

Permit M-1980-244
Cresson Project Amendment 14

Exhibit G
Water Information

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1 INTRODUCTION

As discussed in Exhibit D, under this amendment, Valley Leach Facilities (VLFs) 1 and 2 will be expanded. These modifications are not anticipated to significantly change the impacts to surface or groundwater systems that are contemplated by previous permit amendments. This exhibit has been updated, where necessary, to accommodate the VLF1 and VLF2 expansions.

The following Exhibit G provides water information for the Cresson project including:

1. Location of water courses, wells, springs, and other features on the affected lands and adjacent lands that may be impacted by Amendment 14 activities (See Figures G-1 and G-2) and the programs in place to monitor and protect surface and groundwater from current and future operations;
2. An estimate of the water requirements including flow rates and annual volumes for the mining and reclamation phases of the project;
3. The projected amount from each of the water supply sources that will supply water to the operation and reclamation; and
4. Discussion of the state of Colorado Discharge Permit System permits in place for the site.

Note that baseline surface water and groundwater data have been provided in prior submittals. Quarterly data are provided to the Division on Reclamation Mining and Safety (DRMS) on a regular basis and the data from the last 5 quarters are provided in Appendix 6 of this Amendment 14 permit.

Cripple Creek and Victor Gold Mining Company (CC&V) maintains a series of enhanced management ponds (EMPs) to control surface runoff from active operations and actively disturbed areas to protect surface water quality. CC&V also maintains two discharge permits to ensure water discharged off site satisfies water quality standards and maintains a current hydrogeologic model that demonstrates deep-diatreme groundwater is protected through the neutralizing capacity from carbonate rocks at depth. Lastly, CC&V maintains a monitoring program to monitor key components of the operation to ensure the protection of surface water and groundwater systems. Various plans have been developed by CC&V to address the management of surface water and groundwater systems.

The following sections describe the different surface water drainages affected by the operation, provides an overview of the hydrogeological model used to protect groundwater, and describes Cripple Creek & Victor Gold Mining Company
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the water uses and water supply information. Water features are shown on Exhibit C Drawings and on Figure G-1 and Figure G-2 included in Exhibit G.

2 SITE HYDROLOGY

The following discussion of surface water and groundwater hydrology is an update and summary of the more detailed information provided in the 2015 Hydrologic Evaluation, which was submitted and approved by DRMS with Amendment 11 documentation (December 2015).

2.1 Surface Water

Regionally, surface water flows from the permit area are tributary to the Upper Arkansas River. On the south side, surface water generally flows into Theresa Gulch and Bateman Creek, which are tributaries to Wilson Creek, which then flows into Fourmile Creek and ultimately to the Arkansas River. On the west side, surface water generally flows into Poverty Gulch, Maize Gulch, and Arequa Gulch, all tributaries to Cripple Creek, which flows into Fourmile Creek, which then flows into the Arkansas River. On the north side, surface water generally flows into Grassy Valley, a tributary to Beaver Creek, which flows into the Arkansas River. Figure G-1 shows the surface water system including a two-mile radius around the Cresson Project permit boundary.

Locally, active surface water channels essentially do not exist throughout most of the diatreme-based Cripple Creek Mining District (District). Due to current mining activities, the presence of below grade surface mine areas, the relatively high rock permeability of the diatreme, and the historic lowering of the groundwater table by the area drainage tunnels, precipitation infiltrates and surface water flows are rarely observed. Only during significant snowmelt or after heavy rainstorms is flow observed in the typically dry washes. The stream flow that does occur is seldom continuous along the channel with surface flow appearing and disappearing in a downstream direction, while some sections of the stream channel remain dry even during precipitation events.

Surface water quality in the District has remained relatively stable over the monitoring period of record for most of the monitoring locations although certain historic mine features and activities in many of the drainages appear to have some influence on surface water quality.

Each of the drainages is discussed separately below.

2.1.1 Wilson Creek and Tributaries

The activities associated with Amendment 14 do not affect the Wilson Creek drainage. The Enhanced Management Ponds (“EMPs”) will remain in place to control surface water flows from the existing facilities in the Wilson Creek drainage.

2.1.2 Arequa Gulch

VLF1 Phase 6 will be constructed in the Arequa Gulch although additional impacts to the Arequa Gulch drainage are not expected as the new construction will be lined and is located on previously disturbed area within the diatreme boundary.

2.1.3 Gold Run Gulch

Gold Run Gulch is a small ephemeral watershed flowing southwest into Cripple Creek between Arequa Gulch and Maize Gulch. There are no surface water flows observed in the drainage. No monitoring occurs, as CC&V operations and in particular Amendment 14 activities are not expected to impact Gold Run.

2.1.4 Maize Gulch

VLF2 Phase 4 will be constructed in Maize Gulch although additional impacts to the Maize Gulch drainage are not expected as the new construction will be lined and is located on previously disturbed areas within the diatreme.

2.1.5 Poverty Gulch

Poverty Gulch is an ephemeral tributary to Cripple Creek that has historically exhibited flow only during significant precipitation events. The activities proposed by Amendment 14 are not expected to impact the Poverty Gulch drainage.

2.1.6 Cripple Creek

The activities associated with Amendment 14 are not expected to impact the water quality or surface water monitoring locations in the Cripple Creek drainage.

2.1.7 Grassy Valley

There are no proposed activities in Grassy Valley resulting from Amendment 14.

2.2 Groundwater Information

Information on regional groundwater, including identification of tributary water courses, wells, springs, stock water ponds, reservoirs, and ditches within two miles of the Affected Lands Boundary, are shown on Figure G-1. The regional groundwater system is intersected by the Carlton Tunnel, which conveys regional groundwater six miles to the southwest, to its outlet near Cripple Creek & Victor Gold Mining Company

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the confluence of Fourmile Creek and Cripple Creek. An evaluation of the effects of overall Cresson Project activities on groundwater was provided in Amendment 11 documentation (December 2015). The activities proposed by Amendment 14 are not expected to fundamentally modify the hydro-geologic regime. The average regional groundwater flow from the District has not increased due to current mining and no increase is anticipated to occur due to proposed Amendment 14 activities.

As shown on Figure G-1, no significant groundwater usage occurs in the area of the diatreme. The wells located within the diatreme as shown on Figure G-1 are exclusively Cresson Project groundwater monitoring wells. Shallow groundwater in the Cresson Project occurs at some locations in alluvial aquifers associated with the surficial drainages or in shallow, fractured bedrock. Deeper groundwater in the District occurs in two distinct hydrologic zones that are strongly controlled by the geologic setting: i.e., the volcanic diatreme and the surrounding granitic rocks. A description of the general geology of the region, and specifically the geology beneath project areas has been provided in prior submittals.

The volcanic diatreme that was emplaced into the Pikes Peak granite formed an inverted cone of highly fractured volcanic rocks. The surrounding granite and gneiss are relatively impervious, except in the immediate vicinity of the diatreme, where it was fractured during the volcanic episodes. As a result, the brecciated rock within the diatreme filled with water, receiving recharge from the regional groundwater system, precipitation at the surface and storing it as groundwater in the faults, fractures, veins, and joint structures. The relatively impermeable Pikes Peak granite acted to hold this water in place within the diatreme, with local overflow to the west via springs in valleys that intersect at the boundary. A series of tunnels were created from the 1890s to 1941 as historical underground mining encountered water at depth. These tunnels lowered the regional groundwater elevation from the original elevation of approximately 9,500 feet above mean sea level (amsl) to a level between approximately 7,000 feet and 8,000 feet amsl. The regional groundwater system was intersected in 1941-42 at an elevation of approximately 7,000 feet amsl by the Carlton Tunnel, the portal of which is 7 miles southwest of the diatreme near the confluence of Four Mile Creek and Cripple Creek. Flow from the diatreme to this tunnel has controlled the water table in the diatreme ever since.

Recharge to the diatreme groundwater system occurs by regional inflow from the surrounding granite and infiltration of precipitation in the spring, summer, and fall months. Infiltrating water moves vertically downward through the unsaturated portion of the system either through the brecciated diatreme country rock, through sub-vertical fractures, through mined voids created during historical underground mining, or a combination of these pathways.

Surface manifestation of the natural groundwater flow system and the overlay of the flow removed from the diatreme by the historical flow to the tunnels intersecting the diatreme is apparent throughout the District. Streams in the central and southern portions of the diatreme tend to be ephemeral in nature, as most of the precipitation and snowmelt infiltrates into the porous rock and migrates downward. Exploration drill holes and development wells drilled within the diatreme tend to be dry or have low yields. Present activities at the Cresson Project have not encountered significant groundwater flow other than local perched aquifers that tend to contain limited amounts of water. The specific drainages where groundwater may be impacted are discussed below.

2.2.1 Wilson Creek

The activities associated with Amendment 14 are not expected to impact the groundwater resources in the Wilson Creek Drainage.

2.2.2 Vindicator Valley

The activities associated with Amendment 14 are not expected to impact the groundwater resources in the Vindicator Valley.

2.2.3 Arequa Gulch

The activities associated with Amendment 14 are not expected to impact the groundwater within the Arequa Gulch drainage.

2.2.4 Poverty Gulch

There are four groundwater monitoring wells in Poverty Gulch, PGMW-2, PGMW- 3, PGMW-4, and PGMW-5. PGMW-2 has been dry since installation in 2005 suggesting that bedrock groundwater is captured by the diatreme at this location. Groundwater monitoring within Poverty Gulch will continue during implementation of Amendment 14.

2.2.5 Cripple Creek

There are no groundwater monitoring wells in Cripple Creek. There are monitoring wells located in tributaries to Cripple Creek including Maize Gulch, Poverty Gulch and Arequa Gulch. In addition, the activities associated with Amendment 14 are not expected to impact groundwater quality in Cripple Creek.

2.2.6 Gold Run

Impacts to the groundwater quality and quantity within Gold Run are not expected as a result of the activities associated with Amendment 14.

2.2.7 Maize Gulch

The activities associated with Amendment 14 are not expected to have an impact on groundwater quality in the Maize Gulch drainage as the proposed activities will be entirely on previously disturbed lands.

2.2.8 Grassy Valley

The activities associated with Amendment 14 are not expected to impact groundwater in Grassy Valley.

3 WATER QUALITY MONITORING

CC&V maintains an extensive monitoring and stormwater management network at the Cresson Project. Various plans have been developed by CC&V to manage and monitor surface and groundwater quality including the following:

- Stormwater Management Plan, provided in Appendix 3; and
- Water Monitoring Quality Assurance Project Plan and Field Sampling, provided in Appendix 7.

Surface water and groundwater monitoring is conducted by CC&V qualified staff or outside contractors, as needed. Samples collected in connection with this monitoring program are analyzed by accredited third-party laboratories. Historical surface water and groundwater sampling data is provided as Appendix 6 to this Amendment 14 permit. Appropriate quality assurance and quality control (“QA/QC”) procedures are used to validate the sample collection and analytical methods.

3.1 Surface Water Monitoring

Surface water quality and flow monitoring will be conducted as stated in previous submittals on a quarterly basis. The following locations are recognized as compliance surface monitoring locations: one station down-gradient of Valley Leach Facility 1 (VLF1) on Arequa Gulch (AG-2.0); one station downgradient of the East Cresson Mine area on Theresa Gulch (T-2); a station downgradient of the

operations on Wilson Creek just below the confluence with Bateman Creek (WCSW- 01); and three stations in Grassy Valley (GV-02, GV-03, and GV-06). No surface water monitoring station is located downgradient of the VLF2 in Maize Gulch as this is a zero-discharge facility. VLF2 Phase 4 and VLF1 Phase 6 also will be closed loop facilities. Samples are collected at the surface

water monitoring stations, shown in Table G-1 below and on Figure G-1. A list of surface water parameters is provided below in Table G-2. CC&V analyzes surface water samples in accordance with Colorado Regulation 32 for the applicable stream classifications and numeric standards associated with the specific surface water drainages at the site. This program provides downgradient flows and water quality from major site drainages as a means of monitoring for potential changes to the character of the surface water systems.

Table G-1. Surface Water Monitoring Sites

Site	Location	Monitoring Frequency	Water Quality Standard
AG-2.0	Arequa Gulch Downstream	Quarterly	COARUA22A
GV-02	Grassy Valley adjacent to ECOSA Grassy Valley	Quarterly	COARUA24
GV-03	Downstream of GV-02		
GV-06	Downstream of GV-03 at permit boundary	Monthly	
T-2	Theresa Gulch Downstream	Quarterly	COARUA23
WCSW-01	Wilson Creek Downstream	Quarterly	COARUA23

Table G-2. Surface Water Monitoring Parameters

Parameters		
pH (Field)	Barium (mg/L) Total Recoverable	Temperature (°C)
Ammonia (mg/L as N) Total	Beryllium (mg/L) Total Recoverable	Manganese (mg/L) Total Recoverable
Cyanide [FREE] (Dissolved)	Cadmium (mg/L) Dissolved	Manganese (mg/L) Dissolved
Fluoride (mg/L)	Cadmium (mg/L) Total Recoverable	Mercury (mg/L) Total Recoverable
Nitrate (mg/L as N)	Chlorine (mg/L)	Molybdenum (mg/L) Total Recoverable
Nitrite (mg/L as N)	Chromium (mg/L) Dissolved	Nickel (mg/L) Dissolved
Boron (mg/L)	Chromium III (mg/L) Dissolved	Nickel (mg/L) Total
Chloride (mg/L)	Chromium III (mg/L) Total	Phosphorus (mg/L)
Sulfate (mg/L)	Chromium VI (mg/L) Dissolved	Selenium (mg/L) Dissolved
Aluminum (mg/L) Dissolved	Copper (mg/L) Dissolved	Silver (mg/L) Dissolved
Cyanide [WAD]	Iron (mg/L) Total Recoverable	Sulfide (mg/L)

3.2 Groundwater Monitoring

There are currently 51 active wells used for various monitoring activities at the site. Twenty-nine of these wells are monitored on a quarterly basis at most locations with some locations sampled more frequently. Groundwater data are submitted to DRMS on a quarterly basis and are provided in Appendix 6 of this Amendment 14 permit.

Groundwater monitoring information includes five successive calendar quarters of data for existing wells, which have been summarized for approximately 27 monitoring wells in the Cresson Project area, excluding Grassy Valley. Another 24 wells have been installed and monitored in Grassy Valley to provide overall water quality and water elevation. As noted in prior submittals, groundwater is not developed for use in this area and is not anticipated to be developed for use in the future in light of the overall lack of groundwater.

Groundwater quality and depth to groundwater is monitored on a quarterly basis at the following locations: downgradient of the AGVLF in Arequa Gulch (CRMW-3A, CRMW-3B, CRMW-3C, CRMW-5A, CRMW-5B, CRMW-5C, and CRMW-5D) and Wilson Creek (WCMW-3 and WCMW-6); downgradient of the SGVLF in Maize Gulch (SGMW- 5, SGMW-6A, SGMW-6B, SGMW-7A, SGMW-7B, and SGMW-8); downgradient of the East Cresson Mine area at two locations in Vindicator Valley (VIN-2A and VIN-2B) and seven locations in Grassy Valley (GVMW-8A, GVMW-8B, GVMW-22A, GVMW-22B, GVMW-25, GVMW-26A, and GVMW-26B); downgradient of the North Cresson Mine area in Poverty Gulch at four locations (PGMW-2, PGMW-3, PGMW-4, and PGMW-5); and downgradient of the External Storage Pond (“ESP”) in Arequa Gulch (ESPMW-1). A list of groundwater Point of Compliance Wells is provided in Table G-3, a list of Other Groundwater Monitoring locations in Table G-4, and parameters analyzed are listed in Table G-5.

Table G-3. Point of Compliance Wells

Site Number	Location	Monitoring Frequency
PGMW-5	Poverty Gulch	Quarterly
SGMW-8	Maize Gulch	
CRMW-5B	Arequa Gulch	
WCMW-6	Wilson Creek	
VIN-2B	Vindicator Valley	
GVMW-26A	Grassy Valley	Monthly
GVMW-26B	Grassy Valley	

Table G-4. Other Groundwater Monitoring Sites

Site Number	Location	Monitoring Frequency
PGMW-2	Poverty Gulch	Quarterly
PGMW-3		
PGMW-4		
SGMW-5	Maize Gulch	Quarterly
SGMW-6A		
SGMW-6B		
SGMW-7A		
SGMW-7B		
CRMW-3A	Arequa Gulch	Quarterly
CRMW-3B		
CRMW-3C		
CRMW-5A		
CRMW-5C		
CRMW-5D		
ESPMW-1		
WCMW-3	Wilson Creek	Quarterly
VIN-2A	Vindicator Valley	Quarterly
GVMW-8A	Grassy Valley	Quarterly
GVMW-8B		
GVMW-22A		
GVMW-22B		
GVMW-25		Monthly

Table G-5. Groundwater Monitoring Parameters

Parameters		
Aluminum (dissolved)	Cyanide [Free]	Nitrite (NO ₂)
Antimony (dissolved)	Fluoride (dissolved)	pH
Arsenic (dissolved)	Iron (dissolved)	Selenium (dissolved)
Barium (dissolved)	Lead (dissolved)	Silver (dissolved)
Beryllium (dissolved)	Lithium (dissolved)	Sulfate (dissolved)
Boron (dissolved)	Manganese (dissolved)	Thallium (dissolved)
Cadmium (dissolved)	Mercury (inorganic) (dissolved)	Total Nitrate + Nitrite (NO ₂ +NO ₃ -N)
Chloride (dissolved)	Molybdenum (dissolved)	Uranium (dissolved)
Chromium (dissolved)	Nickel (dissolved)	Vanadium (dissolved)
Cobalt (dissolved)	Nitrate (NO ₃)	Zinc (dissolved)
Copper (dissolved)	Cyanide [WAD] ¹	

¹ CN_{WAD} concentrations must be accompanied by a commensurate level of CN_{Free}. In addition, the CN_{Free} concentration in any sample must exceed 0.2 mg/L.

Groundwater may not be encountered in some wells completed to within a few hundred feet of the surface. In these cases, monitoring will be limited to checking water levels (i.e., checking for the presence of water) and samples will not be analyzed unless sufficient water is encountered to allow sampling and analysis of non-turbid water. No additional surface monitoring locations are proposed, as VLF1 and VLF2 are zero discharge facilities.

3.3 VLF1 Phase 6 Process Solution Storage Area (PSSA) Monitoring

VLF1 Phase 6 will also have a separate PSSA, which will have monitoring requirements similar to existing PSSAs. Design details for the VLF1 Phase 6 PSSA are provided in Appendix 1. Monitoring requirements at the leak detection systems, the high-volume solution collection systems, the low- volume solution collection systems, the pregnant solution storage areas, and

the external pond are described in Exhibit U, and various facility documents including the Water Monitoring Quality Assurance Project Plan and Field Sampling Guidance and the SPCC Plan (Appendix 7 and Appendix 11, respectively). The only change to VLF monitoring anticipated by Amendment 14 is the addition of monitoring requirements for the new Phase 6 PSSA.

The information presented below reflects the currently approved criteria for responding to changes in operating parameters observed as a result in monitoring activities. The situations outlined below are those that require further action.

- Underdrains: The 30-day running average of CNWAD monitoring data for an underdrain exceeds 1.0 mg/L and the 30-day running average pH value from monitoring data for the same underdrain for the same period exceeds 9.0.
- LDS: The 30-day running average of CNWAD monitoring data for a LDS exceeds 0.5 mg/L and the 30-day running average pH value for the same LDS monitoring data for the same period exceeds 9.0.
- HVSCS: The average of the water level monitoring data in the PSSAs exceeds 80 percent of the total capacity of the PSSA in a sustained manner for 24 hours.
- LVSCS, LDCRS: The transducers monitoring data in the LVSCS or LDCRS exceed two feet in a sustained manner for 72 hours.

The first response to the conditions listed above will be to verify that the measurements and data are accurate. This may involve re-sampling or revisiting the monitoring location to confirm the initial monitoring results. In the event that initial monitoring results are confirmed, verbal notice will be provided to DRMS. Recommendations will be provided to DRMS regarding further analysis of the situation and, if warranted, appropriate corrective actions will be developed and implemented. Corrective actions may include, but not be limited to, providing a written plan to DRMS regarding proposed measures for addressing the situation, changing flow rates to the various portions of the VLFs, discontinuing the addition of dilute sodium cyanide solution or make-up water, initiating detoxification operations, or other appropriate responses.

4 GROUNDWATER GEOCHEMISTRY

The groundwater hydrology and geochemistry of the District have been investigated since 1906 (Lindgren and Ransome, 1906). Detailed investigations of the groundwater hydrology and geochemistry have been conducted for permitting of Cresson Project extensions for Amendment 8 (Adrian Brown Consultants, 1998; Shepherd Miller Inc., 1998), MLE - Amendment 9, (Adrian Brown Consultants, 2008), and MLE2 - Amendment 10, (Adrian Brown Consultants, 2010), and Amendment 11 (Adrian Brown Consultants, 2015). The information provided as part of

Amendment 11 remains current. The most recent update to the geochemical model was provided in Appendix 1 in Volume II of Amendment 11 (December 2015).

The activities associated with Amendment 14 are not expected to affect the geochemistry of the site. Prior studies have evaluated the acid-generating potential and acid-neutralizing potential of sulfur oxidation of the rock mass within the District. Geochemical evaluations have been conducted on rock samples from drilling throughout the Cresson Project, from blast hole data, and from rock removed from the back and ribs of the Chicago Tunnel. These data are considered representative of the materials to be mined, stored at the surface or backfilled. The geochemical evaluations also have included an analysis of the reasonable sources, probable fate, and transport mechanisms of metal and acid-producing minerals that may be mobilized during development and reclamation of the Cresson Project.

Using the hydrologic and geochemical information developed for the District, an evaluation was conducted of the fate and transport of water infiltrating to the subsurface through mines, mine backfill, and over burden storage areas (OSAs). The results of the analysis were verified by checking against the observed behavior of the hydraulics and chemistry of the diatreme since Cresson Project surface mining began in 1993, using the measured vertical hydraulic gradients in and near the diatreme, and the flow rate and chemistry of the regional groundwater exiting the Carlton Tunnel portal.

5 PROJECTED WATER REQUIREMENTS

The projected water requirements for the proposed Amendment 14 activities are provided in the water balance developed for VLF1 Phase 6 and VLF2 Phase 4 designs, which is provided in Appendix 1 of the Amendment 14 application. CC&V maintains water supply agreements with the following entities to satisfy the water requirements for the entire Cresson Project including activities associated with Amendment 14.

- Pisgah Reservoir and Ditch Company – 419 acre-feet of storage to be used if needed. This agreement was updated October 17, 2023.
- City of Cripple Creek Utility – January 1, 2019. Lease agreement for 288 acre- feet of water in 2019, 276 acre-feet of water in 2020, 265 acre-feet of water in 2021, and 275 acre-feet in 2022-2024.
- Colorado Springs Utility – Water supply agreement for 300 acre-feet of water with an option of additional 600 acre-feet if needed. Agreement was renewed in 2015 and is valid for 10 years through 2025.

- City of Victor Agreement. Victor agrees to provide CC&V up to 1300 acre- feet per year of raw water with limitations. Agreement is in effect through 2024 with option to extend to 2050.
- Board of Public Works, Pueblo. This agreement states that Pueblo will make available 400 acre-feet of water per year and is in effect through April 30, 2024.

CC&V also maintains a Substitute Water Supply Plan – Consolidated Case No. 02CW122 and 10CW31, which was filed with the State of CO on March 29, 2017 and remains active.

Copies of the water agreements may be found in Appendix 4 of the Amendment 14 application.

6 WATER QUALITY DISCHARGE PERMITS

CC&V has four active Colorado Discharge Permit System (CDPS) discharge permits issued by the Colorado Department of Public Health and Environment (CPDHE) Water Quality Control Division (WQCD). These permits are:

1. CDPS Permit No. CO-0043648
2. CDPS Permit No. CO-0024562, which regulates flow from the Carlton Tunnel to Fourmile Creek
3. CDPS Permit No. CO-0046450, which regulates flows from seeps associated with the Carlton Tunnel area to Fourmile Creek; and,
4. CDPS Permit COR-040049, which is a stormwater permit for the operations.

The activities associated with Amendment 14 do not require additional CDPS permits as VLF1 and VLF2 are closed loop systems.

7 REFERENCES

Cripple Creek & Victor Gold Mining Company, Amendment 8 to the MLRB Permit No. M-1980-244, Volumes I – VIII, 2000.

Cripple Creek & Victor Gold Mining Company, Cresson Project Mine Life Extension, Amendment 9 to the MLRB Permit No. M-1980-244, Volumes I – VII, 2008.

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