UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION 7
901 NORTH 5TH STREET
KANSAS CITY, KANSAS 66101

DEC 23 2010

Mr. John Madras
Director, Water Protection Program
Water Protection and Soil Conservation Division
Missouri Department of Natural Resources
1101 Riverside Drive
Jefferson City, Missouri 65101

Dear Mr. Madras:

Re: Approval of Shibboleth Creek TMDLs

This letter responds to the Missouri Department of Natural Resources (MDNR) submission of a Total Maximum Daily Load (TMDL) document which contains cadmium, lead and zinc in sediment (S), dissolved cadmium, lead and zinc and inorganic sediment TMDLs for Shibboleth Creek segment 2120. The document was originally received by the United States Environmental Protection Agency (EPA), Region 7, on June 21, 2010. Revisions were made to the original submittal and the final version was resubmitted on December 20, 2010.

Shibboleth Creek was identified on the EPA-approved 2008 Missouri § 303(d) List as impaired for inorganic sediment. This submission fulfills the Clean Water Act statutory requirement to develop TMDLs for impairments listed on a state's § 303(d) List. The specific impairments (water body segment and pollutants) are:

Water Body Name	WBID	Pollutants
Shibboleth Creek	MO_2120	cadmium (S), lead (S) and zinc (S); dissolved cadmium, dissolved lead and dissolved zinc; and inorganic sediment

EPA has completed its review of the TMDL document with supporting documentation and information. By this letter, EPA approves the submitted TMDLs. Enclosed with this letter is the EPA Region 7 TMDL Decision Document summarizing the rationale for EPA's approval of the TMDLs. EPA believes the separate elements of the TMDL document, described in the enclosed form adequately address the pollutants of concern, taking into consideration seasonal variation and a margin of safety. Although EPA does not approve the monitoring plan submitted by the state, EPA acknowledges the state's efforts. EPA understands that the state may use the monitoring plan to gauge the effectiveness of the TMDL document and determine if future revisions are necessary or appropriate to meet applicable water quality standards.

EPA is currently in consultation under Section 7 of the Endangered Species Act with the United States Fish and Wildlife Service regarding the Shibboleth Creek TMDLs. While we are approving these TMDLs at the present time, we may decide that changes to the TMDL document are warranted based upon the results of the consultation when it is completed.

We appreciate the thoughtful effort that MDNR has put into these TMDLs. We will continue to cooperate with and assist, as appropriate, in future efforts by MDNR to develop TMDLs.

Sincerely,

Karen A. Flournoy

for William A. Spratlin
Director
Water, Wetlands and Pesticides Division

Enclosure

cc: Mr. John Hoke
Missouri Department of Natural Resources

Mr. Gerald Babao
American Canoe Association

Mr. Paul Sanford
American Canoe Association

Mr. Scott Dye
Sierra Club

Mr. John Simpson
KS Natural Resource Council

EPA Region 7 TMDL Review

TMDL ID: MO_2120 **State:** MO

Document Name: SHIBBOLETH CREEK

Basin(s): UPPER MISSISSIPPI-MERAMEC (BIG RIVER BASIN)

HUC(s): 07140104, 7140104

Water body(ies): SHIBBOLETH BR., SHIBBOLETH CREEK

Tributary(ies): BOTTOM DIGGINS DAM, MILL CREEK, POWDER SPRING LAKE DAM

Pollutant(s): CADMIUM, INORGANIC SEDIMENT, LEAD, ZINC

Submittal Date: 6/21/2010 **Approved:** Yes

Submittal Letter

State submittal letter indicates final Total Maximum Daily Load(s) (TMDL) for specific pollutant(s)/water(s) were adopted by the state, and submitted to EPA for approval under section 303(d) of the Clean Water Act [40 CFR § 130.7(c)(1)]. Include date submitted letter was received by EPA, date of receipt of any revisions, and the date of original approval if submittal is a phase II TMDL.

The TMDL document for Shibboleth Creek (Branch) was formally submitted by the Missouri Department of Natural Resources (MDNR) in a letter received by the United States Environmental Protection Agency (EPA), Region 7, on June 28, 2010. Revisions to the TMDL document were sent by email on October 14 and December 20, 2010.

Water Quality Standards Attainment

The water body's loading capacity (LC) for the applicable pollutant is identified and the rationale for the method used to establish the cause-and-effect relationship between the numeric target and the identified pollutant sources is described. TMDL and associated allocations are set at levels adequate to result in attainment of applicable water quality standards (WQS) [40 CFR § 130.7(c)(1)]. A statement that WQS will be attained is made.

Shibboleth Branch (2120) in Washington County has historically been misnamed in Missouri's WQS and 303(d) lists as Shibboleth "Creek." Effective for MDNR on October 30, 2009, the name, as listed in 10 CSR 20-7.031, Table H, was changed to Shibboleth "Branch" in order to agree with the stream as identified in the U.S. Geological Survey's Geographic Name Information System. Future Missouri 303(d) lists will reflect this correction.

The upper half mile of Shibboleth "Creek" was included on EPA-approved 1998 and 2002 303(d) Lists for Missouri for sediment and nonvolatile suspended solids (NVSS), respectively. The change from sediment to NVSS was to specify that the problem was due to mineral solids (e.g., silt, sand and gravel) coming from eroding mine waste materials and stockpiles. On the 2004/2006 and 2008 303(d) Lists, the pollutant, NVSS, was replaced with "inorganic sediment." Since NVSS and inorganic sediment have essentially the same meaning, the listing was changed to inorganic sediment to better characterize the impairment.

Another modification from previous 303(d) listings is a change by EPA on the 2004/2006 and 2008 303(d) Lists to include the entire classified segment length of three miles as impaired instead of the previous listing of only the upper 0.5 mile. The formerly-listed half mile was upstream of Powder Spring Lake, but the entire 3-mile segment reaches approximately 1.25 miles downstream of Powder Spring Lake's dam. In the 2008 303(d) List, the 3-mile upper segment of Shibboleth Creek (Branch - 2120) is listed as impaired by inorganic sediment eroded from barite mine tailings.

Before modern mechanization, it was common in Washington County for people to hand-mine lead on their family property. Barite was thrown to the side along with other non-lead "waste." Barite, or barium sulfate, also known as "tiff," is a mineral. A barite tailings dam was originally identified as the source of Shibboleth Branch's impairment. Old barite mining dams, such as those in the Shibboleth Branch watershed, were built prior to the

enactment of current safety laws administered by MDNR's Dam and Reservoir Safety Program. The barite mining companies were allowed to keep adding coarse rock to the top of the dams as a means of building up dam height to increase the size of the settling ponds. Due to the nature of the material used to build the dams, the dams themselves always seep water. The seeping water will often appear oily-looking due to bacteria metabolism of organics in clay. Portions or all of the downstream face of these dams remain barren even after decades, not necessarily because they are toxic, but because they lack the soil, nutrients and water retention needed to support plant life in the upper layers. When mining was active, water from a tailings pond was reused at the barite washer. Over time large deposits of red clay and gravel developed behind these dams, often as a deep layer the consistency of thick pudding. Barite tailings dams were not required to have both primary and secondary spillways. If wash water went over the spillway before the suspended clay had time to settle out, overflows could contain suspended clay material that would subsequently be deposited in the bottom of receiving streams. If the open channels, which often served as the only spillway, experienced erosion, clay and gravel would be deposited downstream from that source as well. Both phenomena were occurring at Bottom Diggins Dam and are believed to be the source of the problem sediment when MDNR first added Shibboleth Creek (Branch) to the 1998 303(d) List.

The water quality condition addressed in this TMDL is sedimentation. The stream was placed on the 1998 Missouri 303(d) List primarily based on MDNR's multiple observations of instream conditions exceeding narrative water quality criteria in the form of sediments being deposited into the stream and relatively low numbers of taxa.

Inorganic sediment is composed of mineral particles such as clay, silt, sand, assorted-sized rocks and other non-organic materials. These particles enter the stream via erosion of soils or other materials within the watershed. The deposited red clay constitutes the inorganic sediment that impair Shibboleth Creek (Branch). When these solids enter into a stream, they settle onto the bottom, smothering natural substrates (and interstitial spaces associated with that habitat), aquatic invertebrates and fish eggs.

Fine sediment was patchy, with some low flow areas having a greater than 90 percent cover. The site appeared to have a much higher percentage of sediment coverage in September of 2009, suggesting that sediment deposition may fluctuate seasonally and affect the macroinvertebrate community. Fluctuations in the amount of fine, inorganic sediment could alter the macroinvertebrate community and thus affect the stream's ability to support the aquatic life designated use. However, the presence of taxa considered intolerant to fine sediment suggests that fine sediment alone may not be the consistent source of the stream's impairment.

When water quality criteria are expressed as a narrative, a measurable indicator of a pollutant may be selected to express the narrative as a numeric value. There are many quantitative indicators of sediment, such as total suspended solids (TSS), turbidity and bedload sediment, which are appropriate to describe sediment in rivers and streams. A concentration of TSS was selected to represent the numeric target for this TMDL because it enables the use of the highest quality available data and is included in permit requirements and monitoring data. This target was derived based on a reference approach by targeting the 25th percentile of all available measurements in the Ozark/Meramec ecological drainage unit (EDU) in which Shibboleth Creek (Branch) is located.

The targets for TSS were based on load duration curves (LDCs), which determines the TMDL for that parameter at every flow probability. The reduction in sediment protects the warm water aquatic life use of the stream and the TMDL should result in WQS attainment.

The biological impairment of Shibboleth Creek (Branch) can also be attributed to elevated metals concentrations associated with fine sediment generated by the barite mining activities within the watershed. Concentrations of fine sediment and metals in the sediment will be used as a sediment target for the Shibboleth Creek (Branch) TMDL.

Sediment targets for cadmium, lead and zinc were set using the percent of those metals in a given mass of sediment such that the target level is consistent with the threshold effect concentration (TEC). A percent fine sediment target of 15 percent was developed using the median of the 75th percentiles from each of the control sites on the reference streams of Shoal Creek and the West Fork of Huzzah Creek, which were similar in size and found to be fully supporting of aquatic life (i.e., meeting WQS), as measured by macroinvertebrate counts. The LC was developed based on the mass of fine sediment that could be contained within a bottom sediment sample of a given mass.

At the 50 percent flow exceedence, the LC for Cadmium was 0.0044 pounds per day (lb/day), for Lead was 0.053 lb/day, for Zinc was 2.036 lb/day and for inorganic sediment (i.e., TSS) was 39.25 lb/day. For a 100 milligram (mg) bottom sediment sample, the LC would be less than 15 mg fine sediment.

Numeric Target(s)

Submittal describes applicable WQS, including beneficial uses, applicable numeric and/or narrative criteria. If the TMDL is based on a target other than a numeric water quality criterion, then a numeric expression, site specific if possible, was developed from a narrative criterion and a description of the process used to derive the target is included in the submittal.

Shibboleth Creek (Branch) (WBID 2120) has the following beneficial uses:
Livestock and Wildlife Watering
Protection of Warm Water Aquatic Life
Protection of Human Health (Fish Consumption)
Whole Body Contact Recreation - Category B

Use that is impaired:
Protection of Warm Water Aquatic Life

Inorganic Sediment
The impairment of Shibboleth Creek (Branch) is based on exceedence of the general, or narrative, criteria contained in Missouri's water quality rules at 10 CSR 20-7.031(3)(A), (C) and (G):
(A) Waters shall be free from substances in sufficient amounts to cause the formation of putrescent, unsightly or harmful bottom deposits or prevent full maintenance of beneficial uses.
(C) Waters shall be free from substances in sufficient amounts to cause unsightly color or turbidity, offensive odor or prevent full maintenance of beneficial uses.
(G) Waters shall be free from physical, chemical or hydrologic changes that would impair the natural biological community.

And from 10 CSR 20-7.031(4)(H):
(H) Solids. Water contaminants shall not cause or contribute to solids in excess of a level that will interfere with beneficial uses. The stream or lake bottom shall be free of materials which will adversely alter the composition of the benthos, interfere with the spawning of fish or development of their eggs or adversely change the physical or chemical nature of the bottom.

Metals
Toxic effects of metals on the biological community in Shibboleth Creek (Branch) are an exceedance of the general criteria at 10 CSR 20-7.031(D) that states:
(D) Waters shall be free from substances or conditions in sufficient amounts to result in toxicity to human, animal or aquatic life.

Also the WQS specific criteria for toxic substances found at 10 CSR 20-7.031(4)(B)1 states:
(B)1. Water contaminants shall not cause the criteria in Tables A and B to be exceeded. Concentrations of these substances in bottom sediments or waters shall not harm benthic organisms and shall not accumulate through the food chain in harmful concentrations, nor shall state and federal maximum fish tissue levels for fish consumption be exceeded.

Current cadmium, lead and zinc criteria for the protection of aquatic life use are expressed in dissolved form in units of micrograms per liter, or µg/L. These criteria are hardness dependent and calculated from the formulas shown below from Table A of 10 CSR 20-7.031) where "e" is the base of the natural logarithm (~2.718) and "ln" is the natural logarithm:

Dissolved Cadmium

$$\text{Acute} = e^{(1.0166*\ln(\text{Hardness}) - 3.062490)} * (1.136672 - (\ln(\text{Hardness})*0.041838)) = \mu g/L$$

$$\text{Chronic} = e^{(0.7409*\ln(\text{Hardness}) - 4.719948)} * (1.101672 - (\ln(\text{Hardness})*0.041838)) = \mu g/L$$

Dissolved Lead

$$\text{Acute} = e^{(1.273*\ln(\text{Hardness}) - 1.460448)} * (1.46203 - (\ln(\text{Hardness})*0.145712)) = \mu g/L$$

$$\text{Chronic} = e^{(1.273*\ln(\text{Hardness}) - 4.704797)} * (1.46203 - (\ln(\text{Hardness})*0.145712)) = \mu g/L$$

Dissolved Zinc

$$\text{Acute} = e^{(0.8473*\ln(\text{Hardness}) + 0.884211)} * 0.978 = \mu g/L$$

Chronic $= e^{(0.8473*\ln(\text{Hardness}) + 0.785271)} * 0.986 = \mu g/L$

The dissolved metals criteria are hardness dependent and the 25th percentile hardness value must be used to calculate hardness dependent dissolved metals criteria per 10 CSR 20-7.031(1)(Y) that states:

(Y) Water hardness—The total concentration of calcium and magnesium ions expressed as calcium carbonate. For purposes of this rule, hardness will be determined by the lower quartile (twenty-fifth percentile) value of a representative number of samples from the water body in question or from a similar water body at the appropriate stream flow conditions.

Using available hardness data with this formula results in the 25th percentile of hardness in the Pond Creek watershed being 160 milligrams per liter (mg/L).

When water quality criteria are expressed as a narrative, a measurable indicator of a pollutant may be selected to express the narrative as a numeric value. A concentration of TSS was selected to represent the numeric target for this TMDL because it enables the use of the highest quality available data and is included in permit requirements and monitoring data. The biological impairment of Shibboleth Creek (Branch) can also be attributed to elevated metals concentrations associated with fine sediment generated by the barite mining activities within the watershed. Concentrations of fine sediment and metals in the sediment will be used as another target for the Shibboleth Creek (Branch) TMDL.

Sediment targets for cadmium, lead and zinc were set using the percent of those metals in a given mass of sediment such that the target level is consistent with the TEC. A percent fine sediment target of 15 percent was developed using the median of the 75th percentiles from each of the control sites on the reference streams. The LC relationship was developed based on the mass of fine sediment that could be contained within a bottom sediment sample of a given mass.

A concentration of TSS was selected to represent the numeric target for this TMDL because it enables the use of the highest quality available data and is included in permit requirements and monitoring data. This target was derived based on a reference approach by targeting the 25th percentile of all available measurements in the Ozark/Meramec EDU in which Shibboleth Creek (Branch) is located.

Pollutant(s) of concern

An explanation and analytical basis for expressing the TMDL through surrogate measures (e.g., parameters such as percent fines and turbidity for sediment impairments, or chlorophyll-a and phosphorus loadings for excess algae) is provided, if applicable. For each identified pollutant, the submittal describes analytical basis for conclusions, allocations and margin of safety (MOS) that do not exceed the LC. If submittal is a phase II TMDL there are refined relationships linking the load to WQS attainment. If there is an increase in the TMDL there is a refined relationship specified to validate the increase in TMDL (either load allocation (LA) or waste load allocation (WLA)). This section will compare and validate the change in targeted load between the versions.

The dissolved metals targets were set using a direct link to the chronic numeric Missouri WQS. All other TMDL targets were set using established links. The TMDL links the narrative WQS to reductions in sediment.

When water quality criteria are expressed as a narrative, a measurable indicator of a pollutant may be selected to express the narrative as a numeric value. There are many quantitative indicators of sediment, such as TSS, turbidity and bedload sediment, which are appropriate to describe sediment in rivers and streams. A concentration of TSS was selected to represent the numeric target for this TMDL because it enables the use of the highest quality available data and is included in permit requirements and monitoring data. When narrative criteria are targeted for an impaired segment a reference approach is used. Currently, Missouri does not have a numeric criterion for inorganic sediment. Because a measurement of TSS concentration is the sum of all organic and inorganic suspended solids, inorganic sediment concentration in the water column is at most equal to that of TSS. Assuming the ratio of inorganic sediment to TSS is constant for a particular watershed and during a specific event, any reduction in one would parallel that of the other. TSS concentration may be used as the target for the inorganic sediment impairment.

EDUs are delineated drainage units that are described by physiographic and major riverine components. Similar size streams within an EDU are expected to contain similar aquatic communities and stream habitat conditions. Comparisons of biological, physical and chemical results between test streams and similar size reference streams within the same EDU should then be appropriate. In the case of Shibboleth Creek (Branch), data from the Ozark/Meramec Ecological Drainage Unit (No. 25) was used.

The biological impairment of Shibboleth Creek (Branch) can also be attributed to elevated metals concentrations associated with fine sediment generated by the barite mining activities within the watershed. Concentrations of fine sediment and metals in the sediment will be used as the metals in sediment target for the Shibboleth Creek (Branch) TMDL.

A percent fine sediment target of 15 percent was developed using the median of the 75th percentiles from each of the control sites on the reference streams. The LC was developed based on the mass of fine sediment that could be contained within a bottom sediment sample of a given mass. For example, a 100 mg bottom sediment sample should contain no more than 15 mg of fine sediment.

Examples of Bottom Sediment TMDL at 100 mg Mass of Sample

Mass of Sample (mg)	TMDL Mass Fine Sediment (mg)	TMDL Mass Cadmium (mg)	TMDL Mass Lead (mg)	TMDL Mass Zinc (mg)
100	15	0.00001485	0.000537	0.001815

For heavy metals in fine bed sediment, the anticipated WLA reduction from the point source was calculated by subtracting the consensus based TEC for each of the metals measured in sediment from their maximum respective sediment concentrations in Shibboleth Creek (Branch).

Source Analysis

Important assumptions made in developing the TMDL, such as assumed distribution of land use in the watershed, population characteristics, wildlife resources, and other relevant information affecting the characterization of the pollutant of concern and its allocation to sources, are described. Point, nonpoint and background sources of pollutants of concern are described, including magnitude and location of the sources. Submittal demonstrates all significant sources have been considered. If this is a phase II TMDL any new sources or removed sources will be specified and explained.

There are currently no permitted dischargers (facilities, storm water outfalls or concentrated animal feeding operations [CAFOs]) within the Shibboleth Creek (Branch) watershed that cause or contribute inorganic sediment to the impaired segment. However, active and abandoned mine areas can be classified as point sources due to the nature of mining and milling activities, regardless if they are currently covered by a discharge permit. The Cimbar Performance Materials, Dresser Industries and other abandoned mine land (AML) areas in the watershed may therefore collectively be considered a point source even though there is no longer a State Operating Permit issued in the watershed.

AML: A barite mining company held a site specific permit (MO0000221) for this area from 1976 until June 4, 2004, when the permit was terminated. There were four main barite mine tailings dams in the Cadet area associated with the permitted operation: Bottom Diggins Dam, which was constructed across the headwaters of Shibboleth Creek (Branch) itself, and Cadet Dams #1, #2 and #3. Unsanctioned vehicle traffic across the dam and spillway resulted in substantial erosion on the spillway itself and resulting in continuous contributions of sediment to Shibboleth Creek (Branch). The 1996 relocation of the spillway solved that problem.

Until 1992, Cadet #2 dam discharged into a ditch which found its way to Shibboleth Creek (Branch). Bottom Diggins and Cadet #2 dams were the only point sources that were linked to the various complaints. Nonpoint sources, such as local roads may well have contributed to, or exacerbated, the problem if incidents were associated with heavy rainfall. A general permit, MOG490947, was issued to Cimbar Performance Minerals on October 6, 2006, for their area in NE 1/4, NE 1/4, S32, T38N, R3E, Washington County. The intention was to allow Cimbar, who had ceased mining this area in 1999, to change their MDNR permit. The four dams in the Shibboleth Creek (Branch) watershed, which were formerly covered by site specific permit MO0000221, no longer serviced active mining and were not included in the new general permit. The general permit was issued to cover activities at Cimbar's local headquarters, located approximately 1.5 miles south of the Cadet dams and expires October 5, 2011.

The facility is a dry grinding plant using no water. Barite processed at this facility is imported from outside Missouri rather than mined locally. The receiving stream listed in the general permit is an unnamed, unclassified tributary to Fountain Farm Branch, a Class C stream (WBID 3657), which is a tributary to Mill Creek upstream (south) of the Shibboleth Creek (Branch)/Mill Creek confluence. Because the area covered under this permit is not within the Shibboleth Creek (Branch) watershed, it is not considered a contributor to the stream's impairment.

The four dams formerly associated with the barite mining activities are no longer permitted. While barite mining activities have ceased and the area is no longer permitted by MDNR, the entire barite mining area is considered a point source of the pollutants of concern. MDNR believes these dams are no longer contributing to the impairment.

Bottom Diggins Dam (Dam Safety ID No. MO 30750; Registration Permit No. R-431; expiration date: January

25, 2011)
Cadet Dam #1 (Dam Safety ID No. MO 30704; Registration Permit No. R-444; expiration date: October 30, 2012)
Cadet Dam #2 (Dam Safety ID No. MO 31830; Registration Permit No. R-326; currently expired)
Cadet Dam #3 (Dam Safety ID No. MO 30707; Registration Permit No. R-372; expiration date: October 30, 2012)

The primary cause of the inorganic sediment impairment to Shibboleth Creek (Branch) was originally identified on Missouri's 303(d) lists as the eroding spillway on the left embankment of Bottom Diggins Dam. Since then, the problem spillway was relocated to the right embankment in 1996. Mining and the associated barite washing ceased in the watershed by 1999. Thus, AMLs are currently thought to be the primary contributors to the continued impairment.

Onsite wastewater treatment: Onsite wastewater treatment systems (e.g., individual home septic systems) are considered potential nonpoint sources of pollution. When onsite wastewater treatment systems are properly designed and maintained, they should not serve as a source of contamination to surface waters. When these systems fail hydraulically (surface breakouts) or hydrogeologically (inadequate soil filtration), there can be adverse effects to surface water quality. Failing septic systems are sources of nutrients that can reach nearby streams through both surface runoff and ground water flows. They are not known to be large contributors of inorganic sediment to local streams and therefore is insignificant and will not be addressed in this TMDL.

Storm water runoff: Storm water runoff from urban areas can be a significant source of inorganic sediment. Detailed examination of an aerial photo taken of the alleged urban area in 2009 reveals woodland, a few roads, a few houses, grassland and some barren areas. Even if roads and houses were being lumped into an "urban" land use, only a small fraction of this particular urban area portrayed on the map west and north of old Dresser #4 tailings pond, would actually be considered an urban land use. It is likely that considerably less than 4 percent of the watershed's land use currently supports an urban use. It is unlikely that storm water from the majority of urban land use in the watershed is contributing to the inorganic sediment impairment. It is possible that contributions of inorganic sediment to Shibboleth Creek (Branch) may come from the "home" component of the urban land use category, especially during the construction phase. Significant inorganic sediment suspension and re-deposition can occur during and immediately following high-flow storm events. This process allows previously unavailable inorganic sediment to enter the water column and become a water quality concern as a secondary source of contamination.

Agricultural nonpoint sources: Another potential source of the inorganic sediment impairment to Shibboleth Creek (Branch) is runoff from agricultural nonpoint sources. Anywhere land is exposed, soil is vulnerable to erode and can be carried by storm water into a stream, resulting in increased turbidity and inorganic sediment concentrations. Cropland is particularly vulnerable to erosion. However, since only 1.7 percent (95 acres) of land use in the watershed is in cropland, it is not believed to be a significant contributor to the inorganic sediment impairment of Shibboleth Creek (Branch).

Countywide data from the National Agricultural Statistics Service (NASS) were combined with the size of the Shibboleth Creek (Branch) watershed to estimate that there could be up to 380 cattle in the watershed. The cattle that exist are most likely located on the approximately 1,373 acres (24 percent of land use) of grassland and pastureland in the watershed. There were over 1,000 horses and ponies in Washington County. Their grazing densities have the potential to influence inorganic sediment entering the stream.

Although there are no state-permitted CAFOs in the watershed, the presence of lower density livestock populations must be considered as a possible source of the inorganic sediment load in Shibboleth Creek (Branch). Livestock tend to concentrate near feeding and watering areas causing those areas to become barren of plant cover, thereby increasing the possibility of erosion during a storm event. Overland runoff during rain events can easily carry inorganic sediment to the stream from any areas made barren by livestock related activities. The density of cattle in the upper Shibboleth Creek (Branch) watershed may indeed be high enough to be contributing to the inorganic sediment impairment of the stream.

Animal feeding operations (AFOs) and unpermitted CAFOs are considered under the LA because we do not currently have enough detailed information to know whether these facilities are required to obtain NPDES permits. This TMDL does not reflect a determination by EPA that such facility does not meet the definition of a CAFO, nor that the facility does not need to obtain a permit. To the contrary, a CAFO that discharges or proposes to discharge has a duty to obtain a permit. If it is determined that any such operation is an AFO or CAFO that discharges, any future WLA assigned to the facility must not result in an exceedance of the sum of the WLAs in this TMDL as approved.

Any CAFO that does not obtain an NPDES permit must operate as a no discharge operation. Any discharge from an unpermitted CAFO is a violation of Section 301. It is EPA's position that all CAFOs should obtain an NPDES permit because it provides clarity of compliance requirements, authorization to discharge when the discharges are the result of large precipitation events (e.g., in excess of 25-year and 24-hour frequency/duration) or are from a man-made conveyance.

Riparian: Well-vegetated riparian areas act as buffers and are a vital functional component of stream

ecosystems. They are instrumental in the detention, removal and assimilation of sediment, excess nutrients and other pollutants before they reach a stream. A stream with a well-vegetated riparian corridor is better protected from the impacts of storm water laden with sediment, nutrients and pesticides than is a stream with a poorly vegetated corridor. Wooded riparian corridors can also provide shade that reduces stream temperatures, which can increase the dissolved oxygen saturation capacity of the stream and provide tree roots that stabilize stream banks and resist bank erosion more effectively than grasses, row crops or shrubbery. Almost 15 percent of the land in the upper Shibboleth Creek (Branch) riparian corridor is classified as grassland, which could include pasture areas. Grassland provides limited benefits in riparian corridors compared to wooded corridors and, since it may be grazed, can also be associated with livestock activities that could contribute inorganic sediment to the stream. Forest and woodland comprise 66.5 percent of the land use. Open water and wetlands is 2.3 percent and barren is 1.1 percent of the land use in this watershed. A lack of good riparian corridor conditions is not likely a major contributor to the water quality problem in Shibboleth Creek (Branch).

Nonpoint pollution sources could include storm water runoff from public and private roads and driveways, home construction sites and any areas where local soils are barren of vegetation. The most likely possible nonpoint sources of inorganic sediment entering Shibboleth Creek (Branch) include:

- Local "Tiff" soil series
- Washington County roads
- Home building south of Bottom Diggins Lake

Local Tiff soil series
These deep, red soils are ubiquitous in the area and regardless of past mining activity, provide a continuous source of erodible material. A certain amount of sediment enters the stream naturally due to normal fluvial processes and accounts for a natural background level of inorganic sediments. The existing, ubiquitous soil type is prone to erosion and transport.

Washington County roads
Many of the local roads in the watershed, whose associated ditches eventually drain into Shibboleth Creek (Branch), remain unpaved. These roads are built of local soils and materials, much of which is vulnerable to erosion. Powder Spring Lake Road, which runs along the south side of Shibboleth Creek (Branch) upstream from Powder Spring Lake, was blacktopped five or six years ago. The road ditches can carry locally eroded soil material from the roads themselves, as well as from any local land disturbance activities (e.g., home construction), directly to Shibboleth Creek (Branch). Regardless of whether or not the roads are surfaced, periodic county road maintenance includes opening up the ditches that run along both sides of the roads. The county does this by cutting deep into the ditch and turning the collected red clay up onto the outside top edge of the ditch. This practice succeeds in temporarily opening up the ditches to facilitate handling storm water off road surfaces and is a necessary and unavoidable road maintenance practice. The majority of the removed material is trucked away, but it exposes freshly turned over deposits of clay soil to storm water erosion and may serve as another source of this material. In addition, historically, either private or public entities were known to sometimes "mine" the downstream faces of some of the old barite dams in the county for use on private or public roads. This practice may destabilize the dam and expose deeper layers of materials in the dam that may contain clay fines vulnerable to erosion by precipitation.

Residential home building south of Bottom Diggins Lake
Since the land in this mining area was sold to private concerns starting in 2004, at least eight new homes are reported to have been built in the Shibboleth Creek (Branch) headwaters, many of which were built south of Bottom Diggins Lake. If appropriate best management practices (BMPs) were not used to control soil erosion at building sites, these activities could contribute to the impairment of Shibboleth Creek (Branch). Activities at these building sites are considered nonpoint sources as they were assumed to be less than one acre in size and therefore not covered by MDNR's general land disturbance permit.

In the absence of an NPDES permit, the discharges associated with sources were applied to the LA, as opposed to the WLA for purposes of this TMDL. The decision to allocate these sources to the LA does not reflect any determination by EPA as to whether these discharges are, in fact, unpermitted point source discharges within this watershed. In addition, by establishing these TMDLs with some sources treated as LAs, EPA is not determining that these discharges are exempt from NPDES permitting requirements. If sources of the allocated pollutant in this TMDL are found to be, or become, NPDES-regulated discharges, their loads must be considered as part of the calculated sum of the WLAs in this TMDL. WLA in addition to that allocated here is not available.

All known sources have been considered.

Allocation - Loading Capacity

Submittal identifies appropriate WLA for point, and load allocations for nonpoint sources. If no point sources are present the WLA is stated as zero. If no nonpoint sources are present, the LA is stated as zero [40 CFR § 130.2 (f)]. If this is a phase II TMDL the change in LC will be documented in this section.

For dissolved cadmium, dissolved lead and dissolved zinc, the LAs are zero and the MOS are implicit. Dissolved metals targets were calculated based on the applicable chronic criterion for dissolved cadmium, lead and zinc at

the watershed 25th percentile hardness of 160 mg/L.

For sediment, the LA is zero and the MOS is an explicit 10 percent of the LC.

WLA are calculated using the LDC approach with examples given for various percent flow exceedances.

Mass sediment targets were given for cadmium, lead and zinc as TMDL targets for the metals in sediment.

WLA Comment

Submittal lists individual WLAs for each identified point source [40 CFR § 130.2(h)]. If a WLA is not assigned it must be shown that the discharge does not cause or contribute to WQS excursions, the source is contained in a general permit addressed by the TMDL, or extenuating circumstances exist which prevent assignment of individual WLAs. Any such exceptions must be explained to a satisfactory degree. If a WLA of zero is assigned to any facility it must be stated as such [40 CFR § 130.2(i)]. If this is a phase II TMDL any differences in phase I and phase II WLAs will be documented in this section.

Due to the minor contribution of inorganic sediment from nonpoint sources within the watershed, it is reasonable to allocate the entire LC to point sources. The WLA for bedded sediment must be met at any point in each segment. For percent fine sediment cover in the stream bed, the anticipated WLA reduction from the point source (Cimbar Performance Minerals AMLs) was calculated by subtracting the median of the 75th percentile for cover in the control streams from the central median percent cover in Shibboleth Creek (Branch) (57 percent).

The anticipated average WLA reduction from point sources (i.e., abandoned mine lands) was calculated by subtracting the average WLA during low flow conditions (90th percentile) from the total current point source loading (Section 6.2.2 within the TMDL document). The maximum TSS concentration in the dataset is 6 mg/L, the percent reduction needed is 45 percent.

For heavy metals in fine bed sediment, the anticipated WLA reduction from the point source was calculated by subtracting the consensus based TEC for each of the metals measured in sediment from their maximum respective sediment concentrations in Shibboleth Creek (Branch). Cadmium is a 90 percent reduction, lead is a 96 percent reduction and zinc is a 86 percent reduction.
However, while a WLA was calculated for the unpermitted AML, any allocation given does not reflect an authorization to discharge from an unpermitted point source.

For example at the 90 percent flow exceedance WLAs are:

Dissolved Cadmium (implicit Margin of Safety)
WLA (0.0007 lb/day) = TMDL (0.0007 lb/day) – LA (0.0 lb/day)

Dissolved Lead (implicit Margin of Safety)
WLA (0.008 lb/day) = TMDL (0.008 lb/day) – LA (0.0 lb/day)

Dissolved Zinc (implicit Margin of Safety)
WLA (0.3054 lb/day) = TMDL (0.3054 lb/day) – LA (0.0 lb/day)

Sediment (10 percent MOS)
WLA (8.60 lb/day) = TMDL (9.56 lb/day) – MOS (0.96 lb/day) – LA (0.0 lb/day)

It should be noted, that while a WLA has been calculated for point sources, including any unpermitted abandoned mines, any allocation does not reflect an authorization to discharge from an unpermitted point source. Discharging pollutants to waters of the state without a permit is a violation of both state and federal clean water law. Should it become necessary to permit currently unpermitted abandoned mines or tailings piles, those areas must follow MDNR's permit application and antidegradation processes and will be evaluated in light of this TMDL.

LA Comment

Includes all nonpoint sources loads, natural background, and potential for future growth. If no nonpoint sources are identified the LA must be given as zero [40 CFR § 130.2(g)]. If this is a phase II TMDL any differences in phase I and phase II LAs will be documented in this section.

Because there are negligible nonpoint source loading of dissolved cadmium, lead and zinc and minor nonpoint source loading of inorganic sediment to the impairments in Shibboleth Creek (Branch),

no allocation to nonpoint sources is necessary under this TMDL.

While nonpoint sources of inorganic sediment and metals are minor or negligible under critical low-flow conditions, historic and legacy inorganic sediment and metals within the stream system can be sources of these pollutants, especially during higher flows. As conservative pollutants, inorganic sediment and metals do not degrade and historic pollutants can become re-suspended into the water column and carried downstream via natural fluvial processes. Significant inorganic sediment and metals suspension and re-deposition can occur during and immediately following high-flow storm events. This process allows previously unavailable inorganic sediment and metals to enter the water column and become a water quality concern as a secondary source of metals contamination. However, because the source of these materials is from abandoned mine areas and associated with the point source (WLA) portion of the TMDL, the LA does not reflect this secondary contribution to stream loading.

The LA is zero for dissolved cadmium, lead and zinc metals due to negligible nonpoint source loading of these metals.

The LA is zero for inorganic sediment and fine sediment, due to negligible loading from nonpoint sources.

Margin of Safety

Submittal describes explicit and/or implicit MOS for each pollutant [40 CFR § 130.7(c)(1)]. If the MOS is implicit, the conservative assumptions in the analysis for the MOS are described. If the MOS is explicit, the loadings set aside for the MOS are identified and a rationale for selecting the value for the MOS is provided. If this is a phase II TMDL any differences in MOS will be documented in this section.

This TMDL relies on both implicit and explicit MOS derived from a variety of calculations and assumptions.

In deriving the dissolved cadmium, lead and zinc TMDLs, an implicit margin of safety was applied by using chronic water quality criteria for these metals and using the resulting values for both water column and interstitial water (porewater) targets.

To set inorganic sediment metal TMDLs for cadmium, lead and zinc, TECs for these metals in sediment were used. TECs should be used to identify sediments that are unlikely to be adversely affected by sediment-associated contaminants. In contrast, the Probable Effects Concentration (PEC) should be used to identify sediments that are likely to be toxic to sediment-dwelling organisms. TECs for metals toxicity in sediment was chosen over PECs because it is a level below which no toxicity should occur and is thus protective of chronic and sub-chronic exposure. The conservative assumptions and factors used in this method should account for any uncertainties in the loading calculations.

The MOS for percent fine sediment was also implicit because the WLA percent reduction targets the 75th percentile of the reference population frequency distribution.

Due to the lack of available inorganic sediment data, an explicit MOS of 10 percent was applied when deriving the inorganic sediment TMDL.

Seasonal Variation and Critical Conditions

Submittal describes the method for accounting for seasonal variation and critical conditions in the TMDL(s) [40 CFR § 130.7(c)(1)]. Critical conditions are factors such as flow or temperature which may lead to the excursion of WQS. If this is a phase II TMDL any differences in conditions will be documented in this section.

Federal regulations at 40 CFR § 130.7(c)(1) require TMDLs take into consideration seasonal variation in applicable standards. The impairment of Shibboleth Creek (Branch) is due to inorganic sediments being carried into the water body through storm water runoff. These conditions are more likely to occur during seasonal periods having significant precipitation. The TMDL LDC represents flow under all possible stream conditions. The advantage of a LDC approach is that it avoids the constraints associated with using a single flow critical condition during the development of the TMDL. Because the TMDL is applicable under all flow conditions, it is also applicable for all seasons. Seasonal variation is therefore implicitly taken into account within the TMDL calculations.

Annual low-flow conditions in Missouri typically occur between July 1 and September 15. When flow is at its lowest and there is effectively no flow from nonpoint sources, points source discharges would have the greatest impact on stream integrity. Significant inorganic sediment suspension and re-deposition can occur during and

immediately following high-flow storm events. This process allows previously unavailable inorganic sediment to enter the water column and become a water quality concern as a secondary source of contamination. It is probable that sediment loading of the stream occurs mainly during high flow events that have not been captured by water quality sampling.

The LDC method was used to calculate pollutant specific TMDLs for the impaired segment of Shibboleth Creek (Branch). Because the LDC method relies on measured water quality data, regional water hardness data and a wide range of "flow exceedance" data, it represents a complete range of flows and pollutant loads anticipated in Shibboleth Creek (Branch).

Public Participation

Submittal describes required public notice and public comment opportunity, and explains how the public comments were considered in the final TMDL(s) [40 CFR § 130.7(c)(1)(ii)].

EPA regulations require that TMDLs be subject to public review (40 CFR 130.7). The comment period, for the Shibboleth Creek (Branch) TMDL was open for 45 days, from April 30 to June 14, 2010, by placing a Public Notice, the draft TMDL and the associated TMDL Information Sheet on MDNR's website, making them available to anyone with access to the Internet. Public notices to comment on the draft TMDL were also distributed via mail and electronic mail to stakeholders in the watershed or other potentially impacted parties. No comments were received.

Monitoring Plan for TMDL(s) Under Phased Approach

The TMDL identifies a monitoring plan that describes the additional data to be collected to determine if the load reductions required by the TMDL lead to attainment of WQS, and a schedule for considering revisions to the TMDL(s) (where phased approach is used) [40 CFR § 130.7].

A sediment and biological monitoring study was completed for Shibboleth Creek (Branch) in September 2009. MDNR intends to conduct follow up biological monitoring on Shibboleth Creek (Branch) to confirm the status of the macroinvertebrate community. Biomonitoring is scheduled for both segments of this stream for the 2011 State Fiscal Year, along with monitoring for heavy metals in sediment. Any additional water quality data that is collected in the Shibboleth Creek (Branch) watershed will be evaluated in light of this TMDL.

Reasonable Assurance

Reasonable assurance only applies when less stringent WLAs are assigned based on the assumption of nonpoint source reductions in the LA will be met [40 CFR § 130.2(i)]. This section can also contain statements made by the state concerning the state's authority to control pollutant loads.

EPA believes that point source permitting authority and nonpoint source measures discussed in the implementation plan provides reasonable assurances that the TMDL allocations can be achieved.

Increased reductions in nonpoint source loads are not being required in lieu of less stringent WLAs. There are no permitted point source discharges of inorganic sediment and heavy metals within the Shibboleth Creek (Branch) watershed. The abandoned barite mine lands are considered a point source for the purposes of this TMDL. WLAs to improve water quality may be incorporated into any future Missouri State Operating Permit (either site-specific industrial or storm water) or other appropriate enforceable document.

MDNR has the authority to issue and enforce state operating permits. Inclusion of effluent limits into a state operating permit and requiring that effluent and instream monitoring be reported to MDNR should provide reasonable assurance that instream WQS will be met. Section 301(b)(1)(C) requires that point source permits have effluent limits as stringent as necessary to meet WQS. However, for WLAs to serve that purpose, they must themselves be stringent enough so that (in conjunction with the water body's other loadings) they meet WQS. This generally occurs when the TMDL's combined nonpoint source LAs and point source WLAs do not exceed the WQS-based LC and there is reasonable assurance that the TMDL's allocations can be achieved. Discussion of reduction efforts relating to nonpoint sources can be found in the implementation section of the TMDL.

Past barite mining in the Shibboleth Creek (Branch) watershed left a legacy of related land disturbance, including creation of barite tailings dams. When it rains, the water suspends the fine particles of sediment and metals and carries them to the waterways in the watershed. These particles impair aquatic life due to metals toxicity and/or through loss of habitat due to excessive sedimentation. The following implementation strategies should be considered to ensure the improvement of water quality within the Shibboleth Creek (Branch) watershed addressed by this TMDL.

It is difficult to estimate future development within the watershed. Any activities disturbing one or more acres of

land within the Shibboleth Creek (Branch) watershed must be covered by a permit issued by MDNR's Water Protection Program. Disturbances of under one acre of land within the watershed should ideally involve implementation of appropriate BMPs to control soil erosion.

Local unpaved roads are constructed in the ubiquitous Tiff soil type and are thus potential sources of sediment in Shibboleth Creek (Branch). The county is encouraged to follow BMPs when conducting road maintenance involving the Tiff soil series in order to minimize disturbance and subsequent contributions of sediment to Shibboleth Creek (Branch).

Nonpoint source reductions are currently not necessary to reduce pollutant loading of inorganic sediment and metals to the Shibboleth Creek (Branch) watershed. Reductions obtained by implementing the WLAs found in this TMDL should restore water quality in Shibboleth Creek (Branch). However, BMPs employed within the watershed must continue to be implemented to ensure antidegradation requirements are met. Further nonpoint source reductions in the watershed may be implemented in the future through BMPs funded wholly or in part by Section 319 grants or various cost-share opportunities available through MDNR's Soil and Water Conservation Program and the federal Natural Resources Conservation Service.

Potential follow-up projects include field observation and inventory of the area to determine whether all grassland areas in the watershed are grazed, the condition of that grassland, and if the extrapolated rate of 0.28 cattle per acre is accurate. However, physically canvassing an entire watershed would likely require manpower and landowner consent beyond MDNR's means. The information needed to make this assessment may or may not be available through the local Soil and Water Conservation District (SWCD) or Natural Resources Conservation Service office. This only applies if landowners voluntarily enrolled and participated in the available programs and adopted associated BMPs to reduce soil loss using cost-share. Considering the soil type in the immediate watershed, adoption of BMPs to ensure adequate erosion control in grazing areas would be prudent. However, a records survey by the Washington County SWCD revealed few participants in the county.