Summary and Update of Stream Biology and Habitat Information for the Montanore Project

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December 21, 2004

Summary

The proposed facilities and activities associated with the Montanore Project are within the upper portion of the drainage of Libby Creek and three tributaries to its upper reach, Ramsey Creek, Poorman Creek, and Little Cherry Creek. This report summarizes and updates all available information on fish, stream invertebrates, periphyton, and stream habitat in the Project area. Below the Libby Creek falls, eight fish species and salmonid hybrids have been reported. Only bull trout have been reported upstream of the falls on upper Libby Creek. In Ramsey, Poorman, and Little Cherry Creeks, reported salmonid species occurrence has varied over time and between streams. Hybrids of Columbia basin redband trout, rainbow trout, and westslope cutthroat trout have been identified using genetic analysis. Pre-construction monitoring can more thoroughly characterize habitat in stream reaches that would be impacted by the Operation and provide additional documentation on fish species distribution, spawning and rearing areas, and physical barriers to upstream fish movement.

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Abbreviations

EIS – Environmental Impact Statement

MFWP – Montana Department of Fish, Wildlife and Parks

WRD – Western Resource Development Corporation

WTE – Western Technology & Engineering, Inc.

(a.k.a. WESTECH Environmental Services, Inc.)

USFS – U.S. Forest Service

Acknowledgements

I appreciate the assistance of Paul Hooper and Steve Wegner of the U.S. Forest Service, and Jim Dunnigan , Mike Hensler, and Neil Benson of the Montana Department of Fish, Wildlife and Parks in acquiring and interpreting information for this report.

Background

The Montanore Project is a proposed underground copper and silver mine located in northwest Montana (Figure 1). The proposed facilities and activities associated with the Project are within the upper portion of the drainage of Libby Creek and three tributaries to its upper reach, Ramsey Creek, Poorman Creek, and Little Cherry Creek (Figure 2). Libby Creek and these three upper tributaries originate on the eastern slopes of the Cabinet Mountains. Libby Creek is 29 miles in length. It is a tributary to the Kootenai River, within the Columbia River basin.

Fish populations in the Project area have historically been influenced by human disturbance and introduction of non-native species (details on file with Mark White, USFS, Libby Ranger District). The first such introductions in Libby Creek were rainbow trout from California and brook trout from the eastern U.S. in 1914. Largely unregulated placer mining, underground mining, and ore processing conducted between 1867 and the 1940's destroyed much of the fish habitat in the Project area, with the exception of the upper reaches of Ramsey Creek and Poorman Creek. Floods, regrowth of conifers, and restoration efforts have begun to stabilize the altered portions of streams in the Project area, but fish habitat has not been restored to pre-mining conditions (USFS 1992).

Numerous documented fish, invertebrate, periphyton and stream habitat surveys have been conducted in the Project area, beginning with fish surveys in the 1970's (Table 1, Figure 3). Much of this information was in raw form in USFS and MFWP files and had not been summarized prior to this summary and update report. Some of this information is also summarized in the MFWP MFISH database (Appendix A).

Information that was collected during the late 1980's and early 1990's was summarized in the 1992 EIS. Much of this information was gained during a one-year aquatic biology baseline study that was initiated in May 1988 to meet permitting requirements associated with the Project (WRD 1989). The goals of the aquatic program were to assemble a database for physical habitat, benthic macroinvertebrates and periphyton, and fisheries in streams within and adjacent to the Project area. The finalized aquatic biology study plan was endorsed by the USFS. Fieldwork for

the baseline study was initiated in August 1988 and was completed by mid-November 1988, except for a bull trout redd survey that was conducted during October 1989. All fieldwork was conducted under the supervision of the MFWP. Objectives of the fisheries program were to determine species composition, age structure, relative numbers, population estimates by age group, approximate level of bull trout and whitefish spawning, and baseline heavy metals content of fish tissues in Libby Creek.

Since the 1992 EIS, additional fish, invertebrate, periphyton, and habitat surveys have been conducted in Project area streams, fish genetic analyses have been performed, and a reach of Libby Creek in the Project area has been restored. This summary and update report summarizes all available information on fish, invertebrate, periphyton, and stream habitat in the Project area.

Objectives

- Describe streams in the Project area, including channel characteristics, substrate, fish cover, and physical barriers.
- Summarize data from fish surveys in the Project area to allow ready answers to basic questions and provide detailed information pertaining to fish distribution at the population, species, and individual levels.
- Summarize information from macroinvertebrate and periphyton sampling in Project area streams.
- Compile information pertaining to the above objectives that has not previously been summarized in concise table, figure, and report format,
- Update the bibliography of reports on stream biology and habitat in the Project area.

Habitat

Habitat in Little Cherry, Poorman, and Ramsey Creeks was described in the late 1970's (Table 2). Riparian vegetation and erodable reaches may have changed substantially in the 27 years since these surveys, but they still provide useful, general descriptions. From the late 1980's to the present, stream reaches in the Project area have been classified using the USFS General Aquatic Wildlife System (GAWS) Level III assessment (USDA 1989) which incorporates the Rosgen (1985) system, and more recently using watershed field data sheets that incorporate updates to the Rosgen system (Rosgen 1994, 1996, Figure 4, Appendix B). The Rosgen system is widely accepted, but is not the only stream classification system (e.g. Montgomery and Buffington 1997).

The Rosgen system is based on the tendency of streams to seek a dynamic equilibrium reflecting landscape conditions. The purpose of the Rosgen system is to classify streams based on quantifiable field measurements to produce reproducible descriptions of stream types and conditions. There are four levels in Rosgen's classification hierarchy: 1) geomorphic characterization; 2) morphological description; 3) stream condition assessment; 4) validation and monitoring. Some reaches of Project area streams have had all four Rosgen levels applied.

The Rosgen system uses an alphanumeric code to classify streams based on five morphometric parameters of the stream channel and its flood plain: 1) entrenchment ratio (a measure of flood plain width); 2) width-depth ratio at bankfull flow; 3) sinuosity; 4) stream gradient; 5) median bed-surface particle size.

The five parameters are used to distinguish seven main stream types identified by capital letters A to G (Figure 4). Each main stream type has a number assigned that reflects the bed-material particle size. Uncapitalized letters are used to specify stream gradients outside the typical range for a main stream type.

Fish habitat was also characterized semi-quantitatively based on 25 parameters that were assessed at 33 locations in the Project area streams during the 1988-89 WRD study. Results for three of several habitat indices that were calculated are presented in Figures 5, 6, and 7.

Libby Creek

From its origin in a steep, glacial cirque, Libby Creek flows to the northeast, intermittently, through a narrow canyon over bedrock and coarse deposits in steep and wooded terrain. A fifty-foot waterfall near the junction of FS roads 6210 and 2316 forms a barrier to upstream fish migration (Figure 4). Below the falls, stream gradient begins to lessen and the stream merges with its first major tributary, Howard Creek, which originates in Howard Lake. Below the Howard Creek confluence, MDFWP completed a project during 2002 that restored approximately 3,200 feet of the Libby Creek stream channel to the proper dimension, pattern and profile (Hoffman et al. 2002, Dunnigan et al. 2003, 2004). The following description of the restoration Project, known as the Cleveland Project, was paraphrased from Dunnigan et al. (2003).

Past logging, mining, road construction, and stream channel manipulation had resulted in accelerated bank erosion along a number of meander bends, resulting in an over-widened, unstable, and shallow channel (Sato 2000). These conditions resulted in low quality habitat for native salmonids, including bull trout and redband trout.

Stream restoration work was conducted during the fall of 2002. The resulting stream pattern design increased sinuosity, and subsequently increased total stream length in the restoration area from approximately 2,700 to 3,200 feet. The designed channel profile required excavation at numerous depositional areas throughout the reach and resulted in an increased quantity of pool habitat. Numerous structures were installed including cobble structures for grade control and bank protection in pool tail-outs, rootwad complexes for bank stabilization, and rock vanes to provide gradient control and pool habitat. Substantial effort was also expended to restore a healthy riparian vegetative community, including planting approximately 500 shrubs, 2,000 willow cuttings, 75 cottonwood poles, and 1,600 containerized native shrubs (Dunnigan et al. 2003).

This summary and update report includes information on Libby Creek from the headwaters to above the confluence of Bear Creek, approximately 12 river miles. Much of the bottomland in the lower reach of Libby Creek, which is not addressed in this report, has been subdivided into

one to ten-acre plots. Stream channel stability and water quality in the lower reach has been impacted by mining, logging, grazing and housing development (MFWP, http://fwp.state.mt.us/fishing/guide/q_Libby_Creek__1153213482331.aspx).

Little Cherry Creek

Little Cherry Creek is a first and second order, low velocity stream in a small, low gradient watershed (Table 2, Figure 2). The stream is approximately 3 miles long. Substrate in the upper third of the stream, from the headwaters to a tributary from the south, is a mix of rubble, gravel, and sand. The middle reaches of the stream have debris jams, overhanging devil's club, and undercut banks. The lower reach has thick, overhanging alder, and shallow riffles between shallow pools (WRD 1989). Possible fish barriers are common throughout much of the stream (Table 2). A significant fish barrier was documented 0.25 miles upstream of the Libby Creek confluence. Below the lower barrier, a portion of the lower reach can be subsurface.

Poorman Creek

Poorman Creek originates in a steep, glacial cirque and flows 5 to 6 miles before entering Libby Creek downstream of Ramsey Creek (Table 2, Figure 2). The transition from the steep, bedrock controlled, upper reach to the lower gradient, depositional, lower reach is abrupt. Avalanche activity in the upper reach maintains riparian vegetation in a shrub stage. As such recruitment of large woody debris is low. Riparian vegetation in the lower reach is dominated by mature timber. The lower 2.5 miles of Poorman Creek is destabilized. The banks are eroded, timber recruitment is excessive, and bedload transport is high. The lower half of Poorman Creek is characterized as having cobble substrate, stream braiding, fair to good fish cover, poor spawning habitat and partial barriers to fish in the form of debris jams (Table 2). One steep falls was noted near river mile 2 to 2.5.

Ramsey Creek

Ramsey Creek originates in a steep, glacial cirque and flows 5 to 6 miles before entering Libby Creek (Table 2, Figure 2). Several regularly spaced tributaries draining wooded slopes join Ramsey Creek in its upper reach. Near its headwaters and the Cabinet Wilderness Boundary, the stream runs though a wetland (Figure 3). The stream bottom in this reach is deep silt with large numbers of caddisfly larvae. The stream banks are undercut. Below the wetland, the stream gradient is gentle and the substrate is a mix of bedrock and gravel. The banks are vegetated with overhanging alders. The stream then steepens to a 15% gradient in places, cascading over bedrock with deep bedrock pools below the cascades. Potential fish barriers occur in this reach of Ramsey Creek (WRD 1989). The lower half of Ramsey Creek is dominated by riffle and pool complexes, until nearing the confluence with Libby Creek, where glides predominate and pools are lacking. The substrate is comprised of bedrock, boulders, and large cobble (Table 2).

Fish

Below the Libby Creek falls, rainbow trout, Columbia basin redband trout, westslope cutthroat trout, bull trout, brook trout, torrent sculpin, slimy sculpin, mountain whitefish, and salmonid hybrids have been reported (Tables 3 through 6, Figure 8, see Appendix C for descriptions of native species and Appendices D and E for fish survey and creel survey information, respectively). The MFWP MFISH database (Table 4, Appendix A) lists longnose dace as occurring throughout Libby Creek, although the species was not reported in any of the survey information that was obtained for this summary and update report. Only bull trout have been reported upstream of the falls on upper Libby Creek. In Ramsey, Poorman, and Little Cherry Creeks, reported trout species occurrence has varied over time and between streams. Purebred Columbia basin redband trout, redband/rainbow, redband/cutthroat, and rainbow/cutthroat hybrids have been identified using genetic analysis. Surveys have provided some information on which stream reaches are used for spawning (Table 7).

State and Federal Designations

Four fish species that occur in upper Libby Creek or its tributaries have state or federal designations (Appendix C):

- bull trout (*Salvelinus confluentus*)
  Montana Species of Concern, BLM Special Status, USFWS Listed Threatened (removed as proposed Critical Habitat during September 2004);
- Columbia basin redband trout (*Oncorhynchus mykiss gairdneri*)
  Montana Species of Concern;
- westslope cutthroat trout (*Oncorhynchus clarki lewisi*)
  Montana Species of Concern;
- torrent sculpin (*Cottus rhotheus*)
  Montana Species of Concern.

Montana Species of Concern are defined as native animals breeding in the state that are considered to be at risk due to declining population trends, threats to their habitats, and/or restricted distribution.

Listed Threatened are defined as any species likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Special Status is given to any species proven to be imperiled in at least part of its range and documented to occur on BLM lands. This status does not apply to the USFS and private lands in the Project area.

Critical Habitat is defined as the specific areas (1) within the geographic area occupied by a species, at the time it is listed, on which are found those physical or biological features (a) essential to conserve the species and (b) that may require special management considerations or protection; and (2) specific areas outside the geographic area occupied by the species at the time it is listed upon determination that such areas are essential to conserve the species.

The U.S. Fish and Wildlife Service's Bull Trout Recovery Plan formerly designated Libby Creek, Poorman Creek, and Ramsey Creek as part of the Kootenai River and Bull Lake Proposed Critical Habitat Sub-Unit. Final designation of bull trout Critical Habitat on September 22, 2004 did not include streams in the Project area, or any streams in Montana.

Field Identification

Due to introduction of non-native fish species, variable morphometric and color characteristics, and hybridzation, differentiation between some of the fish species in the Project area based on external characteristics can be uncertain. Unless otherwise indicated, the following descriptions are based mainly on MFWP descriptions and references therein (Appendix C).

Montana's stream-resident redband trout, a subspecies of rainbow trout, vary considerably in coloration. They can generally be differentiated from non-native coastal rainbow trout by larger

more rounded spots, parr marks that tend to remain into adulthood, and more orange-red coloration around the lateral line surrounded by greenish-yellow (redband), rather than pink-red around the lateral line surrounded by dark green and silver (coastal rainbow trout). Redband trout have distinct white tips on the anal, dorsal and pectoral fins. However, rainbow/redband hybrids cannot be positively identified in the field. The possibility of hybridization with westslope cutthroat trout in the Project area further complicates field identification of redband and rainbow trout. The presence of basibranchial teeth (small teeth on the floor of the mouth behind the tongue) in some individuals of a rainbow trout or redband trout population indicates hybridization with westslope cutthroat trout. Characteristics of westslope cutthroat that are hybridized with redband or rainbow trout, in a population that is dominated by westslope cutthroat trout, are spots on the top of the head and the anterior body below the lateral line, reduced scale counts, increased caecal counts (finger-like extensions from the gut), and loss of basibranchial teeth.

Bull trout belong to a different genus than the salmonid species discussed above, and have not been reported to interbreed with them (Table 3). Native bull trout and non-native brook trout will interbreed and create sterile hybrids. Hybrids can be confused with pure breeds of either species (personal communication, Hooper, USFS, Nov. 04). While this does not threaten the genetic integrity of native bull trout, competition by brook trout and sterile hybrids can threaten bull trout populations. Bull trout can be identified by pale-yellow spots on their dorsal surface, red or orange spots on their sides, white leading edges on their pectoral, pelvic, and anal fins, a slightly forked tail, and no black marking on their dorsal fin (rainbow, redband, and westslope cutthroat trout have black markings on their dorsal fin).

Brook trout are dark olive-green or gray-green, mottled with dark, squiggly or wormlike markings from head to tail on their dorsal surface. The sides and belly shade lighter, sometimes with green, gray or lavender tones, and additional irregular marks. The sides also have scattered red dots, surrounded by bright-blue halos. The belly is usually pale yellow-orange, with a blackish or gray streak down the middle. The pectoral, pelvic, and anal fins are pale to bright-orange with a white leading edge followed by a black stripe. There are dark blotches on the

dorsal and caudal fins. The brook trout's tail fin is less forked than that of most trout and salmon, bordering on being square (Hubbs and Lagler 1964, http://www.personal.psu.edu/users/s/a/sak198/assignment7.html).

Slimy sculpin and torrent sculpin are considered to be present in the Project area (personal communication, Hooper, USFS, Nov. 04). Field identification can be uncertain between these species and may require dissection. Field identifications during 2003-04 indicated mainly torrent scuplins (personal communication, Hensler, MFWP, Nov. 04). Torrent sculpin are gray-brown with black speckling. The underside is light and the chin strongly mottled. The first dorsal fin is fringed with orange on spawning males. Palatine teeth are usually present. The body is robust. They usually have coarse prickles on the back, sides, and sometimes on the caudal peduncle. Slimy sculpin are brown to black with mottling. Dark bands are often present. The underside is white. The first dorsal fin is fringed with orange on breeding males. No palatine teeth are present. Pelvic fins have 3 or 4 soft rays; if a fourth (inner) ray is present, it is usually two-thirds or less the length of the longest. Body prickles are usually absent (Hendricks 1997).

Genetics

All information that was located in USFS and MFWP files that pertained to fish genetics analysis in the Project area is included in Appendix F. Pure breeds of salmonids in the Project area can be positively identified using non-lethal sampling for micro-satellite genetic analysis. For this procedure, a small fin clip from the pelvic or caudal fin is collected. Lethal sampling is required to determine the degree of hybridization between redband trout, rainbow trout, and cutthroat trout through a procedure termed allozyme electrophoresis (personal communication, Hooper, USFS, Nov. 04).

A letter from R. Douglas Perkinson, USFS, Libby, MT, December 2, 1991, to district rangers lists streams that were sampled during 1991 for genetic analysis. Among the streams listed were Little Cherry, Poorman, Ramsey, and Upper Libby Creek. All were listed as having cutthroat and rainbow trout (presumably field identifications). In addition, upper Libby Creek was listed as having bull trout. A hand-written note on the letter indicates that Poorman Creek has had bull trout. The letter states that the sampling should reveal that nearly every tributary to the Kootenai

River is a sensitive torrent sculpin watershed except for a few barriered watersheds including upper Libby Creek that has slimy sculpin. Paul Hooper (USFS, personal communication Nov. 04) stated that only bull trout have been collected upstream of the Libby Creek falls, the only sculpin in the Project area are slimy sculpin and torrent scuplin, and that no genetic analyses have been performed on sculpin.

A hand-written note dated January 22, 2004 from Robb (presumably Leary) to Mike (presumably Hensler) includes an attachment listing Libby Creek as including one westslope/rainbow F_1 hybrid. The letter is as follows:

> "Here is the list of samples that contained mainly what appeared to be non-hybridized fish and a few individuals of recent hybrid origin. As we discussed on the phone I strongly feel it would be worthwhile to re-sample some or all of the locations to investigate the temporal stability/instability of these situations. The results would have strong management implications. If you do decide to collect additional fish, I would attempt to collect 50 fish from each location because in terms of hybrid individuals we very likely, in terms of abundance, will be dealing with relatively rare ones. Lethal sampling will be required since we need to use allozyme electrophoresis to address the redband-coastal rainbow trout issue."

Comparison of Fisheries Studies

When the results of the genetic studies, field survey results, and various letters and lists referred to throughout this report are compared, it is unclear in some instances if the term "rainbow" has been used to imply "redband". The most recent genetic results suggest that there is uncertainty with regard to the genetic integrity of redband trout in the Project area. There is reason to suspect hybridization, given that coastal rainbow trout have been stocked in Howard Lake (http://fwp.state.mt.us/fishing/guide/q_Howard_Lake__1158890485920.aspx). The outflow of Howard Lake, Howard Creek, is the first major tributary to upper Libby Creek (Figure 3). Presumably, coastal rainbow trout from Howard Lake could interbreed with native redband trout in the Project area streams downstream of physical barriers that may exist.

Other noteworthy points:

- Longnose dace and largescale sucker are listed in the MFWP MFISH database as occurring in Libby Creek in the Project area, but these species were not reported in any of the information that was located for this report.
- Sculpin and longnose dace are listed as occurring throughout Libby Creek in MFISH, whereas only bull trout have been reported above the falls above the Howard Creek confluence.
- Brook trout were not reported in the Project area until 2004.
- Westslope cutthroat trout were listed in 1991 as being sampled for genetics analysis from Poorman Creek, but genetic results did not indicate the presence of cutthroat trout genes. Cutthroat hybrids were reported in Libby, Ramsey, and Little Cherry Creek.
- The 1992 EIS states that westslope cutthroat trout are not known to inhabit Project area streams.

Spawning

Nearly 22 miles of Libby, Ramsey and Poorman Creeks were surveyed for bull trout redds in October, 1989 (Tables 1 and 7, Appendix G). No redds were observed in Ramsey or Poorman Creek. Two redds were located in Libby Creek below the falls and ten were located above the falls (USFS 1992). No spawning or spent bull trout were observed in the 11.5 mile portion of Lower Libby Creek during the mid-November, 1988 mountain whitefish survey, nor were any schools of spawning whitefish located. Redd surveys conducted during October 1995 and October 1996 in Libby, Ramsey, Poorman, and Little Cherry Creeks revealed a total of four possible redds.

Estimated percent spawning area was typically 20 to 40% in all of the Project area streams (Figure 6). Cobble, boulder, and bedrock substrate predominated in characterized reaches (Figure 4), thus limiting potential spawning habitat. Potential rearing habitat (Figure 7) was

more variable, and was nearly absent in some of the surveyed reaches that had abundant spawning habitat.

Fish Tissue Metals

Twenty-four rainbow trout were collected during September 1988 from Libby Creek, downstream of the Project area (Figure 3, location L3) and analyzed for tissue metals content. Muscle or liver tissue was analyzed for mercury, zinc, cobalt, copper, and lead. Cobalt concentrations decreased with increasing fish size, but also displayed the greatest variability (Table 8). The other metals did not show consistent trends in concentration related to fish size. Zinc concentrations were suspected to have been influenced by contaminated sample bags (WRD 1989).

Macroinvertebrates

Stream macroinvertebrates were collected from 21 locations in the Project area streams, mainly between 1988 and 1994 (WRD 1989, WTE 91 92a, 92b, 93, 94, 95). Some locations were sampled on 16 occasions. As with periphyton sampling conducted during the same period, the objective of the 1991-94 sampling was to assess possible impacts of mining activity during 1991 and elevated concentrations of nitrate in Libby Creek. Methodology differed between some of the sampling periods, which restricts the ability to interpret the data over the entire time period. For example, Table 9 presents ephemeroptera (mayflies), plecoptera (stoneflies), trichoptera (caddisflies) (EPT) abundance divided by chironomid (midge) larvae numbers. EPT species are generally intolerant to pollutants, low oxygen, high silt loads, and high temperatures, whereas chironomids (C) are generally tolerant. As such, the EPT/C quotient can be indicative of water quality. EPT/C was selected for Table 9 because it should be less influenced by sampling methods than other community attributes, such as total abundance. EPT/C was selected from numerous community attributes that could have been chosen to illustrate characteristics of Project area streams and to illustrate variability in stream benthic macroinvertebrate communities.

Three samples per station during 1988 and 1989 were collected using a 250 μm Hess sampler and then sieved through 600 μm mesh. Five samples per station were collected using a 500 μm Hess sampler during 1990. Four 500 μm Hess samples and one kick sample were collected during 1991-94. During 2000 and 2003, MFWP collected 3 samples per location using a 500 μm mesh Surber Sampler at and near the Cleveland project site (Dunnigan et al. 2003). Data in Table 9 only includes Hess sampler data.

Few patterns are apparent in the 1988 through 1994 EPT/C data. Values during 1988-89 were low, which could reflect the relative condition of invertebrate communities during that time period, or could reflect methods differences. Average values were calculated for 1991 and 1992, the only years where the same methods were used and all of the same sites were sampled (Table 9). No spatial, seasonal, or annual trends were apparent.

These results illustrate the general finding that macroinvertebrate communities in the Project area streams are highly variable and influenced by factors other than water quality. The Project area streams generally support a sparse but diverse macroinvertebrate fauna. Macroinvertebrate abundance usually reflects the recent flow regime with repeated spates resetting densities at low levels. The natural flow regime is dictated by drainage basin characteristics and precipitation events, such as rain on snow.

Periphyton

Periphyton was sampled during 1988 and 1989 (WRD 1989, sampling reported but results not reported) and during 1991 and 1992 from all four of the Project area streams, and continued during 1993 and 1994 in Libby Creek (WTE 91 92a, 92b, 93, 94, 95). The objective of the 1991-94 sampling was to assess possible impacts of mining activity during 1991 and elevated concentrations of nitrate in Libby Creek. Conclusions from 1991 and 1992 were that Little Cherry Creek was enriched with nutrients and had a high diversity of algae species, whereas Poorman and Ramsey Creeks were nutrient-poor and had limited algal diversity. Conclusions from Libby Creek for the four years of sampling were that biological integrity upstream and the

nearest station downstream of mining activities was excellent and aquatic life was not impaired. Representative data that supports these conclusions are presented in Tables 10 and 11.

Pre-construction Monitoring

The following pre-construction monitoring tasks would provide additional information for interpreting operational and post-operational monitoring results:

1. Photo-document and thoroughly characterize habitat in Little Cherry Creek and the reach of Libby Creek that would have an altered flow-regime from the proposed tailings dam diversion.
2. Map potentially impacted reaches of Project area streams in their entirety including a continuous lineal record of stream distance, altitude, general habitat type (pool, riffle, glide, cascade, falls), large woody debris, major riparian features, and fish capture locations (see below).
3. Document potential fish barriers.
4. Sample fish using minnow traps above and below potential fish barriers to determine presence/absence of species (sample for genetic analysis) and to identify reaches used for spawning based on presence/absence of parr.

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Table 1. Sampling and report information for the Montanore Project corresponding with stream locations in Figure 3. 1988-89 data are from WRD 89. 2000-2003 data are from MFWP reports for the Cleveland restoration project (MFWP 02, 03, 04). 2004 data are from MFWP raw data sheets. 1990-1994 invertebrate and periphyton data are from WTE 91, 92, 93, 94, 95. All other data are from raw data sheets located in USFS or MFWP files. Sub-stations for fish habitat characterization (WRD 89) are not included in this table, but are included in Figures 5, 6, and 7.

Stream	Location (see Fig. 3)	Other ID's for same location				Month/year that field work was conducted				
		WRD	WTE	MFWP	USFS	Fish	Spawning	Invertebrates	Periphyton	Habitat
Little Cherry	C1	-	LC1	-	-	-	10/95	4/90, 10/90, 4/91, 8/91, 10/91, 4/92, 8/92, 10/92	4/91, 8/91, 10/91, 4/92, 8/92, 10/92	-
	C2	LC1	-	-	-	8/88	10/95	-	-	-
	C3	LC1	-	-	-	-	10/95	8/88, 10/88, 4/89	8/88, 10/88, 4/89	8/88
	C4	-	-	-	#1	-	10/95	-	-	8/97
	C5	LC2	-	-	-	9/88	10/95	8/88, 10/88, 4/89	8/88, 10/88, 4/89	-
Poorman	P1	PC1 Po1	-	-	-	8/82, 8/88, 8/89	10/96	8/88, 10/88, 4/89	8/88, 10/88, 4/89	8/88
	P2	-	Po1	-	#2	8/94	10/96	4/90, 8/90, 10/90, 4/91, 8/91, 10/91, 4/92, 8/92, 10/92	4/91, 8/91, 10/91, 4/92, 8/92, 10/92	8/97, 7/03
	P3	PC2	-	-	-	8/88		-	-	-
	P4	Po2	-	-	-	-		8/88, 10/88, 4/89	8/88, 10/88, 4/89	-
	not specified	-	-	-	-	8/76		-	-	-
Ramsey	R1	-	-	-	#2	-		4/90, 8/90, 10/90	-	7/97, 7/03
	R2	RM1	Ra2	-	-	8/76, 8/88		8/91, 10/91, 4/92, 8/92, 10/92	8/91, 10/91, 4/92, 8/92, 10/92	-
	R3	Ra2	-	-	-	9/82		8/88, 10/88, 4/89	8/88, 10/88, 4/89	8/88
	R4	RM2 Ra3	-	-	-	8/88		8/88, 10/88, 4/89	8/88, 10/88, 4/89	8/88
	R5	Ra4	-	-	-	9/88		8/88, 10/88, 4/89	8/88, 10/88, 4/89	8/88
	not specified						10/96			
Libby	L1	-	L1	-	-	-	11/88	4/90, 8/90, 10/90, 4/91, 8/91, 10/91, 4/92, 8/92, 10/92, 3/93, 8/93, 10/93, 10/94	4/91, 8/91, 10/91, 4/92, 8/92, 10/92, 3/93, 8/93, 10/93, 10/94	-
	L2	-	-	-	-	-	11/88	-	-	8/04
	L3	LB1, L3	-	-	-	9/88	11/88, 10/96	8/88, 10/88, 4/89	8/88, 10/88, 4/89	8/88
	L4	-	-	-	-	-	11/88, 10/95, 10/96	-	-	8/88
	L5	-	-	-	-	-	11/88, 10/95, 10/96	-	-	8/04
	L6	-	L3	-	-	-	11/88, 10/95, 10/96	8/90, 10/90, 4/91, 8/91, 10/91, 4/92, 8/92, 10/92, 3/93, 8/93, 10/93	4/91, 8/91, 10/91, 4/92, 8/92, 10/92, 3/93, 8/93, 10/93	-
	L7	L4	-	-	-	-	11/88, 10/95, 10/96	8/88, 10/88, 4/89	8/88, 10/88, 4/89	8/88
	L8	L5	-	-	-	-	11/88, 10/95, 10/96	8/88, 10/88, 4/89	8/88, 10/88, 4/89	8/88
	L9	L8	-	below Clev.	-	8/04	11/88, 10/95	8/88, 10/88, 4/89	8/88, 10/88, 4/89	8/88
	L10	-	-	Clev.	#12	00, 02, 03, 7/04	11/88, 10/95	00, 03	-	8/04
	L11	LB2	-	-	#13	9/88	11/88, 10/95	-	-	8/04
	L12	-	-	above Clev.	-	8/04	10/95	-	-	8/88
	L13	-	-	-	#15	-	10/95	-	-	8/04
	L14	-	L9	-	-	-	10/95	4/90, 8/90, 10/90, 4/91, 8/91, 10/91, 4/92, 8/92, 10/92, 3/93, 8/93, 10/93, 10/94	4/91, 8/91, 10/91, 4/92, 8/92, 10/92, 3/93, 8/93, 10/93, 10/94	-
	L15	-	-	-	#16	-	10/95	-	-	8/04
	L16	-	-	-	#17	-	10/95	-	-	8/04
	L17	LB3 L10	L10	-	-	9/88		8/88, 10/88, 4/89, 4/90, 8/90, 10/90, 4/91, 8/91, 10/91, 4/92, 8/92, 10/92, 3/93, 8/93, 10/93, 10/94	8/88, 10/88, 4/89, 4/91, 8/91, 10/91, 4/92, 8/92, 10/92, 3/93, 8/93, 10/93, 10/94	8/88
	L18	LB4, L11	-	-	-	9/88		8/88, 10/88, 4/89	8/88, 10/88, 4/89	8/88
	above falls, not specified	-	-	-	-	03, 04		-	-	-

Table 2. General descriptions of streams in the Montanore Project area based on USFS surveys conducted during the 1970's (USFS and MFWP files). A comparable data format was not located for Libby Creek, however, a more thorough habitat inventory has been done for Libby Creek, and portions of Little Cherry, Poorman, and Ramsey Creeks, using Rosgen classification (Figure 4).

	Little Cherry		Poorman						Ramsey			
Information	1.5 to 3 mile	0 to 1.5 mile	3 to 5.5 mile	2.5 to 3 mile	2 to 2.5 mile	1.5 to 2 mile	1 to 1.5 mile	0 to 1 mile	4 to 6 mile	3.5 to 4 mile	1 to 3.5 mile	0 to 1 mile
Date	9/21/77	9/13/78	no data	6/12/78	6/12/78	6/12/78	6/13/78	6/13/78	7/21/77	6/14/78	6/14/78	6/14/78
Width (ft)	-	7	-	20	20	20	18	20	-	18	20	15
Depth (ft)	-	0.4	-	0.8	1.5	0.8	1	0.8	-	1.5	1	1
Velocity (fps)	-	0.9	-	3	5	4	3	3	-	4	4	5
Discharge (cfs)	1	3.1	-	62	188	77	68	62	1 to 15	135	100	94
Temperature (oC)	13	9	-	5	5	5	5	5	-	5	8	5
Gradient (%)	-	7	-	12	10	3	5	3	-	9	3	5
Channel stability	good	fair	-	good	good	good	fair	fair	poor to good	good-very good	fair	good
Turbidity	-	clear	-	clear	clear	clear	clear	clear	-	clear	clear	clear
Pool:riffle:run:glide	-	20:80:0:0	-	25:75:0:0	50:50:0:0	15:85:0:0	40:60:0:0	30:70:0:0	-	50:50:0:0	50:50:0:0	10:0:10:80
Abundant bottom materials	rubble, gravel	gravel, small cobble	-	large cobble	large cobble, bed rock	small and large cobble	large cobble	large cobble	rubble	boulder, bedrock	large cobble, boulders	large cobble, boulders
Aquatic vegetation	-	common	-	present	common	common	present	common	-	abundant	common	present
Instream cover	-	good	-	good-fair	good	fair	good	good	-	good	good	good-fair
Bank cover	good	good	-	good	good	good	good-fair	good	poor-fair	good	fair-good	good
Macroinvertebrates	-	moderate-high	-	moderate-high	low-moderate	moderate-high	moderate-high	high	-	low	low-moderate	low-moderate
Spawning habitat	good	good	-	fair-poor	none	poor	fair	poor	-	poor	poor	poor
Fish barrier	possible	significant barrier 1/4 mile from Libby Ck confluence	-	debris jams	debris jams, steep falls	debris jams	partial barriers	none mentioned	-	possible	none mentioned	possible falls
Comments	good spawning habitat but marginal rearing habitat	silt in spawning areas, unstable bottom materials	-	stream braiding, lack of quality pools, limited gravel, good riparian diversity	overmature trees may be falling in near future	stream braiding, no quality pools, timber falling in stream	stream braiding prominent, potential mass wasting	lack of water breaks, divergent channel, some silt	much downfall	high velocity, lack of gravel	high blowdown potential, heavy instream debris	high velocity, lack of pools and spawning habitat

Table 3. Taxonomic classification of fish reported or assumed to be in the Montanore Project area streams. Refer to Table 4 for details on distribution and taxonomic uncertainty.

Common Name	Family	Genus, Species, Subspecies
rainbow trout	Salmonidae	*Oncorhynchus mykiss*
Columbia basin redband trout	Salmonidae	*Oncorhynchus mykiss gairdneri*
westslope cutthroat trout	Salmonidae	*Oncorhynchus clarki lewisi*
redband/rainbow hybrid	Salmonidae	*Oncorhynchus*
redband/cutthroat hybrid	Salmonidae	*Oncorhynchus*
rainbow/cutthroat hybrid	Salmonidae	*Oncorhynchus*
bull trout	Salmonidae	*Salvelinus confluentus*
brook trout	Salmonidae	*Salvelinus fontinalis*
bull/brook hybrid	Salmonidae	*Salvelinus*
mountain whitefish	Salmonidae	*Prosopium williamsoni*
longnose dace	Cyprinidae	*Rhinichthys cataractae*
largescale sucker	Catostomidae	*Catostomus macrocheilus*
torrent sculpin	Cottidae	*Cottus rhotheus*
slimy sculpin	Cottidae	*Cottus cognatus*

Table 4. Reported occurrence of fish species in the Montanore Project area by year and stream, and level of confidence in identification (see key, below table). Information is from letters in USFS and MFWP files and the MFWP MFISH database.

Species	Libby, above falls	Libby, below falls	Ramsey	Poorman	Little Cherry
rainbow trout	NR	88C 91A 00A 02C 03B 04B MFISH	62C 76C 82C 88C 91B	76C 82C 88C 91A 94C 00A MFISH	81D 88C 91B MFISH
Columbia basin redband trout	NR	00A MFISH	00A MFISH	NR	MFISH
westslope cutthroat trout	NR	91B	91B	81C 91B	78C 81D 91B
redband/rainbow hybrid	NR	00A MFISH 92(52/46%)	NR	NR	92(81/18%)
redband/cutthroat hybrid	NR	NR	00A	00B*	NR
rainbow/cutthroat hybrid	NR	91(93/7%)	91(99/1%)	NR	91(98/2%)
bull trout	88C 99B 03C 04C MFISH	88C 00C 02C 03B 04B	62C 76C 88C MFWP	76C 82C 88C 91D 94C MFISH	MFISH
brook trout	NR	04C MFISH	NR	NR	NR
bull/brook hybrid	NR	Assumed	NR	NR	NR
sculpin (non-specific)	MFISH	88C MFISH	NR	76C 82C 88C	NR
torrent sculpin	NR	04B	NR	NR	NR
slimy sculpin	NR	04B MFISH	NR	MFISH	NR
mountain whitefish	NR	02C MFISH	NR	NR	NR
largescale sucker	NR	MFISH	NR	NR	NR
longnose dace	MFISH	MFISH	NR	NR	NR

A = Confirmed by genetic analysis.
B* = Cannot exclude, based on genetics.
B = Based on field identification, genetic samples were collected but results are not available or were determined to be hybrids.
C = Based on field identification.
D = Based on a statement in a document that did not refer to a specific sampling event.
% = Percent hybridization, e.g. 92(81/18%) = 1992 sample, 81% redband, 18% rainbow.
MFISH = Listed in the MFWP MFISH database as occurring.
NR = Not reported
Bull/brook trout hybrids were assumed to occur based on observations of the two species and uncertainty in field identification of hybrids (personal communication, Hooper, USFS, Nov 04).

Table 5. Fish survey data from streams in the Montanore Project area. Identifications were made in the field. 1988 data are from WRD 89. 2000-2003 data are from MFWP reports for the Cleveland restoration project (WFWP 02, 03, 04). 2004 data are from MFWP raw data sheets. All other data are from raw data sheets located in USFS or MFWP files.

					Rainbow trout												Bull trout													
Stream	Location*	Segment length (ft)	Date	Method	Pop. Est.	No./ 100'	Avg. leng. (in)	Largest (in)	Avg. wt. (lb)	No. age 1	No. age 2	No. age 3	No. age 4	No. <3"	No. 3-7"	No. >7"	Pop. Est.	No./ 100'	Avg. leng. (in)	Largest (in)	Avg. wt. (lb)	No. age 1	No. age 2	No. age 3	No. age 4	No. age 5	No. <3"	No. 3-7"	No. >7"	Other
Little Cherry	C2	500	8/24/88	electrofish, 2 pass	52	10.4	3.6	5.4	0.02	26	9	1	0	ND	ND	ND	0	0.0	ND	ND	ND	0	0	0	0	0	0	0	0	
	C5	500	9/22/88	electrofish, 2 pass	36	7.2	3.8	5.5	0.03	11	7	0	0	ND	ND	ND	0	0.0	ND	ND	ND	0	0	0	0	0	0	0	0	
	ND	ND	7/9/03	ND	24 total count		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0	0.0	ND	ND	ND	0	0	0	0	0	0	0	0	info from MFISH
Poorman	P1	600	8/20/82	snorkel, 1 pass	ND	6.5	ND	8	ND	ND	ND	ND	ND	2	33	4	ND	ND	ND	13	ND	ND	ND	ND	ND	ND	0	0	2	sculpin
	P1	1000	8/25/88	electrofish, 2 pass	105	10.5	4.7	8.6	0.05	9	35	3	0	ND	ND	ND	4	0.4	6.6	8.1	0.11	0	0	0	0	0	0	0	0	sculpin
	P2	5000	8/10/94	snorkel, 1 pass	ND	ND	ND	13	ND	ND	ND	ND	ND	5	14	19	ND	ND	ND	18	ND	ND	ND	ND	ND	ND	0	0	1	
	P3	500	8/26/88	electrofish, 2 pass	45	9.0	4.6	7.8	0.05	1	9	6	0	ND	ND	ND	0	0.0	ND	ND	ND	0	0	0	0	0	0	0	0	
	ND	500	8/25/76	snorkel, 1 pass	ND	2.4	5.6	7	0.08	5	2	ND	ND	0	12	0	ND	0.4	4.9	6.1	0.05	ND	ND	ND	ND	ND	0	2	0	sculpin
	ND	500	8/26/76	snorkel, 1 pass	ND	1.4	5.3	6.9	0.06	5	2	0	0	0	7	0	0	0.0	ND	ND	ND	0	0	0	0	0	0	0	0	
Ramsey	R2	1000	8/30/88	electrofish, 2 pass	46	4.6	4.9	8.6	0.06	6	8	12	3	ND	ND	ND	33	3.3	5.4	12.6	0.09	0	5	2	2	0	ND	ND	ND	
	R2	500	8/25/76	snorkel, 1 pass	ND	1.4	6.3	7.3	0.10	1	4	1	ND	0	6	1	ND	0.4	6.1	8.4	0.12	ND	ND	ND	ND	ND	0	1	1	
	R2	500	8/26/76	snorkel, 1 pass	ND	1.2	6.1	7.3	0.09	1	4	1	0	0	5	1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
	R3	ND	9/8/82	snorkel, 1 pass	ND	ND	ND	8	ND	ND	ND	ND	ND	0	6	1	ND	ND	ND	ND	ND	0	0	0	0	0	0	0	0	
	R4	1000	8/31-9/1/88	electrofish, 3 pass	33	3.3	6.2	8.8	0.10	16	19	9	0	ND	ND	ND	10	1.0	7.9	10	0.17	13	6	3	2	1	ND	ND	ND	
	R4	500	9/7/88	electrofish, 2 pass	0	0.0	ND	ND	ND	0	0	0	0	0	0	0	0	0.0	ND	ND	ND	0	0	0	0	0	0	0	0	
Libby	L4	1000	9/21/88	electrofish, 2 pass	110	11.0	4.9	8.7	0.05	10	37	16	0	ND	ND	ND	8	0.8	4.8	5.7	0.03	1	6	1	0	0	ND	ND	ND	sculpin
	L9	660	8/10/04	electrofish, 2 pass	ND	31.2	4.4	8.1	ND	ND	ND	ND	ND	10	206	10	ND	0.5	5.5	7.6	ND	ND	ND	ND	ND	ND	0	2	1	sculpins, brook trout
	L10	561	2000	electrofish	ND	17.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
	L10	561	2002	electrofish	ND	16.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mountain whitefish
	L10	561	2003	electrofish	ND	11.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
	L10	520	7/22/04	electrofish, 2 pass	ND	10.4	4.5	7.6	ND	ND	ND	ND	ND	14	38	2	ND	0.2	ND	8.3	ND	ND	ND	ND	ND	ND	0	0	1	sculpin
	L11	1000	9/22/88	electrofish, 3 pass	0	0.0	ND	ND	ND	0	0	0	0	0	0	0	38	3.8	7.1	9.1	0.13	0	13	14	0	0	ND	ND	ND	
	L12	470	8/10/04	electrofish, 2 pass	ND	13.4	4.6	8.3	ND	ND	ND	ND	ND	12	63	12	ND	0.6	8.4	9.5	ND	ND	ND	ND	ND	ND	0	0	3	sculpin
	L17	1000	9/6/88	electrofish, 2 pass	0	0.0	ND	ND	ND	0	0	0	0	0	0	0	38	3.8	7.6	9.8	0.15	0	10	18	4	0	ND	ND	ND	
	L18	1000	9/23/88	electrofish, 2 pass	0	0.0	ND	ND	ND	0	0	0	0	0	0	0	0	0.0	ND	ND	ND	0	0	0	0	0	0	0	0	

ND = Not determined or not applicable.
*See Figure 3.

Table 6. Creel surveys conducted in the Montanore Project area (Data are in USFS and MFWP files).

Stream	Time period	Species	Average length (in)	No. fish	Fish/hr
Little Cherry	May-Nov 1978	cutthroat	10	10	6.7
Poorman	May-Nov 1981	cutthroat	8	6	12.0
Ramsey	1962	rainbow	7	13	3.7
Ramsey	1962	bull trout	8	1	0.3

Table 7. Stream spawning and redd surveys conducted in the Montanore Project area. 1988 surveys are from WRD 1989. 1989 surveys were summarized in USFS 1992. A report was not located. All other surveys are from raw data sheets in USFS or MFWP files.

		Stream reach		
Stream	Date	Upstream*	Downstream	Findings as reported
Little Cherry	10/25/1995	C5	Libby confluence	no bull trout redds
Poorman	Oct 1989	not indicated	not indicated	no redds
	10/15/1996	P2	Libby confluence	no redds
Ramsey	Oct 1989	not indicated	not indicated	no redds
	10/17/1996	not indicated	not indicated	3 possible, probably brook 13"
Libby	mid-Nov. 1988	L11	Hwy 2	no mountain whitefish spawning schools
	mid-Nov. 1988	L11	Hwy 2	no spawning or spent bull trout
	Oct 1989	above falls	not indicated	10 bull trout redds
	Oct 1989	below falls	not indicated	2 bull trout redds
	10/22-24/95	Miranda Mine spur road	below Little Cherry	no redds
	10/17/1996	downstream of L8	near Bear confluence	1 possible redd, 0.1 mile upstream of Little Cherry confluence

*See Figure 3.

Table 8. Tissue metal content of rainbow trout collected from Libby Creek above the Bear Creek confluence during September 1988. Sample size = 5 per size class, except 4 that were >7".

	Average tissue* metal content as ug/g (coefficient of variation)				
Fish length (inches)	Hg	Zn	Co	Cu	Pb
3 to 4	0.2 (0.03)	38.9 (0.47)	4.9 (0.78)	6.5 (0.62)	<0.8 to <1.4
4 to 5	0.2 (0.04)	27.8 (0.12)	2.4 (0.38)	11.3 (0.88)	<0.4 to <1.0
5 to 6	0.2 (0.03)	30.4 (0.13)	1.1 (0.36)	4.0 (0.23)	<0.3 to <0.4
6 to 7	0.2 (0.02)	27.1 (0.07)	0.4 (0.25)	6.0 (0.48)	<0.1 to <0.5
>7	0.1 (0.00)	25.6 (0.05)	0.5 (1.00)	4.4 (0.43)	<0.1

*Hg was measured in muscle, other metals were measured in liver. The data report (WRD 89) did not indicate if results were based on wet weight or dry weight.

Table 9. Number of mayfly (ephemeroptera), stonefly (plecoptera), and caddisfly (trichoptera) (EPT) species divided by the number of midge (chironomid) species (EPT/C) in streams in the Montanore Project area (WRD 89, WTE 91, 92b, 93, 94, 95).

		Sampling date																
Stream	Location*	8/88	10/88	4/89	4/90	8/90	10/90	5/91	8/91	10/91	4/92	8/92	10/92	3/93	8/93	10/93	10/94	Avg. (91 and 92)
Little Cherry	C1	-	-	-	22	-	54	80	88	34	4.0	16	20	-	-	-	-	40
	C3	0.8	3	0.7	-	-	-	-	-	-	-	-	-	-	-	-	-	
	C5	17	7.9	0.9	-	-	-	-	-	-	-	-	-	-	-	-	-	
Poorman	P1/P2	6.6	16	2.9	9.4	19	111	39	47	345	18	22	8.2	-	-	-	-	80
	P4	4.6	14	0.8	-	-	-	-	-	-	-	-	-	-	-	-	-	
Ramsey	R1/R2	-	-	-	37	16	-	21	41	81	2.7	20	5.9	-	-	-	-	29
	R3	2.1	64	1.6	-	-	-	-	-	-	-	-	-	-	-	-	-	
	R4	2.4	4.7	1.4	-	-	-	-	-	-	-	-	-	-	-	-	-	
	R5	3.6	6.7	6.3	-	-	-	-	-	-	-	-	-	-	-	-	-	
Libby	L1	-	-	-	2.3	64	347	119	16	737	15	4.1	17	10.7	1.9	17	43	151
	L3	2.5	63	10.7	-	-	-	-	-	-	-	-	-	-	-	-	-	
	L6	-	-	-	-	26	371	13	22	126	8.0	11	9.3	2.9	4.2	4.5	-	32
	L7	2.5	78	2.3	-	-	-	-	-	-	-	-	-	-	-	-	-	
	L8	0.8	23	6.5	-	-	-	-	-	-	-	-	-	-	-	-	-	
	L9	5.1	44	4.1	-	-	-	-	-	-	-	-	-	-	-	-	-	
	L14	-	-	-	40	14	22	90	24	4422	3.2	20	49	4.6	4.4	33	3.5	768
	L17	6.5	23	2.1	32	50	50	15	5.6	114	18	7.4	10	1.1	4.6	7.7	1.8	28
	L18	1.5	8	2	-	-	-	-	-	-	-	-	-	-	-	-	-	

*See Figure 3.

Table 10. Number of diatom species in streams in the Montanore Project area (WTE 93).

		Sampling date			
Stream	Location*	4/92	8/92	10/92	Average
Little Cherry	C1	18	30	35	27.7
Poorman	P2	9	8	11	9.3
Ramsey	R1	15	13	14	14.0
Libby	L1	15	16	23	18.0
	L6	20	19	24	21.0
	L15	13	22	21	18.7
	L17	19	20	17	18.7

*See Figure 3.

Table 11. Biological integrity rating of Libby Creek in the Montanore Project area based on diatom association indexes (WTE 94).

	Sampling date						
Location*	8/91	10/91	8/92	10/92	8/93	10/93	10/94
L1	fair	fair	good	excellent	good	good	good
L6	fair	-	fair	-	fair	-	-
L15	excellent	excellent	excellent	excellent	excellent	excellent	good
L17	excellent	excellent	excellent	excellent	good	excellent	excellent

*See Figure 3.

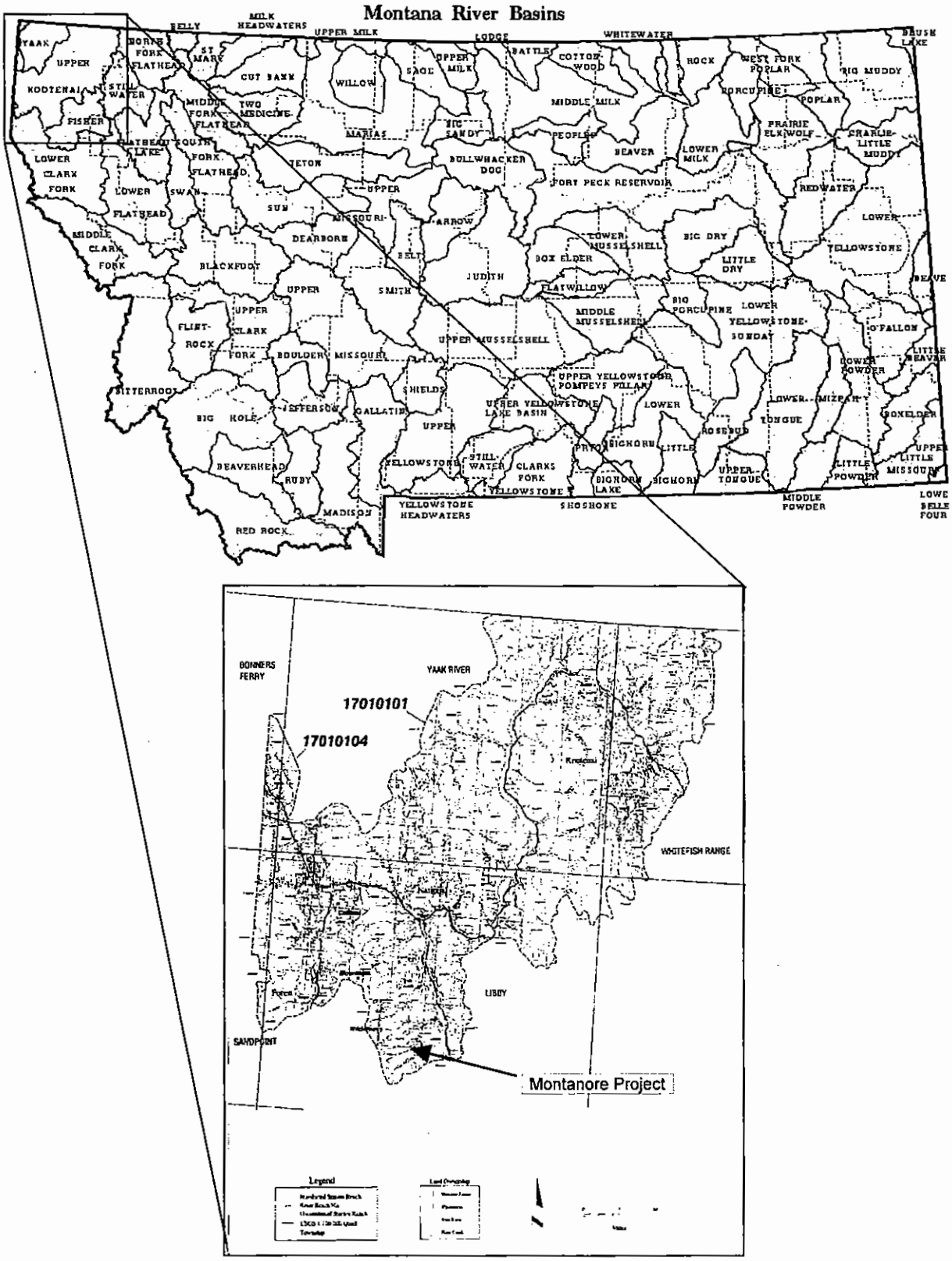


Figure 1. Montanore Project location map.

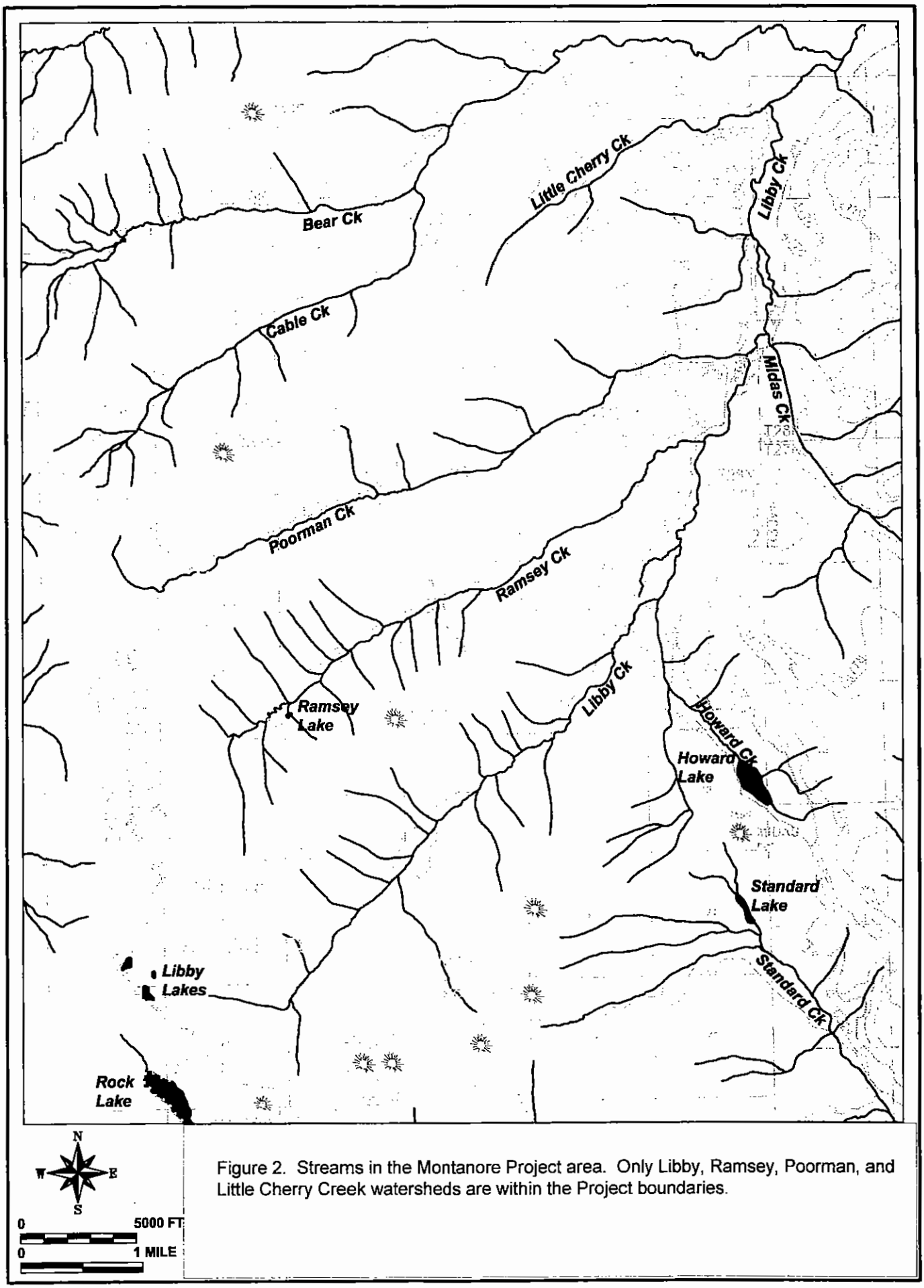
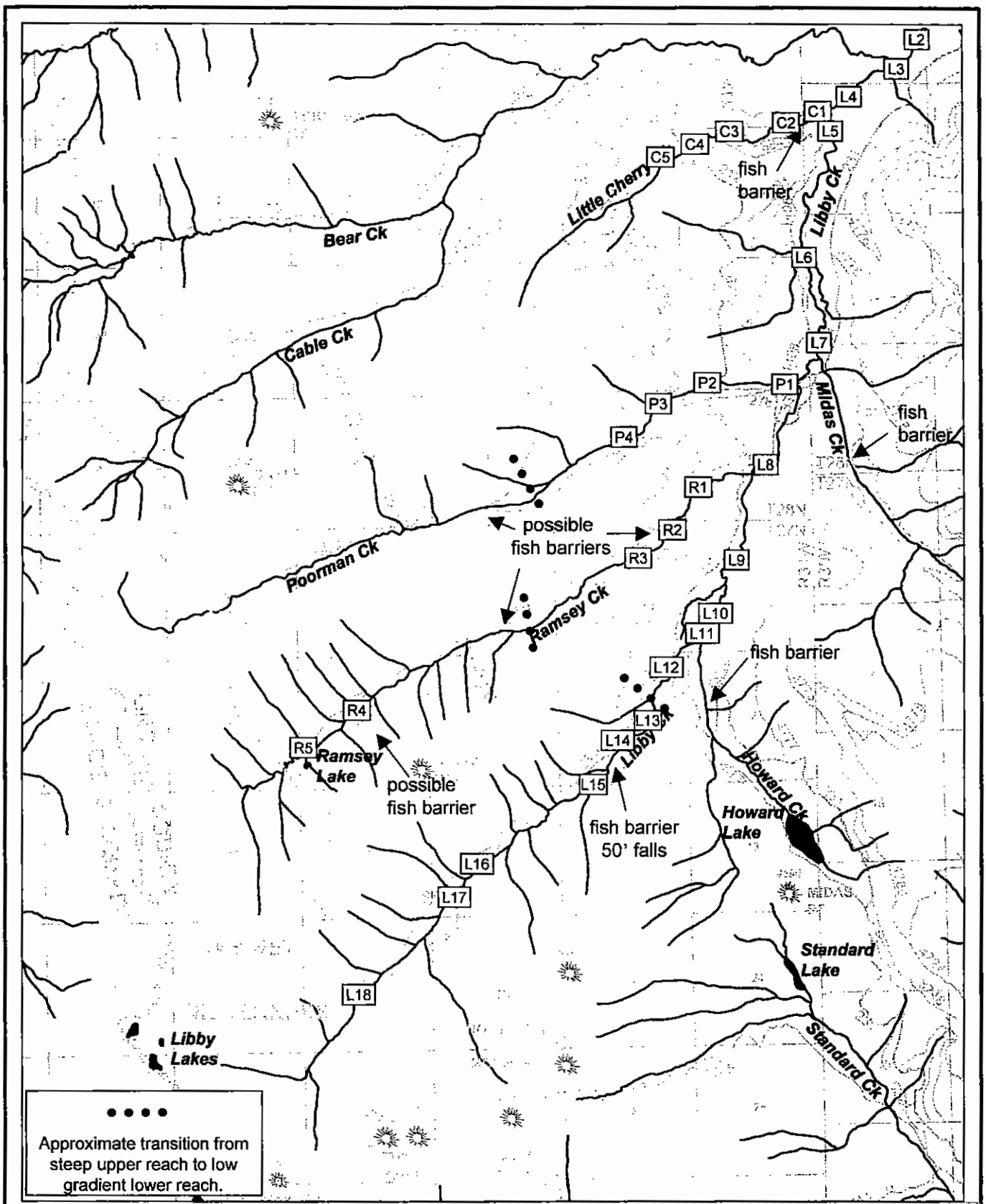


Figure 2. Streams in the Montanore Project area. Only Libby, Ramsey, Poorman, and Little Cherry Creek watersheds are within the Project boundaries.



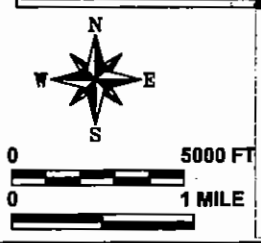


Figure 3. Locations of stream biology samples and habitat characterization in the Montanore Project area. See Table 1 for corresponding information. L1 is not shown on this map. It was the nearest downstream site (~8 miles from the Little Cherry confluence) for WTE macroinvertebrate and periphyton surveys. Sub-stations for fish habitat characterization (WRD 89) are not included in this figure, but are included in Figures 5, 6, and 7.

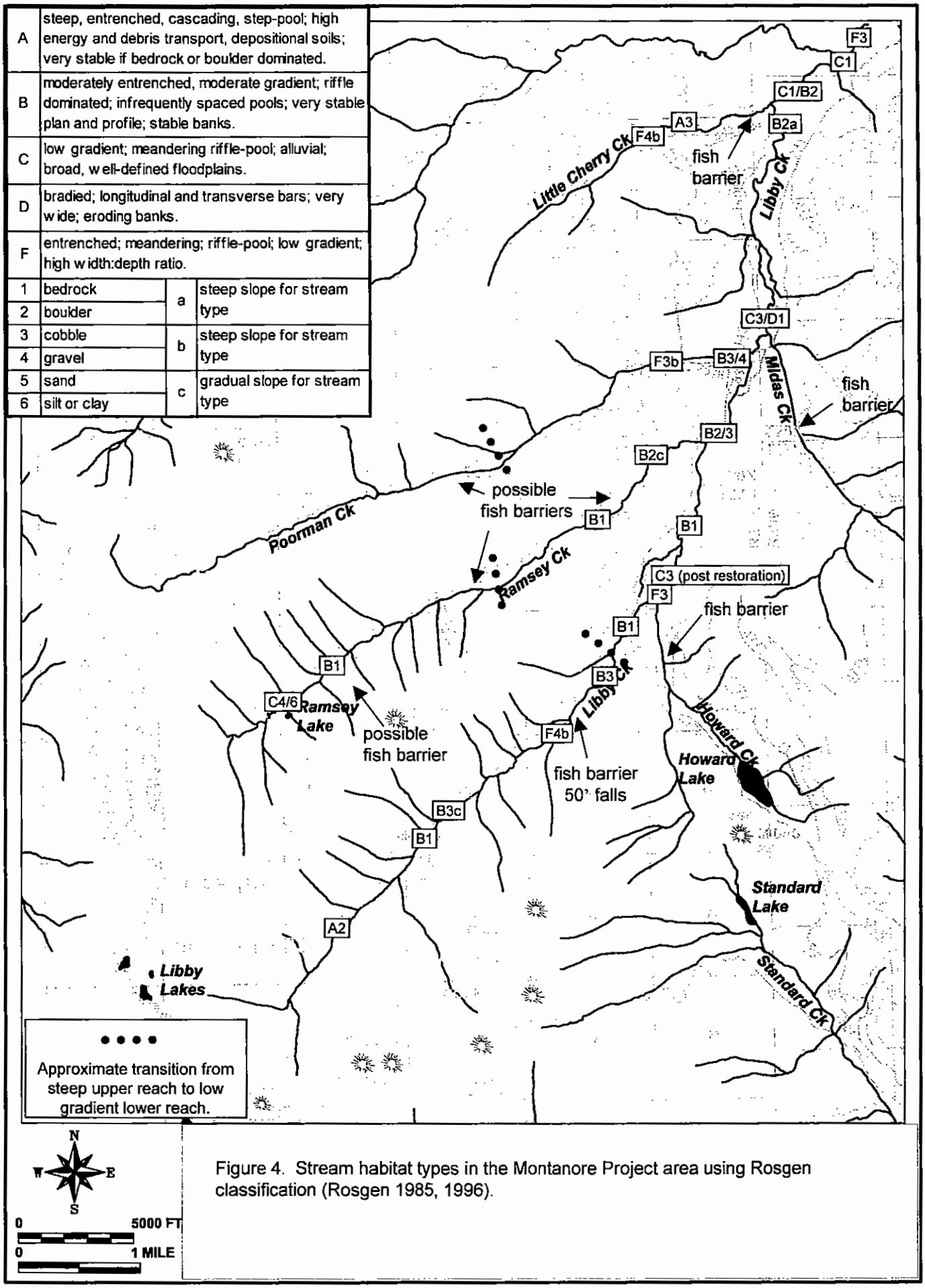


Figure 4. Stream habitat types in the Montanore Project area using Rosgen classification (Rosgen 1985, 1996).

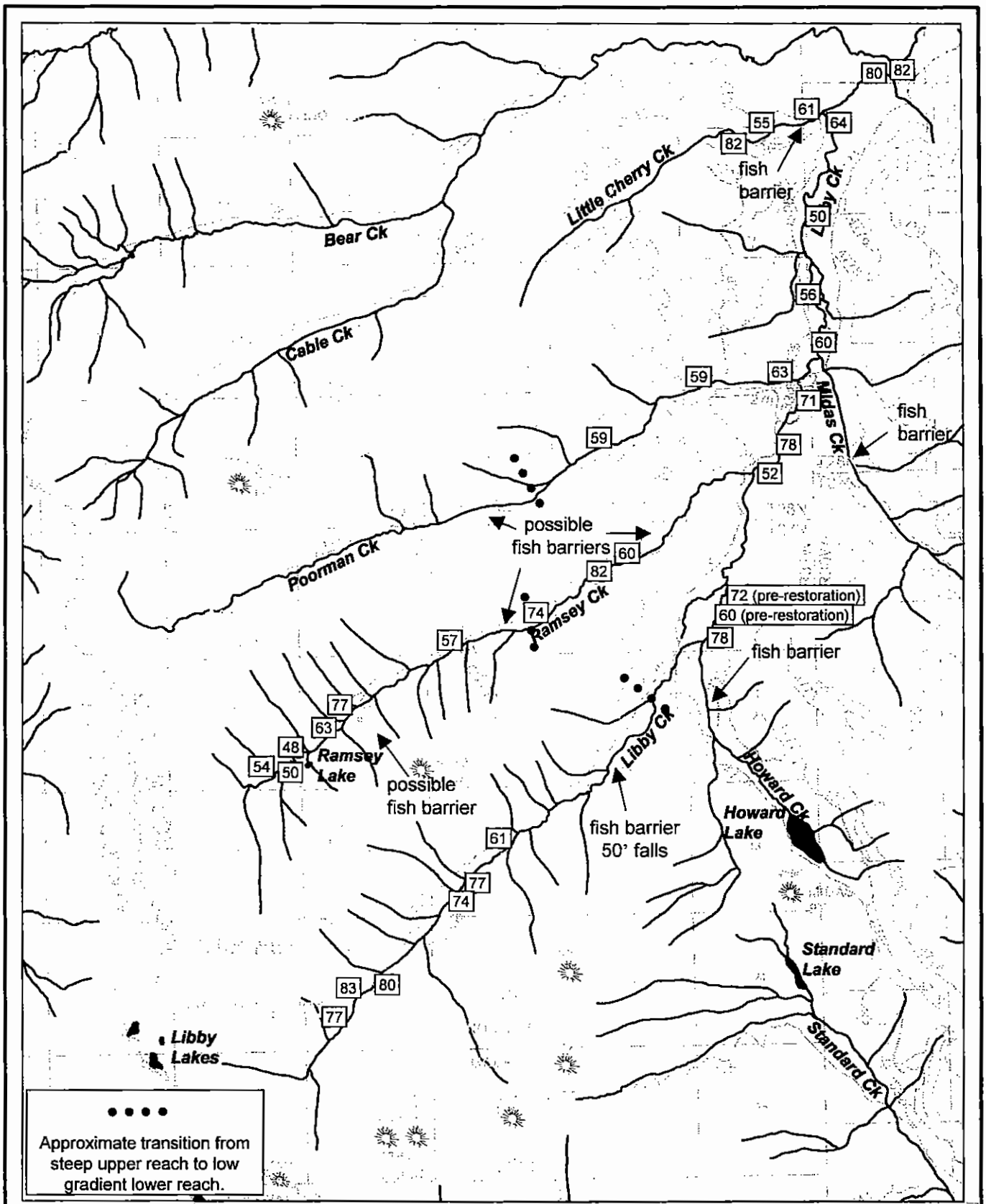


Figure 5. Fish habitat condition index (HCI) in the Montanore Project area . Zero is worst and 100 is best based on the unweighted mean of six fish habitat parameters: pool/riffle; pool structure; substrate; bank cover; bank soil stability; bank vegetation stability (WRD 89).

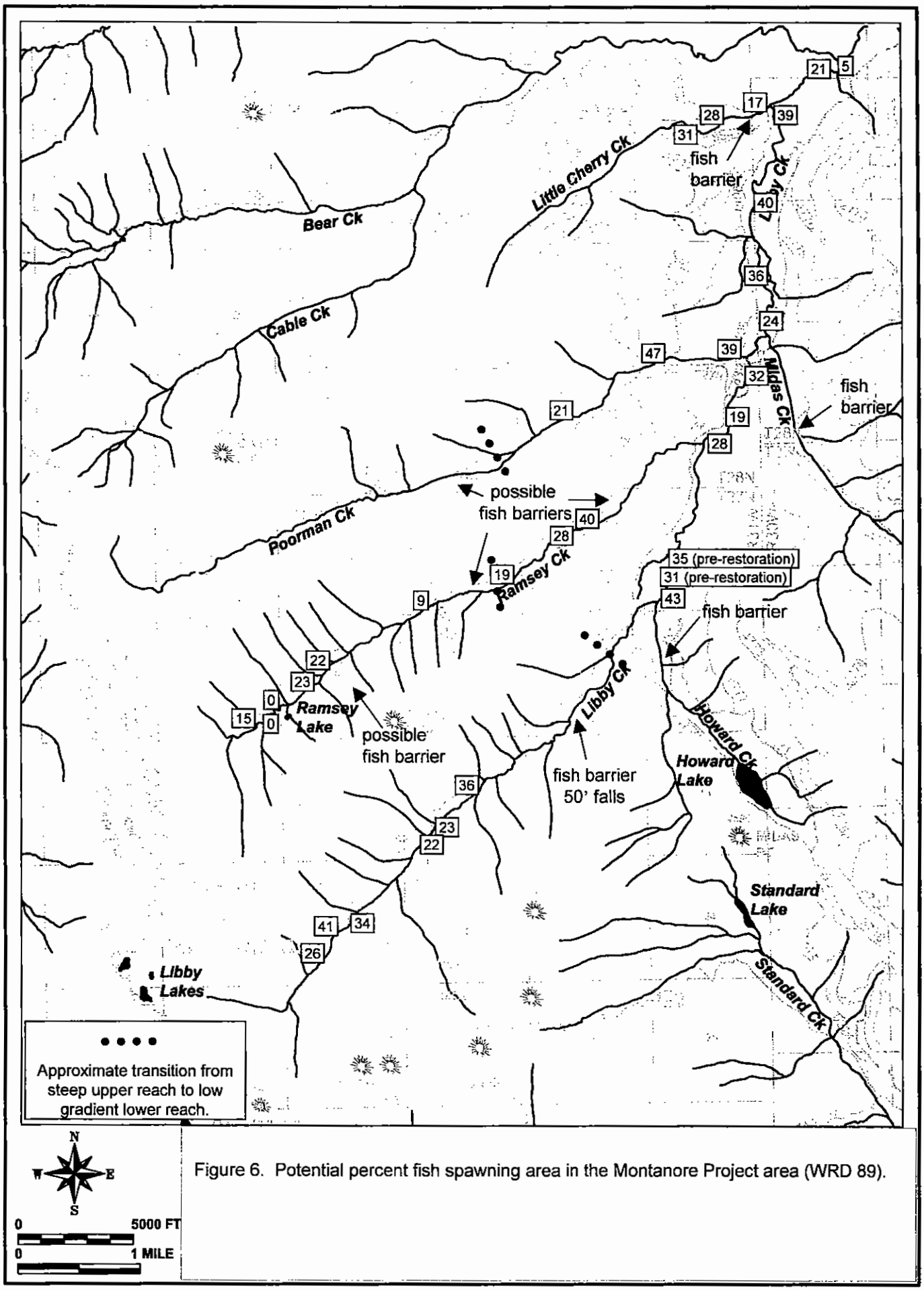


Figure 6. Potential percent fish spawning area in the Montanore Project area (WRD 89).

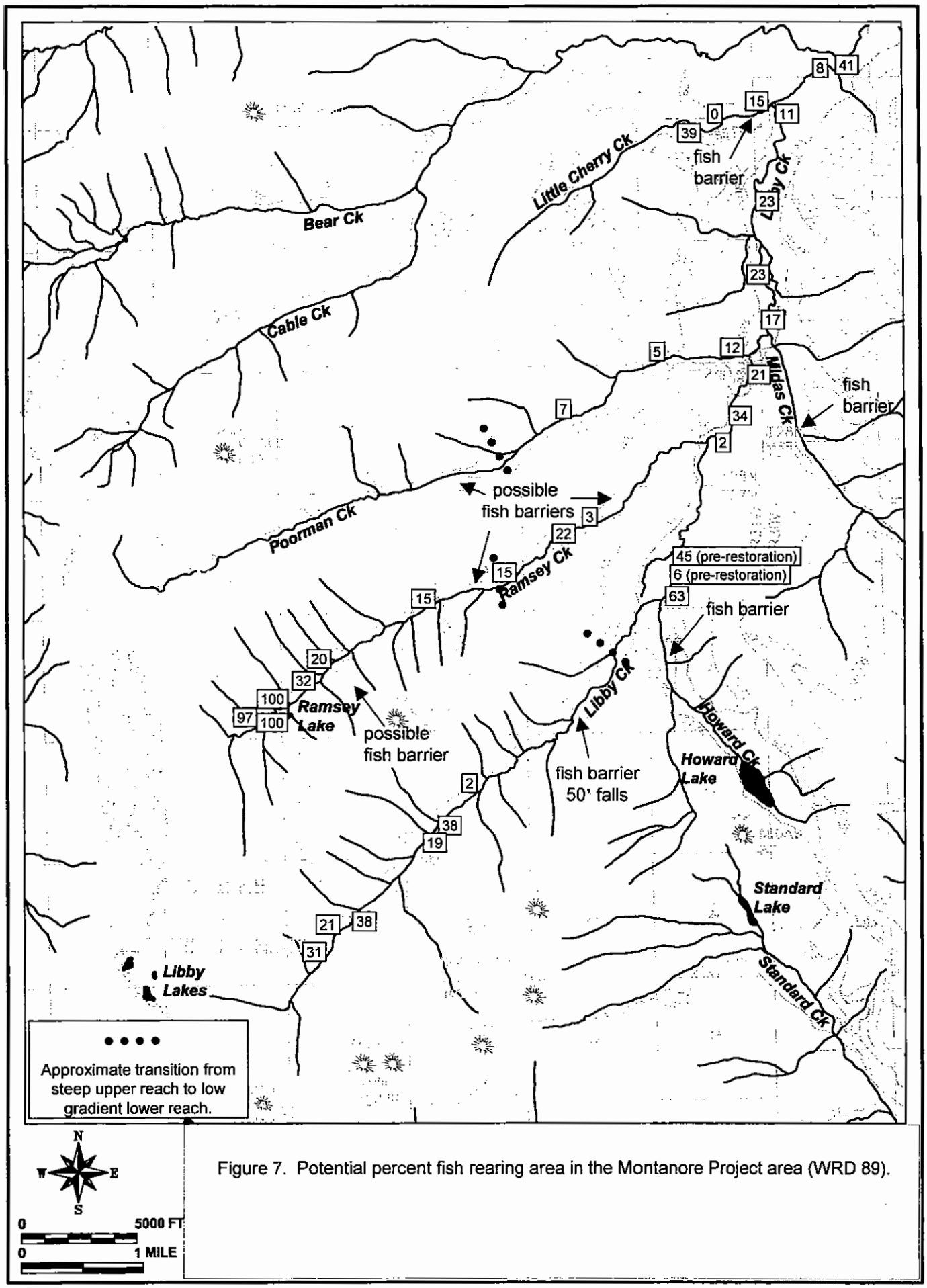


Figure 7. Potential percent fish rearing area in the Montanore Project area (WRD 89).

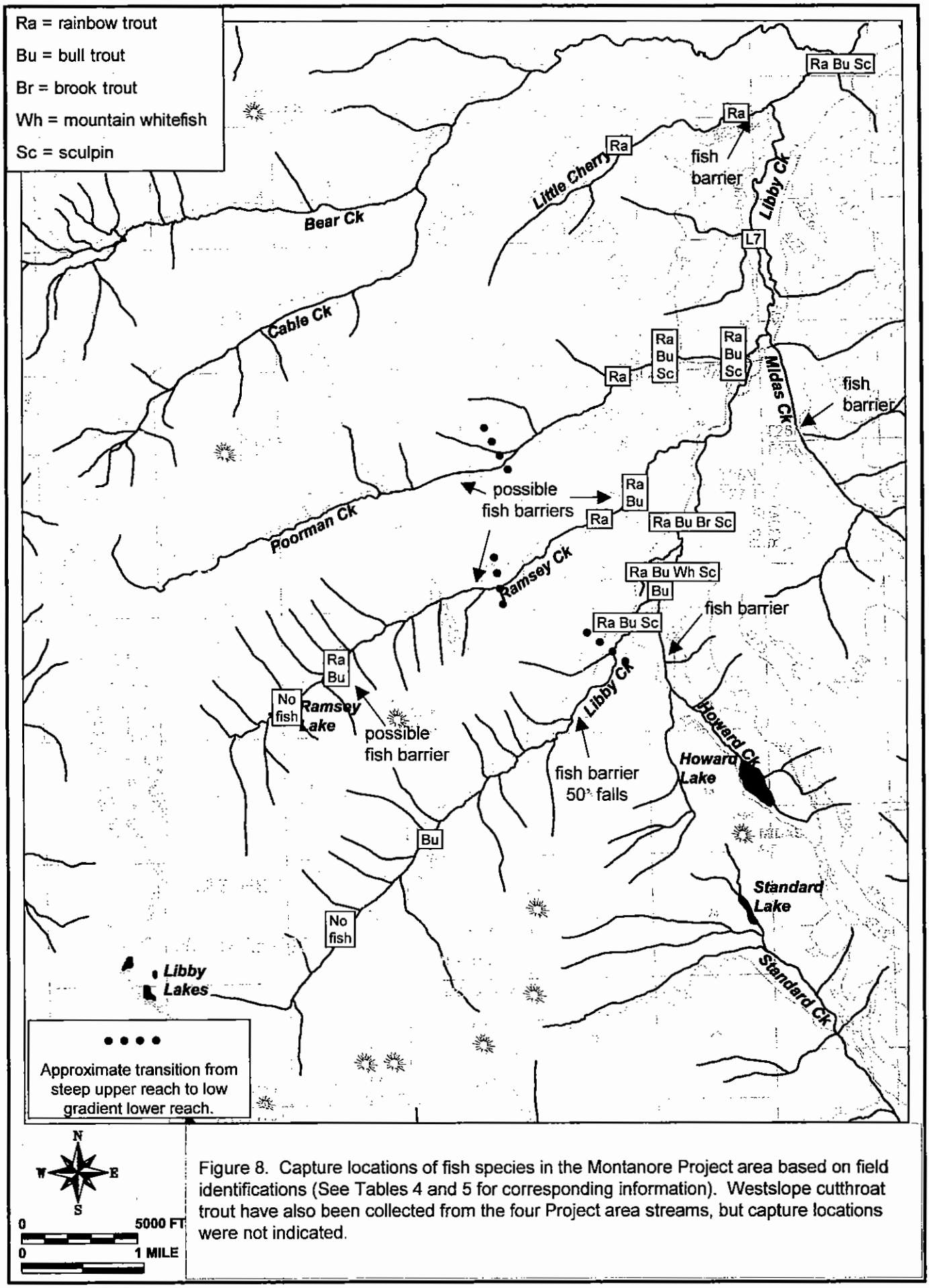


Figure 8. Capture locations of fish species in the Montanore Project area based on field identifications (See Tables 4 and 5 for corresponding information). Westslope cutthroat trout have also been collected from the four Project area streams, but capture locations were not indicated.