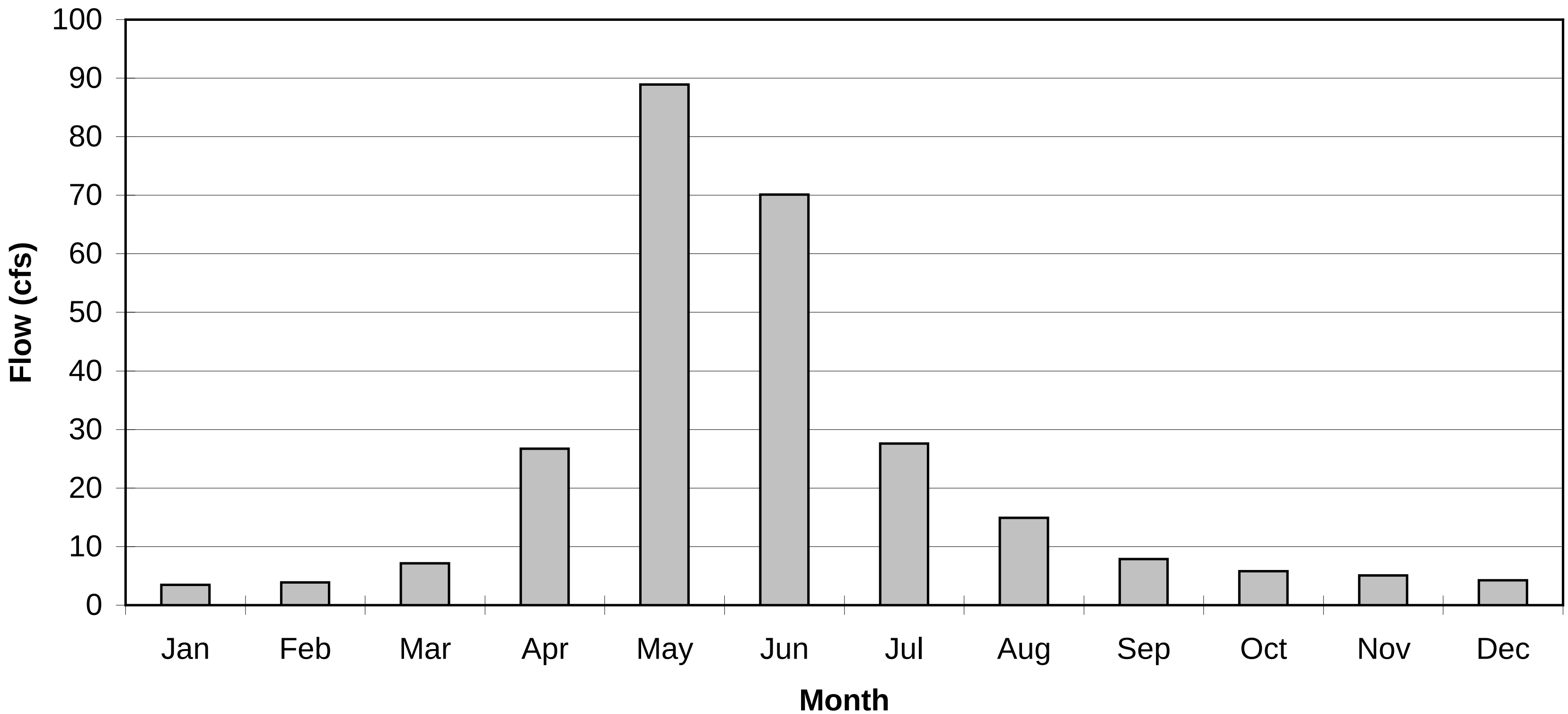

Figure 9
Average Monthly Flow – Minnesota Creek Near Paonia 1937-1947, 1986-2002

North Fork

Baseline characterization of streamflow conditions for the North Fork at the West Elk Mine was developed using data from the USGS Gage near Somerset (09132500). This gage is located immediately upstream of the mine site as shown on Map 34. Discharge volumes on the North Fork averaged 330,500 acre-feet per year based on the 1934 to 2002 monitoring period. The average annual yield of 330,500 acre-feet is equivalent to approximately 628 acre-feet per square mile per year. The mean daily flow during the period of record was 453 cfs. Flows at the Somerset gage were influenced by approximately 3,000 acres of irrigation upstream of the site, as well as storage in sizable reservoirs including Overland Reservoir (capacity 6,280 acre-feet) and Paonia Reservoir (capacity 18,300 acre-feet).

Extreme conditions are of particular concern when assessing hydrologic impacts. Low flow conditions are relevant for the evaluation of minimum streamflows and their relationship to aquatic life, design of water supply systems, assessment of impacts of wastewater discharges, and the determination of water rights yields. Two low flow conditions were identified in the baseline assessment of North Fork streamflow:

1. The historic daily low flow of 17 cfs occurred in November 1950.
2. The annual 7-day low flow of 25 cfs occurred in February 1978

An analysis was performed to determine the frequency that North Fork flows dropped below the Colorado Water Conservation Board's (CWCB) minimum streamflow right of 30 cfs for December through February, and 60 cfs for March through November. Since Paonia Reservoir was constructed in 1961, the North Fork near Somerset gage records were analyzed for the 40-year period of 1963 to 2002. As shown in Figure 10, flows were below CWCB's minimum flows 22 days per year on average, and during November, the probability of any mean daily flow falling below the minimum is nearly 25 percent.

Estimates of peak flood flows for various recurrence intervals for the North Fork were provided by the USGS using a Log-Pearson Type III distribution and Water Resources Council guidelines. The estimates were based on historic streamflow data from the USGS gaging station on the North Fork near Somerset. At the time of analysis, this station was located at the access bridge to Bear Mine. Since the Paonia Reservoir Dam, located a few miles upstream from the gaging station, was completed in 1961, the period of record from 1934 to 1960 only was used in the analyses by the USGS. Estimated discharges for various recurrence intervals and the probabilities of exceeding those estimated discharges are shown graphically in Exhibit 20.

Minnesota Creek

Baseline characterization of streamflow conditions for Minnesota Creek was developed from the USGS/MCC Gage (09134000) 4.5 miles east of Paonia. Discharge volumes averaged 16,100 acre-feet per year based on water years 1937 through 1947, and 1986 to 2000 monitoring records. The annual mean discharge was 22.2 cfs for the 41.3-mi^2 drainage basin. The lowest daily mean flow was 1.0 cfs on November 14, 1936, and the lowest 7-day minimum was 1.4 cfs on January

16, 1990 and February 17, 1999. Flow at this site is influenced by two small reservoirs, Minnesota Reservoir and Beaver Reservoir and a trans-basin diversion from the Coal Creek basin (Little Gunnison Creek) into Minnesota Creek via Dry Fork.

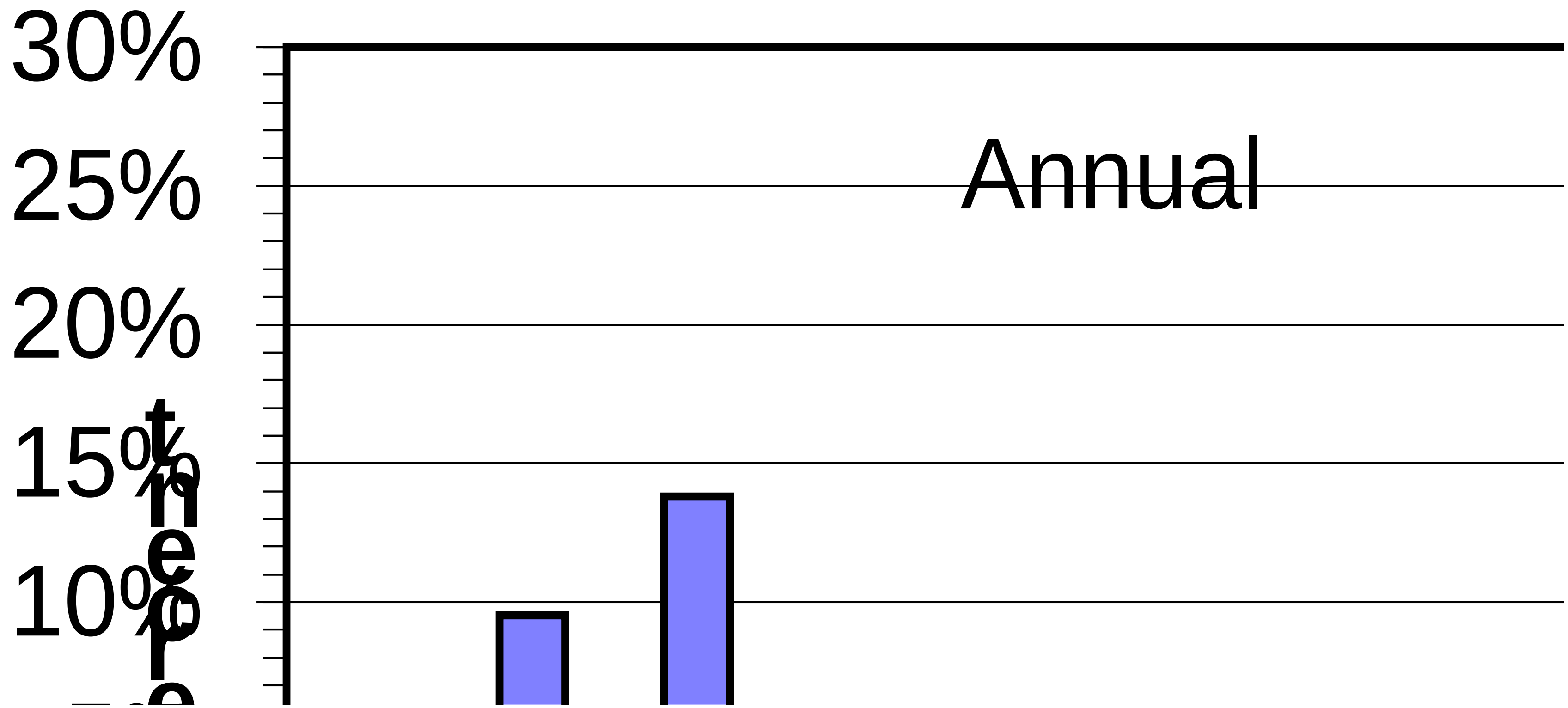

Figure 10
Percent of Days North Fork Flows Fall Below CWCB's Minimum Streamflow

The average annual yield of 16,100 acre-feet translates to about 390 acre-feet per square mile per year. Comparing this value to that of the North Fork (628 acre-feet per square mile per year) illustrates the lack of runoff from the coal lease area watersheds. The decrease in runoff is primarily a function of decreased precipitation at the lower elevations.

The highest gaged flows were recorded on May 28, 1993, during runoff of a wet-year snowpack. The daily mean gage flow was 340 cfs and the instantaneous flow peaked at 359 cfs.

Permit Area Watersheds

WWE and Mr. Ernest Pemberton, P.E. (former Chief Engineer for the U.S. Bureau of Reclamation, Sedimentation and River Hydraulics Section) conceptually quantified the stream hydrology and sediment transport characteristics for watersheds within the permit area. Reports summarizing this work are included in Exhibit 55, 55A and 55B. Further hydrologic characterizations and the overall monitoring program are provided in Exhibits 71 and 71A. Monitoring data are presented in Annual Hydrology Reports.*2.04.7(3)*

Alternative Water Supply Information

If existing sources of water for domestic, agricultural, industrial, fish & wildlife and other legitimate uses are contaminated, diminished, or interrupted due to activities of MCC, MCC will use its water rights on the North Fork of the Gunnison River, Minnesota Creek, or groundwater from wells to replace the water under its approved Adjudicated Augmentation Plan. Further discussions are included in Section 2.05.6(3)(b), Water Rights and Exhibit 58.

Pages 2.04-94 through 2.04-114
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