Appendix A.
MFWP MFISH database search results for Project area streams.
http://maps2.nris.state.mt.us/scripts/esrimap.dll?name=MFISH&Cmd=INST&WCmd=Stream

Montana Fish, Wildlife & Parks

Report 1 of 1
Select Form

Map Waterbody

Little Cherry Creek **Tributary Of:** **Libby Creek** **Total Length (Mi): 3.1**

Report is based on River Miles(rm): (0.0 to 3.1)

View list of tributaries to the Little Cherry Creek and their river miles

Hydrologic Units:
17010101 Upper Kootenai,

Counties:
Lincoln,

FWP Management

Waterbody Location	Region/Fish District	Management
From (rm 0.0) to (rm 3.1)	1 / Western	Trout Water

Fish Species Present

Species	Abundance	Water Use	Data Quality
Bull Trout			
From (rm 0.0) to (rm 3.1)	Rare	Primarily migrating	Extrapolated based on extensive samples
Columbia Basin Redband Trout			
From (rm 0.0) to (rm 3.1)	Unknown	Unknown	Extrapolated based on surveys
Rainbow Trout			
From (rm 0.0) to (rm 3.1)	Rare	Year-round resident	No Survey, Professional judgment
Redband X Rainbow Hybrid			
From (rm 0.0) to (rm 3.1)	Unknown	Year-round resident	Extrapolated based on surveys
Westslope X Rainbow			
From (rm 0.0) to (rm 3.1)	Unknown	Year-round resident	Extrapolated based on surveys

Population Trend Data

From (rm 0.0) to (rm 0.1) Section Name: LC-1

Date: 8/24/1988 **Collector: Unknown,**

Species	Method	Length-(Min-Max(In))	DQR	Total	Units

Species	Method	Length-(Min-Max(In))	DQR	Total	Units
Rainbow Trout	Two pass	3-5.4	Medium quality	104	per 1000 ft.

From (rm 0.0) to (rm 0.1) Section Name: LC-2

Date: 9/22/1988 Collector: Unknown,

Species	Method	Length-(Min-Max(In))	DQR	Total	Units
Rainbow Trout	Two pass	3-5.5	Medium quality	72	per 1000 ft.

From (rm 1.2) to (rm 1.3) Section Name: LITTLE CHERRY

Date: 7/9/2003 Collector: Plum Creek Timber Co. Personnel,

Species	Method	Length-(Min-Max (In))	DQR	Total	Units
Rainbow Trout	Total number captured or presence only	N/A-N/A	Unknown	24	no estimate, counts only

Genetics

From (rm 1.9) to (rm 2.0)

Date	Collector	Agency	TR	Analyzer	Date
9/19/1991	Perkinson, Doug	FS	T28NR31W	Sage, Kevin	7/2/1992

Sample #: 572

Number of Fish: 25

Analysis Type: Allozymes

	Percentage	Count	Hybridization
Rainbow Trout	98.3	0	0
Westslope Cutthroat Trout	1.6	0	0

From (rm 2.3) to (rm 2.4)

Date	Collector	Agency	TR	Analyzer	Date
7/27/1992	Perkinson, Doug	FS	T28NR31W	Sage, Kevin	2/23/1993

Sample #: 644

Number of Fish: 5

Analysis Type: Allozymes

	Percentage	Count	Hybridization
Columbia Basin Redband Trout	81.5	0	0
Rainbow Trout	18.5	0	0

Angling Use - Days Per Year

From (rm 0.0) to (rm 3.1)

	Total			Resident			Non Resident			Ranking	
Year	Press.	s.d.	Trips	Press.	s.d.	Trips	Press.	s.d.	Trips	State	Region
1983	68	68	1	0	0	0	68	68	1	1140	265

Angling Use Data Source:

Data provided by a biannual Statewide Angling Use Survey conducted via mail by Montana Fish, Wildlife and Parks Information Services Unit in Bozeman.

Fish Stocking Since 1990

No Stocking Data Available

Fisheries Resource Values

	Habitat Class	Sport Class	Final Value
From (rm 0.0) to (rm 3.1)	1	4	Outstanding

Fisheries Classification Data Source:
A complex series of ratings and points were assigned to various MFISH data fields and used to determine the Sport Fisheries Values and the Species and Habitat Value for all surveyed streams in Montana. The final resource was determined as the higher of the two values.

Protected Designation

From (rm 0.0) to (rm 3.1)
Protection Status: NWPPC Wildlife Protected Area
Wildlife Reasons for Protection:

- Big game critical wintering/spring area

Protection Designation Data Source:
Stream level protection from future development designated from:

Northwest Power Planning Council Protected Areas Program - Adopted September 14, 1988; protected 44,000 miles of Pacific Northwest streams because of their importance as critical fish and wildlife habitat.

Federal Wild and Scenic Rivers Act - Passed in 1968 and amended in 1982; federal program preserving rivers possessing "outstandingly remarkable" values in their free-flowing condition (16 U.S.C. 1271).

FWP Dewatering Concern Area

Stream not considered dewatered by MFWP

FWP Instream Flow Protection/Quantification

Instream Flows not determined.

Stream Channel Conditions

From (rm 0.0) to (rm 3.1)

Bank Vegetation: N/A

Riparian Vegetation: N/A

SubSurface Cover: N/A

Gradient: 5.3

Sinuosity: N/A

Side Channels: Nil

Data Rating: Low - judgement only

Rosgen Class: N/A

Pool Ratio: N/A Run Ratio: N/A Riffle Ratio: N/A Pocket Ratio: N/A

References

Leary, Robb ,University of Montana, 1993

Sage, Kevin ,University of Montana, 1992

Sage, Kevin ,University of Montana, 1993

The Montana Bull Trout Scientific Group ,The Montana Bull Trout Restoration Team, 1996

Montana Fish, Wildlife & Parks

Report 1 of 1
Select Form

Map Waterbody

Poorman Creek **Tributary Of:** **Libby Creek** **Total Length (Mi): 5.5**

Report is based on River Miles(rm): (0.0 to 5.5)

View list of tributaries to the Poorman Creek and their river miles

Hydrologic Units:
17010101 Upper Kootenai,

Counties:
Lincoln,

FWP Management

Waterbody Location	Region/Fish District	Management
From (rm 0.0) to (rm 5.5)	1 / Western	Trout Water

Fish Species Present

Species	Abundance	Water Use	Data Quality
Bull Trout			
From (rm 0.0) to (rm 5.5)	Rare	Both resident and Fluvial/Adfluvial populations	Extrapolated based on extensive samples
Rainbow Trout			
From (rm 0.0) to (rm 5.5)	Common	Year-round resident	Extrapolated based on surveys
Slimy Sculpin			
From (rm 0.0) to (rm 5.5)	Common	Year-round resident	Extrapolated based on surveys

Population Trend Data

From (rm 0.0) to (rm 0.1) Section Name: CHERRY LOOP BRIDGE TO CULVERT

Date: 8/10/1994 Collector: Resanka,

Species	Method	Length-(Min-Max(In))	DQR	Total	Units
Rainbow Trout	One pass	N/A-N/A	Medium quality	38	no estimate, counts only
Bull Trout	One pass	N/A-N/A	Medium quality	1	no estimate, counts only

From (rm 0.0) to (rm 0.6) Section Name: FROM MTH

Date: 8/20/1982 Collector: Hansen,

Species	Method	Length-(Min-Max(In))	DQR	Total	Units

Rainbow Trout	One pass	N/A-N/A	Medium quality	39	no estimate, counts only
Bull Trout	One pass	N/A-N/A	Medium quality	2	no estimate, counts only

From (rm 0.4) to (rm 0.6) Section Name: PC-1

Date: 8/25/1988 Collector: Unknown,

Species	Method	Length-(Min-Max(In))	DQR	Total	Units
Rainbow Trout	Two pass	3-8.6	Medium quality	105	per 1000 ft.
Bull Trout	Two pass	4.8-8.1	Medium quality	4	per 1000 ft.

From (rm 1.6) to (rm 1.7) Section Name: PC-2

Date: 8/26/1988 Collector: Unknown,

Species	Method	Length-(Min-Max(In))	DQR	Total	Units
Rainbow Trout	Two pass	3-7.8	Medium quality	90	per 1000 ft.

Genetics

From (rm 0.7) to (rm 0.8)

Date	Collector	Agency	TR	Analyzer	Date
8/22/2000	Hensler, Mike	FWP	T28NR31W	Leary, Robb	5/1/2003

Sample #: 2807

Number of Fish: 25

Analysis Type: Allozymes

	Percentage	Count	Hybridization
Rainbow Trout	100	0	0

From (rm 1.5) to (rm 1.6)

Date	Collector	Agency	TR	Analyzer	Date
9/19/1991	Perkinson, Doug	FS	T28NR31W	Leary, Robb	7/2/1992

Sample #: 568

Number of Fish: 5

Analysis Type: Allozymes

	Percentage	Count	Hybridization
Rainbow Trout	100	0	0

Angling Use - Days Per Year

From (rm 0.0) to (rm 5.5)

	Total			Resident			Non Resident			Ranking	
Year	Press.	s.d.	Trips	Press.	s.d.	Trips	Press.	s.d.	Trips	State	Region
2003	488	366	13	488	366	13	0	0	0	399	95
1999	34	34	1	34	34	1	0	0	0	1713	370

1997	138	109	4	138	109	4	0	0	0	923	203
1995	69	69	2	69	69	2	0	0	0	1288	304
1991	409	248	13	409	248	13	0	0	0	447	96
1983	206	206	1	206	206	1	0	0	0	897	208

Angling Use Data Source:
Data provided by a biannual Statewide Angling Use Survey conducted via mail by Montana Fish, Wildlife and Parks Information Services Unit in Bozeman.

Fish Stocking Since 1990

No Stocking Data Available

Fisheries Resource Values

	Habitat Class	Sport Class	Final Value
From (rm 0.0) to (rm 5.5)	1	4	Outstanding

Fisheries Classification Data Source:
A complex series of ratings and points were assigned to various MFISH data fields and used to determine the Sport Fisheries Values and the Species and Habitat Value for all surveyed streams in Montana. The final resource was determined as the higher of the two values.

Protected Designation

From (rm 0.0) to (rm 5.5)
Protection Status: NWPPC Wildlife Protected Area
Wildlife Reasons for Protection:

- **Big game critical wintering/spring area**
- **Critical grizzly bear habitat (documented use) - Cabinet/Yaak ecosystem)**

Protection Designation Data Source:
Stream level protection from future development designated from:
Northwest Power Planning Council Protected Areas Program - Adopted September 14, 1988; protected 44,000 miles of Pacific Northwest streams because of their importance as critical fish and wildlife habitat.
Federal Wild and Scenic Rivers Act - Passed in 1968 and amended in 1982; federal program preserving rivers possessing "outstandingly remarkable" values in their free-flowing condition (16 U.S.C. 1271).

FWP Dewatering Concern Area

Stream not considered dewatered by MFWP

FWP Instream Flow Protection/Quantification

Instream Flows not determined.

Stream Channel Conditions

From (rm 0.0) to (rm 5.5)

Bank Vegetation: N/A
SubSurface Cover: N/A
Sinuosity: N/A
Data Rating: Low - judgement only
Riparian Vegetation: N/A
Gradient: 2
Side Channels: Nil
Rosgen Class: N/A

Pool Ratio: N/A Run Ratio: N/A Riffle Ratio: N/A Pocket Ratio: N/A

References

Leary, Robb ,University of Montana, 1992

Leary, Robb ,University of Montana, 2003

Report 1 of 1

Montana Fish, Wildlife & Parks

Report 1 of 1
Select Form

Map Waterbody

Ramsey Creek **Tributary Of:** **Libby Creek** **Total Length (Mi): 6.0**

Report is based on River Miles(rm): (0.0 to 6.0)

View list of tributaries to the Ramsey Creek and their river miles

Hydrologic Units:
17010101 Upper Kootenai,

Counties:
Lincoln,

FWP Management

Waterbody Location	Region/Fish District	Management
From (rm 0.0) to (rm 6.0)	1 / Western	Trout Water

Fish Species Present

Species	Abundance	Water Use	Data Quality
Bull Trout			
From (rm 0.0) to (rm 6.0)	Rare	Year-round resident	Extrapolated based on extensive samples
Columbia Basin Redband Trout			
From (rm 0.0) to (rm 6.0)	Rare	Year-round resident	Extrapolated based on surveys

Population Trend Data

From (rm 0.0) to (rm 0.1) Section Name: ?

Date: 9/8/1982 Collector: Hansen,

Species	Method	Length-(Min-Max(In))	DQR	Total	Units
Rainbow Trout	One pass	N/A-N/A	Medium quality	7	no estimate, counts only

From (rm 1.3) to (rm 1.5) Section Name: RM-1

Date: 8/30/1988 Collector: Unknown,

Species	Method	Length-(Min-Max(In))	DQR	Total	Units
Rainbow Trout	Two pass	3.1-8.6	Medium quality	46	per 1000 ft.
Bull Trout	Two pass	3.5-12.6	Medium quality	33	per 1000 ft.

From (rm 3.7) to (rm 3.8) Section Name: RM-3

Date: 9/7/1988 Collector: Unknown,

Species	Method	Length-(Min-Max(In))	DQR	Total	Units
Trout	Two pass	N/A-N/A	Medium quality	0	per 1000 ft.

From (rm 3.7) to (rm 3.9) Section Name: RM-2

Date: 8/31/1988 Collector: Unknown,

Species	Method	Length-(Min-Max(In))	DQR	Total	Units
Rainbow Trout	Multi-pass, maximum likelihood	3.5-8.8	Medium quality	33	per 1000 ft.
Bull Trout	Multi-pass, maximum likelihood	6.7-10	Medium quality	10	per 1000 ft.

Genetics

From (rm 0.4) to (rm 0.5)

Date	Collector	Agency	TR	Analyzer	Date
9/19/1991	Perkinson, Doug	FS	T28NR31W	Sage, Kevin	7/2/1992

Sample #: 569

Number of Fish: 6

Analysis Type: Allozymes

	Percentage	Count	Hybridization
Rainbow Trout	98.7	0	0
Westslope Cutthroat Trout	1.3	0	0

From (rm 3.3) to (rm 3.4)

Date	Collector	Agency	TR	Analyzer	Date
8/22/2000	Hensler, Mike	FWP	T27NR31W	Leary, Robb	5/1/2003

Sample #: 2805

Number of Fish: 25

Analysis Type: Allozymes

	Percentage	Count	Hybridization
Columbia Basin Redband Trout	-10	24	0
Redband X Westslope Cutthroat	-10	1	First generation hybrid

Angling Use - Days Per Year

No Stream Pressure Data Available

Fish Stocking Since 1990

No Stocking Data Available

Fisheries Resource Values

Habitat Class	Sport Class	Final Value

From (rm 0.0) to (rm 6.0)	1	4	Outstanding

Fisheries Classification Data Source:
A complex series of ratings and points were assigned to various MFISH data fields and used to determine the Sport Fisheries Values and the Species and Habitat Value for all surveyed streams in Montana. The final resource was determined as the higher of the two values.

Protected Designation

From (rm 0.0) to (rm 6.0)
Protection Status: NWPPC Wildlife Protected Area
Wildlife Reasons for Protection:

- **Big game critical wintering/spring area**

Protection Designation Data Source:
Stream level protection from future development designated from:
Northwest Power Planning Council Protected Areas Program - Adopted September 14, 1988; protected 44,000 miles of Pacific Northwest streams because of their importance as critical fish and wildlife habitat.
Federal Wild and Scenic Rivers Act - Passed in 1968 and amended in 1982; federal program preserving rivers possessing "outstandingly remarkable" values in their free-flowing condition (16 U.S.C. 1271).

FWP Dewatering Concern Area

Stream not considered dewatered by MFWP

FWP Instream Flow Protection/Quantification

Instream Flows not determined.

Stream Channel Conditions

From (rm 0.0) to (rm 6.0)

Bank Vegetation: N/A | **Riparian Vegetation: N/A**

SubSurface Cover: N/A | **Gradient: N/A**

Sinuosity: N/A | **Side Channels: Nil**

Data Rating: Low - judgement only | **Rosgen Class: N/A**

Pool Ratio: N/A **Run Ratio: N/A** **Riffle Ratio: N/A** **Pocket Ratio: N/A**

References

Leary, Robb ,University of Montana, 2003

Sage, Kevin ,University of Montana, 1992

Report 1 of 1

Montana Fish, Wildlife & Parks

Report 1 of 1
Select Form

Map Waterbody

Libby Creek **Tributary Of:** **Kootenai River** **Total Length (Mi): 29.2**

Report is based on River Miles(rm): (0.0 to 29.2)
View list of tributaries to the Libby Creek and their river miles

Hydrologic Units:
17010101 Upper Kootenai,

Counties:
Lincoln,

FWP Management

Waterbody Location	Region/Fish District	Management
From (rm 0.0) to (rm 29.2)	1 / Western	Trout Water

Fish Species Present

Species	Abundance	Water Use	Data Quality
Brook Trout			
From (rm 0.0) to (rm 18.6)	Rare	Year-round resident	Extrapolated based on surveys
From (rm 18.6) to (rm 19.4)	Unknown	Year-round resident	Extrapolated based on surveys
From (rm 19.4) to (rm 24.3)	Rare	Year-round resident	Extrapolated based on surveys
Bull Trout			
From (rm 24.3) to (rm 27.9)	Rare	Year-round resident	Extrapolated based on extensive samples
Columbia Basin Redband Trout			
From (rm 21.9) to (rm 22.8)	Unknown	Year-round resident	Extrapolated based on surveys
Largescale Sucker			
From (rm 0.0) to (rm 24.3)	Common	Year-round resident	Extrapolated based on surveys
Longnose Dace			
From (rm 0.0) to (rm 29.2)	Rare	Year-round resident	Extrapolated based on surveys
Mountain Whitefish			
From (rm 0.0) to (rm 16.7)	Abundant	Year-round resident	Extrapolated based on surveys
From (rm 16.7) to (rm 24.3)	Incidental	Year-round	Extrapolated based

		resident	on surveys
Rainbow Trout			
From (rm 0.0) to (rm 16.7)	Common	Both resident and Fluvial/Adfluvial populations	Extrapolated based on surveys
From (rm 22.8) to (rm 24.3)	Unknown	Year-round resident	Extrapolated based on surveys
Redband X Rainbow Hybrid			
From (rm 6.5) to (rm 21.6)	Unknown	Year-round resident	Extrapolated based on surveys
From (rm 21.9) to (rm 22.8)	Unknown	Year-round resident	Extrapolated based on surveys
Sculpin			
From (rm 0.0) to (rm 18.6)	Rare	Year-round resident	Extrapolated based on surveys
From (rm 18.6) to (rm 19.4)	Common	Year-round resident	Extrapolated based on surveys
From (rm 21.6) to (rm 29.2)	Rare	Year-round resident	Extrapolated based on surveys
Slimy Sculpin			
From (rm 19.4) to (rm 21.6)	Abundant	Year-round resident	Extrapolated based on surveys
From (rm 21.9) to (rm 22.8)	Abundant	Year-round resident	Extrapolated based on surveys
Westslope X Rainbow			
From (rm 2.4) to (rm 16.7)	Unknown	Year-round resident	Extrapolated based on surveys

Population Trend Data

From (rm 2.3) to (rm 3.5)

Date: 8/27/1976 Collector: Huston, Joe

Species	Method	Length-(Min-Max(In))	DQR	Total	Units
Rainbow Trout	Log-likelihood	N/A-N/A	Low quality	280	per 1000 ft.

From (rm 2.3) to (rm 3.5) Section Name: LIBBY CR BRIDGE TO BRIDGE

Date: 8/1/1986 Collector: Hensler, Mike

Species	Method	Length-(Min-Max(In))	DQR	Total	Units
Rainbow Trout	Log-likelihood	3-N/A	Medium quality	92	per 1000 ft.

Date: 8/16/1986 Collector: Hensler, Mike

Species	Method	Length-(Min-Max(In))	DQR	Total	Units
Rainbow Trout	Log-likelihood	3-N/A	Medium quality	82	per 1000 ft.

From (rm 24.2) to (rm 24.4) Section Name: LB-2 AND LB-3(POP.IDENTICAL)

Date: 9/6/1988 Collector: Unknown,

Species	Method	Length-(Min-Max(In))	DQR	Total	Units

Bull Trout	Two pass	5.3-9.1	Medium quality	38	per 1000 ft.

From (rm 24.2) to (rm 24.4) Section Name: LB-4

Date: 9/23/1988 Collector: Unknown,

Species	Method	Length-(Min-Max(In))	DQR	Total	Units
Trout	Two pass	N/A-N/A	Medium quality	0	per 1000 ft.

Genetics

From (rm 6.9) to (rm 7.0)

Date	Collector	Agency	TR	Analyzer	Date
10/19/2000	Hensler, Mike	FWP	T29NR31W	Leary, Robb	5/1/2003

Sample #: 2809

Number of Fish: 25

Analysis Type: Allozymes

	Percentage	Count	Hybridization
Redband X Rainbow Hybrid	-10	25	0

From (rm 12.8) to (rm 12.9)

Date	Collector	Agency	TR	Analyzer	Date
8/18/2000	Hensler, Mike	FWP	T29NR30W	Leary, Robb	5/1/2003

Sample #: 2808

Number of Fish: 25

Analysis Type: Allozymes

	Percentage	Count	Hybridization
Redband X Rainbow Hybrid	-10	25	0

From (rm 15.9) to (rm 16.0)

Date	Collector	Agency	TR	Analyzer	Date
9/19/1991	Perkinson, Doug	FS	T28NR30W	Sage, Kevin	7/2/1992

Sample #: 567

Number of Fish: 7

Analysis Type: Allozymes

	Percentage	Count	Hybridization
Rainbow Trout	92.9	0	0
Westslope Cutthroat Trout	7.1	0	0

From (rm 22.1) to (rm 22.2)

Date	Collector	Agency	TR	Analyzer	Date
7/27/1992	Perkinson, Doug	FS	T28NR31W	Leary, Robb	2/23/1993

Sample #: 643 Number of Fish: 25 Analysis Type: Allozymes		Percentage	Count	Hybridization
	Columbia Basin Redband Trout	52.3	0	0
	Rainbow Trout	45.7	0	0

From (rm 23.6) to (rm 23.7)

Date	Collector	Agency	TR	Analyzer	Date
1/1/2000	Hensler, Mike	FWP	T27NR31W	Leary, Robb	5/1/2003

Sample #: 2806 Number of Fish: 30 Analysis Type: Allozymes		Percentage	Count	Hybridization
	Rainbow Trout	100	0	0

From (rm 23.8) to (rm 23.9)

Date	Collector	Agency	TR	Analyzer	Date
9/19/1991	Perkinson, Doug	FS	T27NR31W	Leary, Robb	1/1/1992

Sample #: 570 Number of Fish: 5 Analysis Type: Allozymes		Percentage	Count	Hybridization
	Rainbow Trout	100	0	0

Angling Use - Days Per Year

From (rm 0.0) to (rm 29.2)

	Total			Resident			Non Resident			Ranking	
Year	Press.	s.d.	Trips	Press.	s.d.	Trips	Press.	s.d.	Trips	State	Region
2003	193	193	2	193	193	2	0	0	0	671	151
2001	190	118	4	41	41	1	149	111	3	672	157
1999	411	201	11	411	201	11	0	0	0	492	114
1997	1726	845	38	1074	606	30	652	589	8	204	44
1995	163	101	3	81	58	2	82	82	1	805	196
1993	997	656	20	897	653	16	100	61	4	256	54
1991	170	94	5	145	91	4	25	25	1	773	165
1989	424	178	9	254	154	5	170	88	4	413	88
1985	776	444	5	708	439	4	68	68	1	355	80
1983	651	440	4	583	434	3	68	68	1	459	106
1982	970	827	9	970	827	9	0	0	0	352	76

Angling Use Data Source:
Data provided by a biannual Statewide Angling Use Survey conducted via mail by Montana Fish, Wildlife and Parks

Information Services Unit in Bozeman.

Fish Stocking Since 1990

No Stocking Data Available

Fisheries Resource Values

	Habitat Class	Sport Class	Final Value
From (rm 0.0) to (rm 29.2)	1	4	Outstanding

Fisheries Classification Data Source:
A complex series of ratings and points were assigned to various MFISH data fields and used to determine the Sport Fisheries Values and the Species and Habitat Value for all surveyed streams in Montana. The final resource was determined as the higher of the two values.

Protected Designation

From (rm 0.0) to (rm 22.8)
Protection Status: NWPPC Fisheries Protected Area

Fish Reasons for Protection:

Essential spawning habitat

Wildlife Reasons for Protection:

From (rm 22.8) to (rm 24.3)
Protection Status: NWPPC Fisheries and Wildlife Protected Area

Fish Reasons for Protection:

Essential spawning habitat

Wildlife Reasons for Protection:

- Big game critical wintering/spring area
- Critical grizzly bear habitat (documented use) - Cabinet/Yaak ecosystem)

From (rm 24.3) to (rm 29.2)
Protection Status: NWPPC Fisheries and Wildlife Protected Area

Fish Reasons for Protection:

Essential spawning habitat

Wildlife Reasons for Protection:

- Critical grizzly bear habitat (documented use) - Cabinet/Yaak ecosystem)

Protection Designation Data Source:
Stream level protection from future development designated from:

Northwest Power Planning Council Protected Areas Program - Adopted September 14, 1988; protected 44,000 miles of Pacific Northwest streams because of their importance as critical fish and wildlife habitat.

Federal Wild and Scenic Rivers Act - Passed in 1968 and amended in 1982; federal program preserving rivers possessing "outstandingly remarkable" values in their free-flowing condition (16 U.S.C. 1271).

FWP Dewatering Concern Area

	Level of Concern
Area Affected: (Mile 0.0) to (River Mile 14.3)	Periodic Dewatering

Dewatered Stream Section Data Source:

Created 1991/updated 1997 by MFWP fisheries biologists. Streams that support important or contribute to important fisheries that are significantly dewatered by man-caused flow depletions. Chronic: dewatering is a significant problem in virtually all years; Periodic: dewatering is a significant problem only in drought or water-short years.

FWP Instream Flow Protection/Quantification

Instream Flows not determined.

Stream Channel Conditions

From (rm 0.0) to (rm 18.6)

Bank Vegetation: N/A | **Riparian Vegetation: N/A**
SubSurface Cover: N/A | **Gradient: 0**
Sinuosity: N/A | **Side Channels:**
Data Rating: N/A | **Rosgen Class: N/A**

Pool Ratio: N/A **Run Ratio: N/A** **Riffle Ratio: N/A** **Pocket Ratio: N/A**

From (rm 18.6) to (rm 19.4)

Bank Vegetation: N/A | **Riparian Vegetation: N/A**
SubSurface Cover: N/A | **Gradient: 0**
Sinuosity: N/A | **Side Channels: Nil**
Data Rating: Low - judgement only | **Rosgen Class: N/A**

Pool Ratio: N/A **Run Ratio: N/A** **Riffle Ratio: N/A** **Pocket Ratio: N/A**

From (rm 19.4) to (rm 21.6)

Bank Vegetation: N/A | **Riparian Vegetation: N/A**
SubSurface Cover: N/A | **Gradient: 1.5**
Sinuosity: N/A | **Side Channels: Nil**
Data Rating: N/A | **Rosgen Class: N/A**

Pool Ratio: N/A **Run Ratio: N/A** **Riffle Ratio: N/A** **Pocket Ratio: N/A**

From (rm 21.6) to (rm 21.9)

Bank Vegetation: N/A | **Riparian Vegetation: N/A**
SubSurface Cover: N/A | **Gradient: 0**
Sinuosity: N/A | **Side Channels:**
Data Rating: N/A | **Rosgen Class: N/A**

Pool Ratio: N/A **Run Ratio: N/A** **Riffle Ratio: N/A** **Pocket Ratio: N/A**

From (rm 21.9) to (rm 22.8)

Bank Vegetation: N/A | **Riparian Vegetation: N/A**
SubSurface Cover: N/A | **Gradient: 2**
Sinuosity: N/A | **Side Channels: Nil**
Data Rating: N/A | **Rosgen Class: N/A**

Pool Ratio: N/A **Run Ratio: N/A** **Riffle Ratio: N/A** **Pocket Ratio: N/A**

From (rm 22.8) to (rm 24.3)

Bank Vegetation: N/A | **Riparian Vegetation: N/A**
SubSurface Cover: N/A | **Gradient: 0**
Sinuosity: N/A | **Side Channels:**
Data Rating: N/A | **Rosgen Class: N/A**

Pool Ratio: N/A **Run Ratio: N/A** **Riffle Ratio: N/A** **Pocket Ratio: N/A**

From (rm 24.3) to (rm 29.2)

Bank Vegetation: N/A

Riparian Vegetation: N/A

SubSurface Cover: N/A

Gradient: 0

Sinuosity: N/A

Side Channels: Nil

Data Rating: Low - judgement only

Rosgen Class: N/A

Pool Ratio: N/A Run Ratio: N/A Riffle Ratio: N/A Pocket Ratio: N/A

References

Boland, Ralph ,Montana Dept. of Fish, Wildlife and Parks, 1987

Boland, Ralph W. ,Montana Dept. of Fish, Wildlife and Parks, 1985

Dalbey, Steve, And Brian Marotz ,Montana Dept. of Fish, Wildlife and Parks,Confederated Salish and Kootenai Tribes,Kootenai Tribe of Idaho, 1997

Domrose, Robert ,Montana Dept. of Fish, Wildlife and Parks, 1987

Domrose, Robert ,Montana Dept. of Fish, Wildlife and Parks, 1986

Dossantos, Joseph M. ,Montana State University, 1985

Hensler, Mike ,Montana Dept. of Fish, Wildlife and Parks, 1995

Leary, Robb ,University of Montana, 1992

Leary, Robb ,University of Montana, 1993

Leary, Robb ,University of Montana, 2003

Marotz, Brian, And John Fraley ,Bonneville Power Administration, 1986

May, Bruce ,U.S. Forest Service, 1982

Montana Department Of Fish And Game ,Montana Fish and Game Department, 1977

Montana Dept. Of Fish, Wildlife And Parks ,Montana Dept. of Fish, Wildlife and Parks, 1985

Ostle, Bernard ,Ames, Iowa: Iowa State College Press, 1954

Riggs, Vic ,Montana Dept. of Fish, Wildlife & Parks, 2000

Sage, Kevin ,University of Montana, 1992

The Montana Bull Trout Scientific Group ,The Montana Bull Trout Restoration Team, 1996

The Montana Bull Trout Scientific Group ,The Montana Bull Trout Restoration Team, 1996

Report 1 of 1

Appendix B.
Habitat survey field data sheets and associated information.

APPENDIX I: KOOTENAI NATIONAL FOREST WATERSHED FIELD DATA
including ROSGEN CHANNEL CLASSIFICATION INFO

Stream Name: Libby **Reach ID:** #10 **HUC #:** ____
Crew: Thompson, Jungst, Agne **Date:** 8/11/04 **Elev. Start Reach:** ____ **English:** X **Metric:** ____
Reach Length: 837 **Permanent:** ____ **Basin Survey:** ____ **Reference:** Y N **Overall Reliability:** 1 2 3 4 5

Channel Type: F3 **Reviewed Channel Type:** ____ **Reviewed by:** ____ **Date:** ____

1) Thread:
- ✓ single no side channels
- ____ single w/ side channels
- ____ multiple channels

2) Entrenchment: Measured: X Estimate: ____
/ 42.0 / 34.3 / 39.0 / 35.0 / 36.2 / 38.5 / 44.0 /
/ 29.0 / 35.7 / 38.5 / BF widths / 37.42 / avg. BFW
- 37.5 bankfull width @ station 33
- 1.73 max bankfull depth
- 50 floodprone width (width @ 2X max BF)
- 1.33 entrenchment ratio (FPW/ BFW @ station)

3) W/D Ratio: Measured: X Estimate: ____
- 40.08 computed bankfull area
- 1.06 avg. BF depth (BFA/BFW@station) (Arithmetic)
- 35.08 width/depth ratio (BFW@station/avg.BFD)

4) Sinuosity: Measured: X Estimate: ____
- 837 stream length (thalweg)
- 750 valley length (straight line between thalweg pts.)
- 1.12 sinuosity (stream length/valley length)

5) Gradient: Measured: ____ Estimate: ____
2.65 / 1.82 / 2.0 / ____ elevation change
300 / 227 / 310 / ____ distance
.009 / .008 / .002 / ____ gradient
.012 average reach gradient

6) Particle size distribution: Measured: X Estimate: ____
- 128 - cobble dominant size class (mm) 43.3 %Grand Total
- 128 D 50 (mm)

comments: ____

7) Depositional Pattern:
- ____ point bars
- X point bars w/mid-channel bars
- ____ many side-channel bars
- ____ side or diagonal bars
- ____ channel composed of bars/islands
- ____ none

8) Bed Features:
- ____ cascade
- ____ step-pool
- ____ plane bed/glide
- X pool-riffle
- ____ other: ____

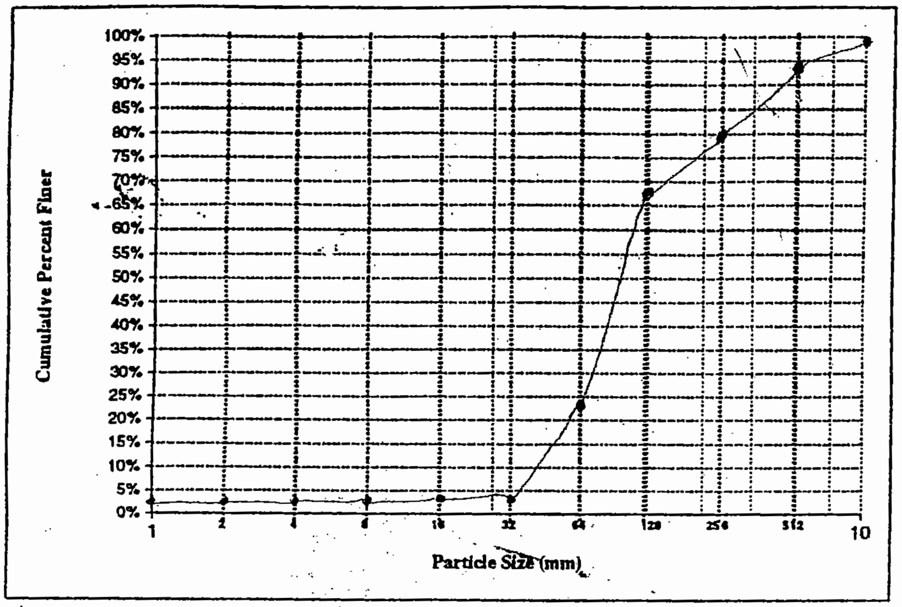
Distance (from L.Pin)	Width	Elevation	BF depth (E - BFE)	Area (WxBFD)
1	.5		0	0
2	1.5		.15	.23
4	2		.76	1.52
6	2		1.0	2
8			1.0	2
10			1.1	2.2
12			.95	1.9
14			1.2	2.4
16			1.46	2.92
18			1.4	2.8
20			1.38	2.76
22			1.62	3.24
24			1.72	3.44
26			1.73	3.46
28			1.25	2.5
30			1.15	2.3
32			0.75	1.5
34			.55	1.1
36	2		.78	1.56
38	1.25		.2	.25
38.5	.25		0	0
				40.08

Stream Notes:
* Trib comes in @ 750 ft
UTM 5337714 @ Station
* UTM 5337648 = Confluence of Bear and Libby

Photos: # 26 description: dwnstrm. station
27 description: upstream station
____ description: ____
____ description: ____
____ description: ____
____ description: ____
____ description: ____

Map Attached: Y N

size (mm)	Particle	#	~~Pool~~ Riffle	~~Riffle~~ Pool	Total	%C[illegible]	
0-.062	silt	0			3	2.5	
.062-2	sand	1			0	0	
2-4	v. fine gravel	2			0	0	
4-8	fine gravel	3			0	0	2[illegible]
8-16	med. gravel	4			1	.8	3.3
16-32	course gravel	5			0	0	3.3
32-64	v. course gravel	6			25	20.8	24.1
64-128	small cobble	7			52	43.3	67.[illegible]
128-256	large cobble	8			16	13.3	80.[illegible]
256-512	small boulder	9			17	14.2	94.[illegible]
512-1024	med. boulder	10			6	5	99.[illegible]
1024-4096	large boulder	11					
4096+	bedrock	12					
			15	85	120	Grand Total	



Stability Notes:

CHANNEL STABILITY

UPPER BANKS	EXCELLENT		GOOD		FAIR		POOR	
1. landform slope of floodprone area	upper bank slope < 30%	2 (circled)	upper bank slope 30-40%	4	upper bank slope 40-60%	6	upper bank slope 60+%	8
2. mass wasting (existing or potential)	no evidence of past, or potential for future wasting into channels	3	infrequent and/or very small, mostly healed, low future potential	6 (circled)	moderate number and size with some raw and others available at high flows	9	numerous or large, erode at all flow levels or imminent danger of same	12
3. debris accumulation in floodprone area (debris & limbs)	mostly long/large debris, potential for log jam formation is low	2 (circled)	mostly short/lg debris, potential for log jam formation is slight	4	mostly short/small debris occasional dense log jam with trash accumulations	6	all short/small debris many dense log jams with trash accumulation	8
4. floodprone area resistant to bankfull flows (veg. & rocks)	90+% plant, lg. debris, boulder armoring with deep, dense rooting	3	70-90% plant, lg. debris boulder armoring with deep dense rooting	6	50-70% plant, lg debris, or boulder armoring with shallow/dense soil rooting	9 (circled)	< 50% plant, lg debris, boulder armoring with little rooting of soils	12
LOWER BANKS & CHANNEL								
5. channel capacity (floodprone area accessable to BF flows)	ample capacity, peakflow contained, width/depth ratio < 10	1	adequate, overbank flows rare, riffle, w/d 10-15	2	barely contains present peakflow, floods evident, riffle, w/d 15-25	3	inadequate for peakflow, floods common, w/d >25	4
6. bank rock content	65+% boulders >12" dia. some angular rock/bldrs	2	40-65% rounded boulders mostly 6-12" dia	4	20-40% round cobble, most 3-6" dia and some gravel	6 (circled)	< 20% rock content, most rock is 1-3" gravel	8
7. obstructions, flow deflectors and sediment traps	bldrs/debris abundant, one main channel, flow uniform, sed. traps < 1/2 full	2 (circled)	bldrs/debris common, one main channel with few flow deflectors, sed. traps 3/4 full	4	bldrs/debris common, one migrating channel, many bedload deposits, sed. sed. traps full	6	bldrs/debris uncommon, migrating channels, many bedload deposits, sed. traps full	8
8. bank cutting	little or none evident, no sloughing present	4	common at outcurves and constrictions, some sloughing present	8 (circled)	common throughout, raw banks, overhangs and sloughing are present	12	nearly continuous, rawbanks, mats and rootwads present in stream	16
9. depositional bars	few bars, vegetated with annuals, rare fresh sand gravel deposits on bars	4	bars growing, some unvegetated, sand/gravel bar deposits frequent	8	gravel bars unvegetated new sand/gravel bars common, few cobble channel bars	12 (circled)	gravel/cobble channel bars extensive w/ no vegetation widespread sand deposits	16
CHANNEL BOTTOM								
10. rock angularity	irregular shapes, rough surfaces, sharp edges	1	rectangular shapes, round edges, some smooth surface	2 (circled)	cube shape w/ all edges rounded, mostly smooth	3	nearly all stones round ball shape and smooth	4
11. rock brightness	all stones dark colored on top, clean bottoms	1	many stones dark colored, up to 35% clean surfaces	2 (circled)	35-65% clean surfaces, color nearly same as rock bottoms	3	65+% clean surfaces, no color difference on rock	4
12. particle packing	assorted sizes tightly packed and/or overlapped	2	moderately packed with some overlapping	4 (circled)	lightly packed assortment, little particle overlapping	6	no packing, easily moved no particle overlap	8
13. percent stable bottom materials	no change in channel rock assortment, 80-100% stable materials	4	scattered bright rocks indicate assortment change, 50-80% stable materials	8 (circled)	individual bright rocks common throout, 20-50% stable materials	12	rock assortment skewed/ changed throout, 0-20% stable materials	16
14. scouring & deposition	less than 5% of bottom affected by scour/ deposition (bright bottom patches)	6	5-30% affected, scour at constrictions and steep grades, some pool deposition	12 (circled)	30-50% affected, deposits common and pools filling very wide/shallow channel	18	> 50% of channel changed yearly, abandon channel deposits evident	24
15. clinging vegetation (moss & algae)	abundant in dense mats in all areas, moss and summer algae "fronds"	1	common, "fronds" mostly in pools & low velocity areas, moss in all areas	2	spotty in backwaters only, "fronds" and moss uncommon mostly rock slime	3	"fronds" and moss rare, rock slime mostly slow water, all riffles clean	4 (circled)

Total reach score = col. E ____ + col. G ____ + col. F ____ + col. P 4 = ______

#10 reference: Y/N

: 8/11/04

Elevation(ft)

REACH LENGTH:

Survey crew: Thompson, Jungst, Ague

Rosgen channel type:

Units: English / metric

Riparian width (est) ______ (ft)

RIFFLE BANKFULL WIDTHS (10)

42.0	34.3	39.0	35.0	38.2
38.5	44	29.0	35.7	37.5

AVERAGE RIFFLE WIDTH = 37.5

REACH LENGTH (avg x 20) =

--channels <10') MEASURE ALL RIFFLES; MEASURE ALL POOLS

--channels >10') MEASURE EVERY OTHER RIFFLE; MEASURE ALL POOLS

POOLS

Max Depth	Pool tail Max Depth	% Pool tail fines (<7mm)	Pool Width	Pool Length
2.4	1.2	20	11	40
3.1	1.25	15	9	29
2.9	0.75	20	20	61

RIFFLES

UNSTABLE (ft) LEFT BANK	UNSTABLE (ft) RIGHT BANK	RIFFLE LENGTH (ft)
0	152	452
0	200	249

% pocket pools in reach = Ø ∑ POOL LENGTH = 130 (ft)

Pool Frequency = (reach length / # pools) = 1 pool / 279 (ft)

AVERAGE % FINES IN POOL TAILS = 18.3

∑ RIFFLE LENGTH = 701

% stable banks in riffles = 25%

Width / depth ratio - RIFFLE = 35.08

831

LARGE WOODY DEBRIS

TYPE: Diameter:	live > bfw *** >6"	live > bfw <6"	dead > bfw *** >6"	dead > bfw <6"		live < bfw >6"	live < bfw <6"	dead < bfw >6"	dead < bfw <6"
Rootwad	1		11					1	
Embedded			1						
Suspended			11					1	
Recruiting	111		1				11	1111	
Ramp			111					111	
Misc.									

bfw = bankfull width

GRADIENT

Pool/Riffle sets.

Δelev	stream distance	% gradient
2.49	300	.9
1.82	227	.8
6.0	310	2

(Δelev / dist)(100) = % gradient

Rosgen reach gradient = 1.2 %

LWD FREQUENCY = (REACH LENGTH) / (TOTAL NUMBER OF PIECES WITH *** IN columns) = 69.75

MISC COMMENTS:

SNORKEL SURVEY COMPLETED ? ______

CORE SAMPLES COLLECTED ? Y/N % FINES ______

PICTURES: (frame #) 26 / 27 / /

CAMERA # ______

CHANNEL IMPACTS: (circle if applicable) grazing / timber harvest / roads / debris removal / other ______

VRC code: ______

Riparian width (ft) ______

Riparian habitat type: ______

Valley bottom unit: ______

Geology: ______

Comments: ______

Revised 2/97

APPENDIX I: KOOTENAI NATIONAL FOREST WATERSHED FIELD DATA including ROSGEN CHANNEL CLASSIFICATION INFO

Stream Name: Libby Cr. **Reach ID:** 11.5 **HUC #:** ____

Crew: Thompson, Jungst, Agu **Date:** 8-10-04 **Elev. Start Reach:** ____ **English:** X **Metric:** ____

Reach Length: 670 **Permanent:** ____ **Basin Survey:** X **Reference:** Y N **Overall Reliability:** 1 2 3 4 5

Channel Type: B2a **Reviewed Channel Type:** ____ **Reviewed by:** ____ **Date:** ____

266
300
104

1) Thread:
- X single no side channels
- ____ single w/ side channels
- ____ multiple channels

2) Entrenchment: Measured: X Estimate: ____

/ 29 / 25 / 41 / 30.5 / 35.6 / 29.3 / 30.7 /
/ 31.8 / 40.6 / 36.0 / BF widths / 33.3 / avg. BFW

- 36.0 bankfull width @ station 296.5
- 4.56 max bankfull depth
- 75.5 floodprone width (width @ 2X max BF)
- 2.1 entrenchment ratio (FPW/ BFW@ station)

3) W/D Ratio: Measured: X Estimate: ____
- 16.92 computed bankfull area
- 0.47 avg. BF depth (BFA/BFW@station) (Arithmetic)
- 76.6 width/depth ratio (BFW@station/avg.BFD)

4) Sinuosity: Measured: X Estimate: ____
- 670 stream length (thalweg)
- 597 valley length (straight line between thalweg pts.)
- 1.12 sinuosity (stream length/valley length)

5) Gradient: Measured: X Estimate: ____

4.22 / 3.8 / 4.2 / 4.2 elevation change 4.72 4.5 4.9
79 / 104 / 83 / 100 distance 115 85 104
.05 / .04 / .05 / 0.04 gradient .04 .05 .04
.044 average reach gradient

215

6) Particle size distribution: Measured: X Estimate: ____
- 256-512 dominant size class (mm) 27.6 %Grand Total
- 256-512 D 50 (mm)

comments: ____

7) *Depositional Pattern:*
- ____ point bars
- X point bars w/mid-channel bars
- ____ many side-channel bars
- ____ side or diagonal bars
- X channel composed of bars/islands
- ____ none

8) *Bed Features:*
- X cascade
- ____ step-pool
- ____ plane bed/glide
- X pool-riffle
- ____ other: ____

Distance (from L.Pin)	Width	Elevation	BF depth (E - BFE)	Area (WxBFD)
1	.25		0	0
2	.5		.25	.125
3			0	0
4			0	0
5			.25	.125
6			.90	.45
7			.96	.46
8			1.45	.73
9			.75	.38
10			1.10	.55
11			1.30	.65
12			0.42	.21
13			.45	.23
14			1.03	.52
15			1.78	.89
16			1.78	.89
17			1.72	.86
18			.30	.15
19			.76	.38
20			.25	.13
21			.55	.28
22			.54	.27
23			.35	.18
24			1.78	.89
25			1.70	.85
26			1.44	.72
27			1.70	.85
28			.32	.16
29			.51	.26
30			.51	.26
31			2.15	1.08
32			2.28	1.14
33			1.79	.90
34	.5		1.6	.80
35			1.06	.53
36	.25		0	0
				16.92

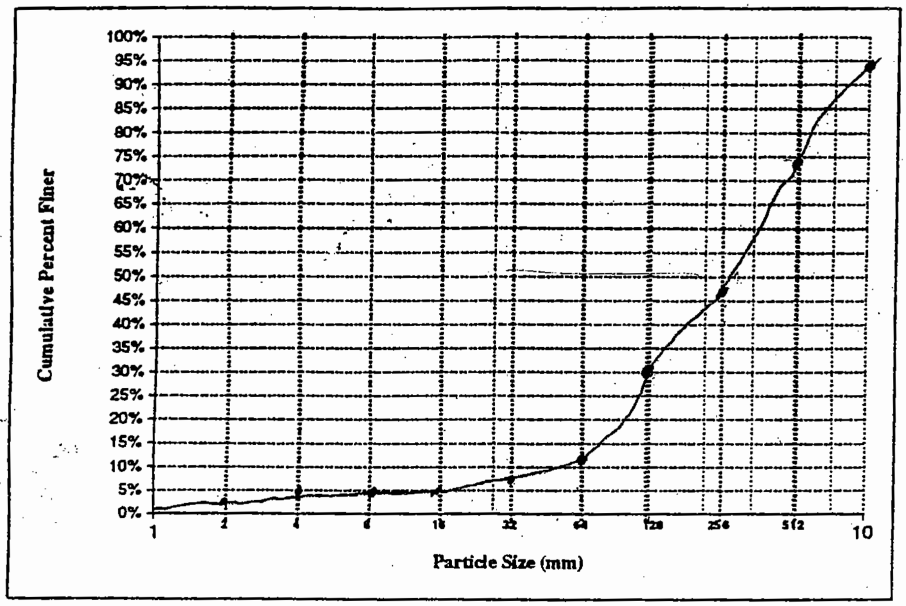
Stream Notes: ____

Photos:
- # ____ description: ____
- # ____ description: ____
- # ____ description: ____
- # ____ description: ____
- # ____ description: ____
- # ____ description: ____
- # ____ description: ____

Map Attached: Y N

PEBBLE COUNT INFORMATION

size (mm)	Particle	#	Pool	Riffle	Total	%Class	%C
0-.062	silt	0			2	1.6	1.6
.062-2	sand	1			2	1.6	3.2
2-4	v. fine gravel	2			2	1.6	4.8
4-8	fine gravel	3			0	0	4.8
8-16	med. gravel	4			0	0	4.8
16-32	course gravel	5			3	2.4	7.2
32-64	v. course gravel	6			6	4.7	11.9
64-128	small cobble	7			23	18.1	30
128-256	large cobble	8			22	17.3	47.3
256-512	small boulder	9			35	27.6	74.9
512-1024	med. boulder	10			25	19.7	94.6
1024-4096	large boulder	11			7	5.5	100.1
4096+	bedrock	12			0	0	100.1
			20	107	127 Grand Total		



Stability Notes:

CHANNEL STABILITY

UPPER BANKS	EXCELLENT		GOOD		FAIR		POOR	
1. landform slope of floodprone area	upper bank slope < 30%	2	upper bank slope 30-40%	(4)	upper bank slope 40-60%	6	upper bank slope 60+%	8
2. mass wasting (existing or potential)	no evidence of past, or potential for future wasting into channels	(3)	infrequent and/or very small, mostly healed, low future potential	6	moderate number and size with some raw and others available at high flows	9	numerous or large, erode at all flow levels or imminent danger of same	12
3. debris accumulation in floodprone area (debris & limbs)	mostly long/large debris, potential for log jam formation is low	(2)	mostly short/lg debris, potential for log jam formation is slight	4	mostly short/small debris occasional dense log jam with trash accumulations	6	all short/small debris many dense log jams with trash accumulation	8
4. floodprone area resistant to bankfull flows (veg. & rocks)	90+% plant, lg. debris, boulder armoring with deep, dense rooting	3	70-90% plant, lg. debris boulder armoring with deep dense rooting	(6)	50-70% plant, lg debris, or boulder armoring with shallow/dense soil rooting	9	< 50% plant, lg debris, boulder armoring with little rooting of soils	12
LOWER BANKS & CHANNEL								
5. channel capacity (floodprone area accessable to BF flows)	ample capacity, peakflow contained, width/depth ratio < 10	1	adequate, overbank flows rare, riffle, w/d 10-15	2	barely contains present peakflow, floods evident, riffle, w/d 15-25	3	inadequate for peakflow, floods common, w/d >25	(4)
6. bank rock content	65+% boulders >12" dia, some angular rock/bldrs	2	40-65% rounded boulders mostly 6-12" dia	(4)	20-40% round cobble, most 3-6" dia and some gravel	6	< 20% rock content, most rock is 1-3" gravel	8
7. obstructions, flow deflectors and sediment traps	bldrs/debris abundant, one main channel, flow uniform, sed. traps < 1/2 full	(2)	bldrs/debris common, one main channel with few flow deflectors, sed. traps 3/4 full	4	bldrs/debris common, one migrating channel, many bedload deposits, sed. traps full	6	bldrs/debris uncommon, migrating channels, many bedload deposits, sed. traps full	8
8. bank cutting	little or none evident, no sloughing present	4	common at outcurves and constrictions, some sloughing present	(8)	common throughout, raw banks, overhangs and sloughing are present	12	nearly continuous, rawbanks, mats and rootwads present in stream	16
9. depositional bars	few bars, vegetated with annuals, rare fresh sand gravel deposits on bars	4	bars growing, some unvegetated, sand/gravel bar deposits frequent	(8)	gravel bars unvegetated new sand/gravel bars common, few cobble channel bars	12	gravel/cobble channel bars extensive w/ no vegetation widespread sand deposits	16
CHANNEL BOTTOM								
10. rock angularity	irregular shapes, rough surfaces, sharp edges	1	rectangular shapes, round edges, some smooth surface	(2)	cube shape w/ all edges rounded, mostly smooth	(3)	nearly all stones round ball shape and smooth	4
11. rock brightness	all stones dark colored on top, clean bottoms	(1)	many stones dark colored, up to 35% clean surfaces	2	35-65% clean surfaces, color nearly same as rock bottoms	3	65+% clean surfaces, no color difference on rock	4
12. particle packing	assorted sizes tightly packed and/or overlapped	2	moderately packed with some overlapping	(4)	lightly packed assortment, little particle overlapping	6	no packing, easily moved no particle overlap	8
13. percent stable bottom materials	no change in channel rock assortment, 80-100% stable materials	4	scattered bright rocks indicate assmt change, 50-80% stable materials	8	individual bright rocks common throout, 20-50% stable materials	(12)	rock assortment skewed/ changed throout, 0-20% stable materials	16
14. scouring & deposition	less than 5% of bottom affected by scour/ deposition (bright bottom patches)	6	5-30% affected, scour at constrictions and steep grades, some pool deposition	12	30-50% affected, deposits common and pools filling very wide/shallow channel	18	> 50% of channel changed yearly, abandon channel deposits evident	(24)
15. clinging vegetation (moss & algae)	abundant in dense mats in all areas, moss and summer algae "fronds"	(1)	common, "fronds" mostly in pools & low velocity areas, moss in all areas	2	spotty in backwaters only, "fronds" and moss uncommon mostly rock slime	3	"fronds" and moss rare, rock slime mostly slow water, all riffles clean	4

Total reach score = col. E 9 + col. G 36 + col. F 12 + col. P 28 = 85

Stream: Libby CR.
Reach: 1.5 reference: Y/N
Date: 8-10-04
Elevation(ft)
REACH LENGTH: 670
RIFFLE BANKFULL WIDTHS (10)

Survey crew: Thompson, Jungst, Aquile
Rosgen channel type:
Units: English / metric
Riparian width (est) (ft)

29	28	41	30.5	35.6
29.3	30.7	31.8	40.6	

AVERAGE RIFFLE WIDTH = 33.3
REACH LENGTH (avg x 20) = 670
--channels <10' } MEASURE ALL RIFFLES; MEASURE ALL POOLS
--channels >10' } MEASURE EVERY OTHER RIFFLE; MEASURE ALL POOLS

POOLS

Max Depth	Pool tail Max Depth	% Pool tail fines (<7mm)	Pool Width	Pool Length
1.7	.8	10	11	28
1.8	.76	30	25	30
2.2	.80	5	9	26

RIFFLES

UNSTABLE (ft) LEFT BANK	UNSTABLE (ft) RIGHT BANK	RIFFLE LENGTH (ft)
0	270	266
0	0	53
0	0	19
0	0	170
0	0	64
0	0	14

% pocket pools in reach = 20% Σ POOL LENGTH = 84 (ft)
Pool Frequency = (reach length / # pools) = 1 pool / 223 (ft)
AVERAGE % FINES IN POOL TAILS = 15

Σ RIFFLE LENGTH = 586
% stable banks in riffles = 23%
Width / depth ratio - RIFFLE = 76.6

LARGE WOODY DEBRIS

TYPE: Diameter:	live > bfw *** > 6"	live > bfw < 6"	dead > bfw *** > 6"	dead > bfw < 6"		live < bfw > 6"	live < bfw < 6"	dead < bfw > 6"	dead < bfw < 6"
Rootwad				II					
Embedded									
Suspended									
Recruiting									
Ramp									
Misc.									

bfw = bankfull width

GRADIENT
Pool/Riffle sets.

Δelev	stream distance	% gradient
4.22	79	.05
3.8	104	.04
4.2	83	.05
4.2	100	.04
4.22	115	.04
4.5	85	.05
4.56	104	.04

(Δelev / dist)(100) = % gradient
Rosgen reach gradient = .044 %

LWD FREQUENCY = (REACH LENGTH) / (TOTAL NUMBER OF PIECES WITH *** IN columns) = 0

MISC COMMENTS:
SNORKEL SURVEY COMPLETED ? NO
CORE SAMPLES COLLECTED ? Y/N (N circled) % FINES /
PICTURES: (frame #) / / /
CAMERA #

CHANNEL IMPACTS: (circle if applicable) grazing / timber harvest / roads / debris removal / other (timber harvest and roads circled)

Comments:

WRC code:
Riparian width (ft) 1500
Riparian habitat type:
Valley bottom unit:
Geology:

Revised 2/97

APPENDIX I: KOOTENAI NATIONAL FOREST WATERSHED FIELD DATA including ROSGEN CHANNEL CLASSIFICATION INFO

Stream Name: Libby Cr. # 12 **Reach ID:** 12 **HUC #:**
Crew: Thompson, Jungst, Ague **Date:** 8-11-04 **Elev. Start Reach:** **English:** X **Metric:**
Reach Length: 1000 **Permanent:** **Basin Survey:** X **Reference:** Y N **Overall Reliability:** 1 2 3 4 5

Channel Type: C3 **Reviewed Channel Type:** **Reviewed by:** **Date:**

1) Thread:
- X single no side channels
- single w/ side channels
- multiple channels

2) Entrenchment: Measured: Estimate:
/ 30.7 / 28.0 / 26.0 / 30.2 / 26.5 / 27.5 / 24.6 /
/ 28 / 28.6 / 28.5 / BF widths / 27.8 / avg. BFW
28.5 bankfull width @ station
1.45 max bankfull depth
116.5 floodprone width (width @ 2X max BF)
4.09 entrenchment ratio (FPW/ BFW@ station)

3) W/D Ratio: Measured: Estimate:
14.23 computed bankfull area
.50 avg. BF depth (BFA/BFW@station) (Arithmetic)
57 width/depth ratio (BFW@station/avg.BFD)

4) Sinuosity: Measured: Estimate:
600 stream length (thalweg)
509 valley length (straight line between thalweg pts.)
1.2 sinuosity (stream length/valley length)

5) Gradient: Measured: Estimate:
.4 / 1.1 / .4 / 2.35 elevation change
180 / 120 / 107 / 193 distance
.002 / .009 / .003 / .012 gradient
.0065 = .007 average reach gradient

6) Particle size distribution: Measured: Estimate:
128 cobble dominant size class (mm) 37.1 %Grand Total
128 D 50 (mm)
comments:

7) *Depositional Pattern:*
- point bars
- point bars w/mid-channel bars
- many side-channel bars
- X side or diagonal bars
- channel composed of bars/islands
- none

8) *Bed Features:*
- cascade
- step-pool
- plane bed/glide
- X pool-riffle
- other:

Distance (from L.Pin)	Width	Elevation	BF depth (E - BFE)	Area (WxBFD)
1	.25		0	0
2	.5		0	0
3			.6	.3
4			.95	.48
5			1.05	.53
6			.9	.45
7			1.02	.51
8			1.1	.55
9			1.15	.58
10			1.16	.58
11			1.1	.53
12			1.3	.65
13			1.18	.59
14			1.36	.68
15			1.26	.63
16			1.32	.66
17			1.4	.7
18			1.4	.7
19			1.27	.64
20			1.38	.69
21			1.36	.68
22			1.23	.62
23			1.45	.73
24			1.26	.63
25			.75	.38
26			.63	.32
27			.49	.25
28	~~.55~~		.27	.14
29	.25		.1	.03
				14.23

Stream Notes: Trib comes in at 300 ft. down the Reach on Left.

~~* Reached Restoration area (FWP)~~

* UTM-5330761

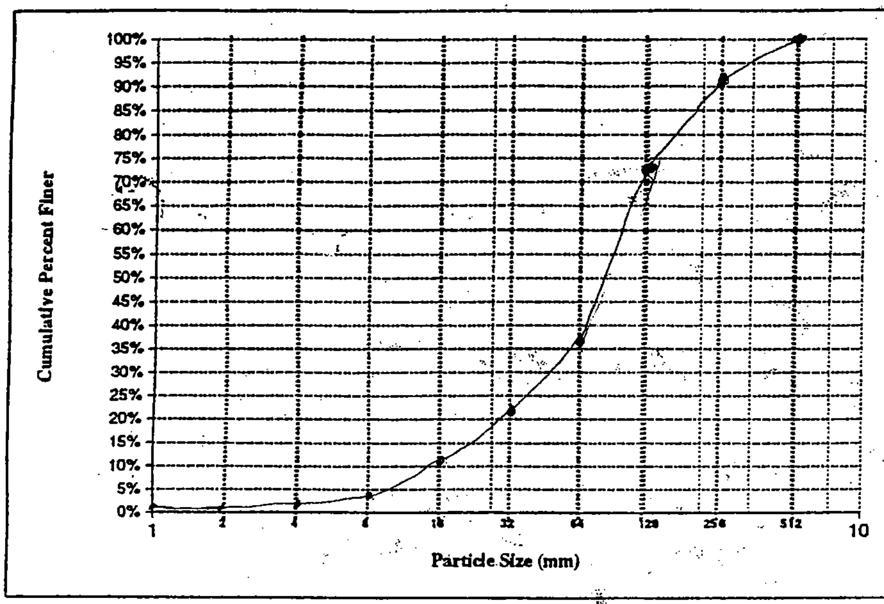
Photos: # 22 description: downstream @station
23 description: upstream
description:
description:
description:
description:
description:

Map Attached: Y N

PEBBLE COUNT INFORMATION

size (mm)	Particle	#	Pool 20	Riffle 80	Total	% Class	
0-.062	silt	0			1	.8	
.062-2	sand	1			0	0	.8
2-4	v. fine gravel	2			1	.8	1.6
4-8	fine gravel	3			3	2.6	4.2
8-16	med. gravel	4			8	6.9	11.1
16-32	course gravel	5			13	11.2	22.3
32-64	v. course gravel	6			16	13.8	36.1
64-128	small cobble	7			43	37.1	73.2
128-256	large cobble	8			22	19.1	92.2
256-512	small boulder	9			9	7.8	100.0
512-1024	med. boulder	10					
1024-4096	large boulder	11					
4096+	bedrock	12					

116 **Grand Total**



Stability Notes: ____________________

CHANNEL STABILITY

UPPER BANKS	EXCELLENT		GOOD		FAIR		POOR	
1. landform slope of floodprone area	upper bank slope < 30%	(2)	upper bank slope 30-40%	4	upper bank slope 40-60%	6	upper bank slope 60+%	8
2. mass wasting (existing or potential)	no evidence of past, or potential for future wasting into channels	3	infrequent and/or very small, mostly healed, low future potential	(6)	moderate number and size with some raw and others available at high flows	9	numerous or large, erode at all flow levels or imminent danger of same	12
3. debris accumulation in floodprone area (debris & limbs)	mostly long/large debris, potential for log jam formation is low	2	mostly short/lg debris, potential for log jam formation is slight	4	mostly short/small debris occasional dense log jam with trash accumulations	6	all short/small debris many dense log jams with trash accumulation	8
4. floodprone area resistant to bankfull flows (veg. & rocks)	90+% plant, lg. debris, boulder armoring with deep, dense rooting	3	70-90% plant, lg. debris boulder armoring with deep dense rooting	6	50-70% plant, lg debris, or boulder armoring with shallow/dense soil rooting	9	< 50% plant, lg debris, boulder armoring with little rooting of soils	(12)
LOWER BANKS & CHANNEL								
5. channel capacity (floodprone area accessable to BF flows)	ample capacity, peakflow contained, width/depth ratio < 10	1	adequate, overbank flows rare, riffle, w/d 10-15	2	barely contains present peakflow, floods evident, riffle, w/d 15-25	3	inadequate for peakflow, floods common, w/d >25	4
6. bank rock content	65+% boulders >12" dia. some angular rock/bldrs	2	40-65% rounded boulders mostly 6-12"dia	4	20-40% round cobble, most 3-6" dia and some gravel	(6)	< 20% rock content, most rock is 1-3" gravel	8
7. obstructions, flow deflectors and sediment traps	bldrs/debris abundant, one main channel, flow uniform, sed. traps < 1/2 full	2	bldrs/debris common, one main channel with few flow deflectors, sed. traps 3/4 full	(4)	bldrs/debris common, one migrating channel, many bedload deposits, sed. sed. traps full	6	bldrs/debris uncommon, migrating channels, many bedload deposits, sed. traps full	8
8. bank cutting	little or none evident, no sloughing present	(3)	common at outcurves and constrictions, some sloughing present	8	common throughout, raw banks, overhangs and sloughing are present	12	nearly continuous, rawbanks, mats and rootwads present in stream	16
9. depositional bars	few bars, vegetated with annuals, rare fresh sand gravel deposits on bars	(4)	bars growing, some unvegetated, sand/gravel bar deposits frequent	8	gravel bars unvegetated new sand/gravel bars common, few cobble channel bars	12	gravel/cobble channel bars extensive w/ no vegetation widespread sand deposits	16
CHANNEL BOTTOM								
10. rock angularity	irregular shapes, rough surfaces, sharp edges	(1)	rectangular shapes, round edges, some smooth surface	2	cube shape w/ all edges rounded, mostly smooth	3	nearly all stones round ball shape and smooth	4
11. rock brightness	all stones dark colored on top, clean bottoms	(1)	many stones dark colored, up to 35% clean surfaces	2	35-65% clean surfaces, color nearly same as rock bottoms	3	65+% clean surfaces, no color difference on rock	4
12. particle packing	assorted sizes tightly packed and/or overlapped	2	moderately packed with some overlapping	4	lightly packed assortment, little particle overlapping	(6)	no packing, easily moved no particle overlap	8
13. percent stable bottom materials	no change in channel rock assortment, 80-100% stable materials	4	scattered bright rocks indicate assortment change, 50-80% stable materials	(8)	individual bright rocks common throout, 20-50% stable materials	12	rock assortment skewed/ changed throout, 0-20% stable materials	16
14. scouring & deposition	less than 5% of bottom affected by scour/ deposition (bright bottom patches)	6	5-30% affected, scour at constrictions and steep grades, some pool deposition	(12)	30-50% affected, deposits common and pools filling very wide/shallow channel	18	> 50% of channel changed yearly, abandon channel deposits evident	24
15. clinging vegetation (moss & algae)	abundant in dense mats in all areas, moss and summer algae "fronds"	1	common, "fronds" mostly in pools & low velocity areas, moss in all areas	2	spotty in backwaters only, "fronds" and moss uncommon mostly rock slime	3	"fronds" and moss rare, rock slime mostly slow water, all riffles clean	(4)

Total reach score = col. E ____ + col. G ____ + col. F ____ + col. P ____ = ______

Stream: Libby CR. #12
Reach: 12 reference: Y/N
Date: 8-11-04
Elevation(ft)
REACH LENGTH:

Survey crew: Thompson, Jungst Ague
Rosgen channel type:
Units: English / metric
Riparian width (cat) ____ (ft)

RIFFLE BANKFULL WIDTHS (10)

30.7	28.0	26.0	30.2	26.5
27.5	24.6	29.0	28.6	28.5

AVERAGE RIFFLE WIDTH = 27.8
REACH LENGTH (avg x 20) = 600
--channels <10' } MEASURE ALL RIFFLES; MEASURE ALL POOLS
--channels >10' } MEASURE EVERY OTHER RIFFLE; MEASURE ALL POOLS

600

POOLS

Max Depth	Pool tail Max Depth	% Pool tail fines (<7mm)	Pool Width	Pool Length
2.9	.5	15%	15.2	53
2.3	.45	15%	11	36
2.0	.9	5%	9.0	28

RIFFLES

UNSTABLE (ft) LEFT BANK	UNSTABLE (ft) RIGHT BANK	RIFFLE LENGTH (ft)
0	0	210
0	0	144
0	0	119
		10

373

102

% pocket pools in reach = 2% (11)
Σ POOL LENGTH = 117 (ft)
Pool Frequency = (reach length / # pools) = 1 pool / 5.13 (ft)
AVERAGE % FINES IN POOL TAILS = 11.7

Σ RIFFLE LENGTH = 483
% stable banks in riffles = 100
Width / depth ratio - RIFFLE = 57

LARGE WOODY DEBRIS

TYPE:	live > bfw		dead > bfw			live < bfw		dead < bfw	
Diameter:	*** > 6"	< 6"	*** > 6"	<6"		>6"	<6"	>6"	<6"
Rootwad	I		III					IIII	
Embedded				I					
Suspended									
Recruiting	III								
Ramp				II					
Misc. Agg.			4 pieces						

bfw = bankfull width

GRADIENT
Pool/Riffle sets.

Δelev	stream distance	% gradient
.4	180	.2
1.1	120	.9
.4	107	.3
2.35	193	1.2

(Δelev / dist)(100) = % gradient
Rosgen reach gradient = .65 %

LWD FREQUENCY = (REACH LENGTH) / (TOTAL NUMBER OF PIECES WITH *** IN columns) = 50

ISC COMMENTS:
NORKEL SURVEY COMPLETED ? ______
ORE SAMPLES COLLECTED ? Y/N % FINES ______
PICTURES: (frame #) 221 231 /
CAMERA # ______

HANNEL IMPACTS: (circle if applicable) grazing / timber harvest / roads / debris removal / other ______

RC code:
parian width (ft) ______
parian habitat type: ______
alley bottom unit: ______
ology: ______

Comments: ______

vised 2/97

APPENDIX I: KOOTENAI NATIONAL FOREST WATERSHED FIELD DATA including ROSGEN CHANNEL CLASSIFICATION INFO

Stream Name: Libby Cr #13 **Reach ID:** 13 **HUC #:** ____
Crew: Thompson, Jungst, Ague **Date:** 8/11/04 **Elev. Start Reach:** ____ **English:** X **Metric:** ____
Reach Length: 575 **Permanent:** ____ **Basin Survey:** ____ **Reference:** Y N **Overall Reliability:** 1 2 3 4 5

Channel Type: F3 **Reviewed Channel Type:** ____ **Reviewed by:** ____ **Date:** ____

1) Thread:
- X single no side channels
- ____ single w/ side channels
- ____ multiple channels

252.4

2) Entrenchment: Measured: ____ Estimate: ____
/ 33.5 / 27 / 25 / 23.5 / 24 / 27.6 / 31.5 / 31.0 / 29.5 / 33 / BF widths / 28.6 / avg. BFW
- 33 bankfull width @ station
- 1.24 max bankfull depth
- 37.7 floodprone width (width @ 2X max BF)
- 1.14 entrenchment ratio (FPW/ BFW@ station)

3) W/D Ratio: Measured: X Estimate: ____
- 25.05 computed bankfull area
- 0.76 avg. BF depth (BFA/BFW@station) (Arithmetic)
- 43.42 width/depth ratio (BFW@station/avg.BFD)

4) Sinuosity: Measured: X Estimate: ____
- 575 stream length (thalweg)
- 465 valley length (straight line between thalweg pts.)
- 1.2 sinuosity (stream length/valley length)

5) Gradient: Measured: X Estimate: ____
- 2.9 / 1.3 / 2.7 / 1.14 elevation change .58
- 200 / 100 / 165 / 87 distance 23
- .015 / .013 / .016 / .013 gradient .025
- .016 average reach gradient

6) Particle size distribution: Measured: X Estimate: ____
- 64-128 dominant size class (mm) 36.5 %Grand Total
- 64-128 D 50 (mm)

comments: ____

7) Depositional Pattern:
- ____ point bars
- ____ point bars w/mid-channel bars
- ____ many side-channel bars
- X side or diagonal bars
- ____ channel composed of bars/islands
- ____ none

8) Bed Features:
- ____ cascade
- ____ step-pool
- ____ plane bed/glide
- X pool-riffle
- ____ other: ____

Distance (from L.Pin)	Width	Elevation	BF depth (E - BFE)	Area (WxBFD)
1.0	0.75		0	0
2.5	1.5		.42	0.63
4.0			.75	1.13
5.5			.72	1.08
7.0			.75	1.13
8.5			.88	1.32
10.0			.79	1.19
11.5			.74	1.11
13.0			.7	1.05
14.5			.34	0.51
16.0			.73	1.10
17.5			.73	1.10
18.0			1.0	1.5
19.5			.99	1.49
21.0			.65	0.98
22.5			.95	1.43
24.0			.68	1.02
26.5			.62	0.93
28.0			.8	1.2
29.5			1.0	1.5
31.0			1.24	1.86
32.5	1.5		1.19	1.79
34.0	0.75		0	0
				25.05

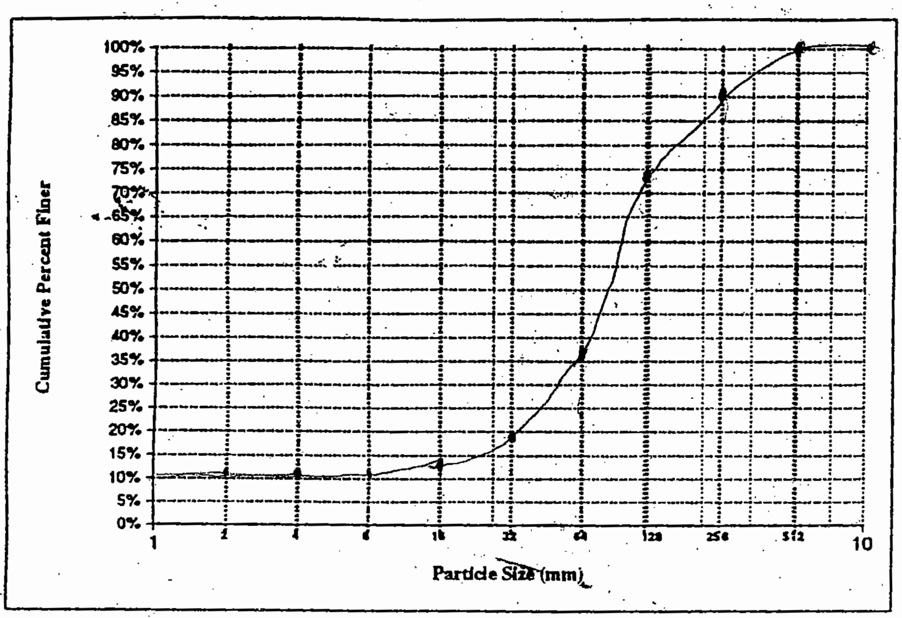
Stream Notes: UTM - 5330329

Photos:
- # 24 description: downstream
- # 25 description: up
- # ____ description: ____
- # ____ description: ____
- # ____ description: ____
- # ____ description: ____
- # ____ description: ____

Map Attached: Y N

size (mm)	Particle	#	Pool 18	Riffle 82	Total	%Class	%
0-.062	silt	0			8	8.5	8.5
.062-2	sand	1			3	2.8	11.3
2-4	v. fine gravel	2			0	0	11.3
4-8	fine gravel	3			0	0	11.3
8-16	med. gravel	4			2	1.9	13.2
16-32	course gravel	5			7	6.5	19.7
32-64	v. course gravel	6			19	17.8	37.5
64-128	small cobble	7			39	36.5	74
128-256	large cobble	8			19	17.8	91.8
256-512	small boulder	9			10	9.4	101.2
512-1024	med. boulder	10			0	0	101.2
1024-4096	large boulder	11			0	0	101.2
4096+	bedrock	12			0	0	101.2

107 **Grand Total**



Stability Notes:

CHANNEL STABILITY

UPPER BANKS	EXCELLENT		GOOD		FAIR		POOR	
1. landform slope of floodprone area	upper bank slope < 30%	2	upper bank slope 30-40%	(4)	upper bank slope 40-60%	6	upper bank slope 60+%	8
2. mass wasting (existing or potential)	no evidence of past, or potential for future wasting into channels	3	infrequent and/or very small, mostly healed, low future potential	6	moderate number and size with some raw and others available at high flows	(9)	numerous or large, erode at all flow levels or imminent danger of same	12
3. debris accumulation in floodprone area (debris & limbs)	mostly long/large debris, potential for log jam formation is low	(2)	mostly short/lg debris, potential for log jam formation is slight	4	mostly short/small debris occasional dense log jam with trash accumulations	6	all short/small debris many dense log jams with trash accumulation	8
4. floodprone area resistant to bankfull flows (veg. & rocks)	90+% plant, lg. debris, boulder armoring with deep, dense rooting	3	70-90% plant, lg. debris boulder armoring with deep dense rooting	(6)	50-70% plant, lg debris, or boulder armoring with shallow/dense soil rooting	9	< 50% plant, lg debris, boulder armoring with little rooting of soils	12
LOWER BANKS & CHANNEL								
5. channel capacity (floodprone area accessable to BF flows)	ample capacity, peakflow contained, width/depth ratio < 10	1	adequate, overbank flows rare, riffle, w/d 10-15	2	barely contains present peakflow, floods evident, riffle, w/d 15-25	3	inadequate for peakflow, floods common, w/d >25	(4)
6. bank rock content	65+% boulders >12" dia, some angular rock/bldrs	2	40-65% rounded boulders mostly 6-12"dia	(4)	20-40% round cobble, most 3-6" dia and some gravel	6	< 20% rock content, most rock is 1-3" gravel	8
7. obstructions, flow deflectors and sediment traps	bldrs/debris abundant, one main channel, flow uniform, sed. traps < 1/2 full	(2)	bldrs/debris common, one main channel with few flow deflectors, sed. traps 3/4 full	4	bldrs/debris common, one migrating channel, many bedload deposits, sed. sed. traps full	6	bldrs/debris uncommon, migrating channels, many bedload deposits, sed. traps full	8
8. bank cutting	little or none evident, no sloughing present	4	common at outcurves and constrictions, some sloughing present	(8)	common throughout, raw banks, overhangs and sloughing are present	12	nearly continuous, rawbanks, mats and rootwads present in stream	16
9. depositional bars	few bars, vegetated with annuals, rare fresh sand gravel deposits on bars	4	bars growing, some unvegetated, sand/gravel bar deposits frequent	(8)	gravel bars unvegetated new sand/gravel bars common, few cobble channel bars	12	gravel/cobble channel bars extensive w/ no vegetation widespread sand deposits	16
CHANNEL BOTTOM								
10. rock angularity	irregular shapes, rough surfaces, sharp edges	1	rectangular shapes, round edges, some smooth surface	(2)	cube shape w/ all edges rounded, mostly smooth	(3)	nearly all stones round ball shape and smooth	4
11. rock brightness	all stones dark colored on top, clean bottoms	(1)	many stones dark colored, up to 35% clean surfaces	2	35-65% clean surfaces, color nearly same as rock bottoms	3	65+% clean surfaces, no color difference on rock	4
12. particle packing	assorted sizes tightly packed and/or overlapped	2	moderately packed with some overlapping	(4)	lightly packed assortment, little particle overlapping	6	no packing, easily moved no particle overlap	8
13. percent stable bottom materials	no change in channel rock assortment, 80-100% stable materials	4	scattered bright rocks indicate assortment change, 50-80% stable materials	(8)	individual bright rocks common throout, 20-50% stable materials	12	rock assortment skewed/ changed throout, 0-20% stable materials	16
14. scouring & deposition	less than 5% of bottom affected by scour/ deposition (bright bottom patches)	6	5-30% affected, scour at constrictions and steep grades, some pool deposition	(12)	30-50% affected, deposits common and pools filling very wide/shallow channel	18	> 50% of channel changed yearly, abandon channel deposits evident	24
15. clinging vegetation (moss & algae)	abundant in dense mats in all areas, moss and summer algae "fronds"	1	common, "fronds" mostly in pools & low velocity areas, moss in all areas	(2)	spotty in backwaters only, "fronds" and moss uncommon mostly rock slime	3	"fronds" and moss rare, rock slime mostly slow water, all riffles clean	4

Total reach score = col. E 5 + col. G 54 + col. F 9 + col. P 4 = 76

Stream: Libby Cr # 13
Survey crew: Thompson, Jungst, Ague
Reach: 13 reference: Y/N
Rosgen channel type: F3
Date: 8-11-04
Units: English / metric
Elevation(ft):
Riparian width (est) 1000 (ft)
REACH LENGTH: 575
RIFFLE BANKFULL WIDTHS (10)

33.5	27	25	23.5	24
27.6	31.5	31.0	29.5	33

AVERAGE RIFFLE WIDTH = 28.6
REACH LENGTH (avg x 20) = 575
--channels <10' } MEASURE ALL RIFFLES; MEASURE ALL POOLS
--channels >10' } MEASURE EVERY OTHER RIFFLE; MEASURE ALL POOLS

POOLS

Max Depth	Pool tail Max Depth	% Pool tail fines (<7mm)	Pool Width	Pool Length
2.1	.2	20%	16	~~50~~
2.0	.5	40%	13	23
1.2	.3	10%	13	33

RIFFLES

UNSTABLE (ft) LEFT BANK	UNSTABLE (ft) RIGHT BANK	RIFFLE LENGTH (ft)
0	0	140
0	0	87
0	0	242

% pocket pools in reach = |||| 4 % ∑ POOL LENGTH = 106 (ft)
Pool Frequency = (reach length / # pools) = 1 pool / 191.7 (ft)
AVERAGE % FINES IN POOL TAILS = 23.3%

∑ RIFFLE LENGTH = 469
% stable banks in riffles = 100%
Width / depth ratio - RIFFLE = 43.42

LARGE WOODY DEBRIS

TYPE: Diameter:	live > bfw *** > 6"	live > bfw < 6"	dead > bfw *** > 6"	dead > bfw <6"	live < bfw >6"	live < bfw <6"	dead< bfw >6"	dead< bfw <6"
Rootwad			|	|			||||	||
Embedded			|||	|||			||||	
Suspended			||||	|||			|	
Recruiting								
Ramp			|||	||||			|||	
Misc. Agg.			5 piece					

bfw = bankfull width
LWD FREQUENCY = (REACH LENGTH) / (TOTAL NUMBER OF PIECES WITH *** IN columns) = 35.9

GRADIENT
Pool/Riffle sets.

Δelev	stream distance	% gradient
2.9	200	1.5
1.3	100	1.3
2.7	165	1.6
1.14	87	1.3

.58 | 23 | 2

(Δelev / dist)(100) = %gradient
Rosgen reach gradient = 1.6 %

MISC COMMENTS:
SNORKEL SURVEY COMPLETED ? NO
PICTURES: (frame #) 24, 25, ,
CORE SAMPLES COLLECTED ? Y/(N) % FINES /
CAMERA #

CHANNEL IMPACTS: (circle if applicable) grazing / (timber harvest) / (roads) / debris removal / other

Comments: UTM 5330329

WRC code:
Riparian width (ft) 1000
Riparian habitat type:
Valley bottom unit:
Geology:

Revised 2/97

APPENDIX I: KOOTENAI NATIONAL FOREST WATERSHED FIELD DATA including ROSGEN CHANNEL CLASSIFICATION INFO

Stream Name: Libby CR. #15 **Reach ID:** 15 **HUC #:** ____
Crew: Thompson, Agde, Jungst **Date:** 8-10-04 **Elev. Start Reach:** ____ **English:** ____ **Metric:** ____
Reach Length: 510 **Permanent:** ____ **Basin Survey:** ____ **Reference:** Y N **Overall Reliability:** 1 2 3 4 5

Channel Type: B3 **Reviewed Channel Type:** ____ **Reviewed by:** ____ **Date:** ____

1) Thread: 280 280
X single no side channels
X single w/ side channels
____ multiple channels

2) Entrenchment: Measured: ____ Estimate: ____
/31.2/26.5/27.5/24.5/20.7/22.9/27/
/18/17.4/22.3/ BF widths /23.8/ avg. BFW
22.3 **bankfull width @ station**
1.82 **max bankfull depth**
31.8 **floodprone width** (width @ 2X max BF)
1.4 **entrenchment ratio** (FPW/ BFW@ station)

3) W/D Ratio: Measured: ____ Estimate: ____
17.71 computed bankfull area
.79 **avg. BF depth** (BFA/BFW@station) (Arithmetic)
28.2 **width/depth ratio** (BFW@station/avg.BFD)

4) Sinuosity: Measured: ____ Estimate: ____
510 **stream length** (thalweg)
454.0 **valley length** (straight line between thalweg pts.)
1.12 **sinuosity** (stream length/valley length)

5) Gradient: Measured: ____ Estimate: ____
2.63 / 4.05 / 2.4 / 1.5 **elevation change**
150 / 130 / 132 / 98 **distance**
.018 / .03 / .02 / .015 **gradient**
.021 **average reach gradient**

6) Particle size distribution: Measured: ____ Estimate: ____
128 cobble dominant size class (mm) 27.6 %Grand Total
128 **D 50** (mm)
comments: ____

7) *Depositional Pattern:*
____ point bars
____ point bars w/mid-channel bars
____ many side-channel bars
X side or diagonal bars
____ channel composed of bars/islands
____ none

8) *Bed Features:*
X cascade
____ step-pool
____ plane bed/glide
____ pool-riffle
____ other: ____

Photos: # 20 description: upstream
21 description: downstream
____ description: ____
____ description: ____
____ description: ____
____ description: ____
____ description: ____

Distance (from L.Pin)	Width	Elevation	BF depth (E - BFE)	Area (WxBFD)
1	.25		0	0
2	.5		1.76	.88
3			1.77	.89
4			1.79	.90
5			1.74	.87
6			1.78	.89
7			1.54	.77
8			1.52	.76
9			1.52	.76
10			1.73	.87
11			1.69	.85
12			1.36	.68
13			1.82	.91
14			1.73	.87
15			1.70	.85
16			1.74	.87
17			1.8	.90
18			1.76	.88
19			1.66	.83
20			1.62	.81
21			1.72	.86
22	.5		1.62	.81
23.3	1.05		0	0
				17.71

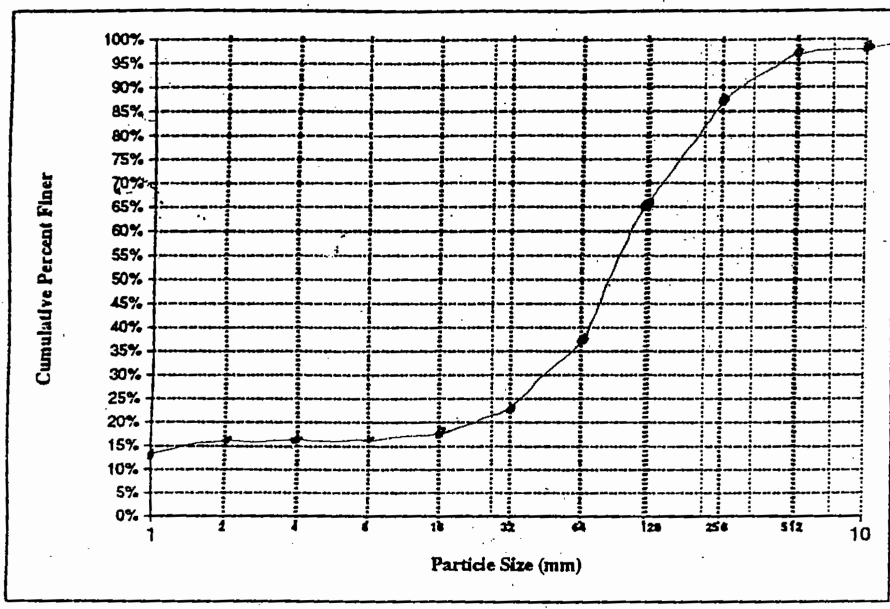
Stream Notes: UTM = 5329448

Map Attached: Y N

PEBBLE COUNT INFORMATION

size (mm)	Particle	#	Pool 22	Riffle 78	Total	%Class	%Cum.
0-.062	silt	0			14	13.3	13.3
.062-2	sand	1			3	2.7	16
2-4	v. fine gravel	2			0	0	16
4-8	fine gravel	3			0	0	16
8-16	med. gravel	4			2	1.9	17.9
16-32	course gravel	5			6	5.7	23.6
32-64	v. course gravel	6			15	14.3	37.9
64-128	small cobble	7			29	27.6	65.5
128-256	large cobble	8			23	21.9	87.4
256-512	small boulder	9			11	10.5	97.9
512-1024	med. boulder	10			1	.1	98
1024-4096	large boulder	11			1	.1	98.1
4096+	bedrock	12					

105 **Grand Total**



Stability Notes:

CHANNEL STABILITY

UPPER BANKS	EXCELLENT		GOOD		FAIR		POOR	
1. landform slope of floodprone area	upper bank slope < 30%	2 (circled)	upper bank slope 30-40%	4	upper bank slope 40-60%	6	upper bank slope 60+%	8
2. mass wasting (existing or potential)	no evidence of past, or potential for future wasting into channels	3	infrequent and/or very small, mostly healed, low future potential	6 (circled)	moderate number and size with some raw and others available at high flows	9	numerous or large, erode at all flow levels or imminent danger of same	12
3. debris accumulation in floodprone area (debris & limbs)	mostly long/large debris, potential for log jam formation is low	2	mostly short/lg debris, potential for log jam formation is slight	4 (circled)	mostly short/small debris occasional dense log jam with trash accumulations	6	all short/small debris many dense log jams with trash accumulation	8
4. floodprone area resistant to bankfull flows (veg. & rocks)	90+% plant, lg. debris, boulder armoring with deep, dense rooting	3 (circled)	70-90% plant, lg. debris boulder armoring with deep dense rooting	6	50-70% plant, lg debris, or boulder armoring with shallow/dense soil rooting	9	< 50% plant, lg debris, boulder armoring with little rooting of soils	12
LOWER BANKS & CHANNEL								
5. channel capacity (floodprone area accessable to BF flows)	ample capacity, peakflow contained, width/depth ratio < 10	1	adequate, overbank flows rare, riffle, w/d 10-15	2	barely contains present peakflow, floods evident, riffle, w/d 15-25	3	inadequate for peakflow, floods common, w/d >25	4 (circled)
6. bank rock content	65+% boulders >12" dia. some angular rock/bldrs	2 (circled)	40-65% rounded boulders mostly 6-12" dia	4	20-40% round cobble, most 3-6" dia and some gravel	6	< 20% rock content, most rock is 1-3" gravel	8
7. obstructions, flow deflectors and sediment traps	bldrs/debris abundant, one main channel, flow uniform, sed. traps < 1/2 full	2	bldrs/debris common, one main channel with few flow deflectors, sed. traps 3/4 full	4 (circled)	bldrs/debris common, one migrating channel, many bedload deposits, sed. traps full	6	bldrs/debris uncommon, migrating channels, many bedload deposits, sed. traps full	8
8. bank cutting	little or none evident, no sloughing present	4	common at outcurves and constrictions, some sloughing present	8 (circled)	common throughout, raw banks, overhangs and sloughing are present	12	nearly continuous, rawbanks, mats and rootwads present in stream	16
9. depositional bars	few bars, vegetated with annuals, rare fresh sand gravel deposits on bars	4 (circled)	bars growing, some unvegetated, sand/gravel bar deposits frequent	8	gravel bars unvegetated new sand/gravel bars common, few cobble channel bars	12	gravel/cobble channel bars extensive w/ no vegetation widespread sand deposits	16
CHANNEL BOTTOM								
10. rock angularity	irregular shapes, rough surfaces, sharp edges	1	rectangular shapes, round edges, some smooth surface	2	cube shape w/ all edges rounded, mostly smooth	3 (circled)	nearly all stones round ball shape and smooth	4
11. rock brightness	all stones dark colored on top, clean bottoms	1 (circled)	many stones dark colored, up to 35% clean surfaces	2	35-65% clean surfaces, color nearly same as rock bottoms	3	65+% clean surfaces, no color difference on rock	4
12. particle packing	assorted sizes tightly packed and/or overlapped	2 (circled)	moderately packed with some overlapping	4	lightly packed assortment, little particle overlapping	6	no packing, easily moved no particle overlap	8
13. percent stable bottom materials	no change in channel rock assortment, 80-100% stable materials	4 (circled)	scattered bright rocks indicate assmt change, 50-80% stable materials	8	individual bright rocks common throout, 20-50% stable materials	12	rock assortment skewed/ changed throout, 0-20% stable materials	16
14. scouring & deposition	less than 5% of bottom affected by scour/ deposition (bright bottom patches)	6	5-30% affected, scour at constrictions and steep grades, some pool deposition	12 (circled)	30-50% affected, deposits common and pools filling very wide/shallow channel	18	> 50% of channel changed yearly, abandon channel deposits evident	24
15. clinging vegetation (moss & algae)	abundant in dense mats in all areas, moss and summer algae "fronds"	1 (circled)	common, "fronds" mostly in pools & low velocity areas, moss in all areas	2	spotty in backwaters only, "fronds" and moss uncommon mostly rock slime	3	"fronds" and moss rare, rock slime mostly slow water, all riffles clean	4

Total reach score = col. E ____ + col. G ____ + col. F ____ + col. P ____ = ______

Stream: Libby CR. #15
Reach: 15 reference: Y/N
Date: 8-10-04
Elevation(ft)
REACH LENGTH:

Survey crew: Thompson Jung st Ague
Rosgen channel type:
Units: English / metric
Riparian width (est) 500 (ft)

RIFFLE BANKFULL WIDTHS (10)

31.2	26.5	27.5	24.5	20.7
22.9	27	18	17.4	22.3

AVERAGE RIFFLE WIDTH = 23.8
REACH LENGTH (avg x 20) = 510
--channels <10' } MEASURE ALL RIFFLES; MEASURE ALL POOLS
--channels >10' } MEASURE EVERY OTHER RIFFLE; MEASURE ALL POOLS

POOLS

Max Depth	Pool tail Max Depth	% Pool tail fines (<7mm)	Pool Width	Pool Length
1.7	.75	10%	22.5	46
1.5	.45	5%	12.0	10
1.95	.75	10%	20.1	32
2.2	.45	10%	25.0	20

RIFFLES

UNSTABLE (ft) LEFT BANK	UNSTABLE (ft) RIGHT BANK	RIFFLE LENGTH (ft)
0	0	150
0	0	74
0	0	110
0	0	68

% pocket pools in reach = 0
Σ POOL LENGTH = 108 (ft)
Pool Frequency = (reach length / # pools) = 1 pool / 127.5 (ft)
AVERAGE % FINES IN POOL TAILS = 8.75

Σ RIFFLE LENGTH = 402
% stable banks in riffles = 100%
Width / depth ratio - RIFFLE = 28.2

LARGE WOODY DEBRIS

TYPE:	live > bfw		dead > bfw			live < bfw		dead < bfw	
Diameter:	*** > 6"	< 6"	*** > 6"	<6"		>6"	<6"	>6"	<6"
Rootwad									
Embedded									
Suspended			l						
Recruiting	lll	l							
Ramp			ll						
Misc.									

bfw = bankfull width

GRADIENT
Pool/Riffle sets.

Δelev	stream distance	% gradient
2.63	150	1.8
4.05	130	3
2.4	132	2
1.5	98	1.5

(Δelev / dist)(100) = %gradient
Rosgen reach gradient = 2.1 %

LWD FREQUENCY = (REACH LENGTH) / (TOTAL NUMBER OF PIECES WITH *** IN columns) = 85 (6)

MISC COMMENTS:
SNORKEL SURVEY COMPLETED ? N
CORE SAMPLES COLLECTED ? Y/N % FINES ______
PICTURES: (frame #) 20, 21
CAMERA # ______

CHANNEL IMPACTS: (circle if applicable) grazing / timber harvest / roads / debris removal / other ______

WRC code:
Riparian width (ft) 500
Riparian habitat type:
Valley bottom unit:
Geology:

Comments:

Revised 2/97

APPENDIX I: KOOTENAI NATIONAL FOREST WATERSHED FIELD DATA
including ROSGEN CHANNEL CLASSIFICATION INFO

Stream Name: Libby #16 **Reach ID:** 16 **HUC #:** ____
Crew: Thompson, Jungst **Date:** 8-9-04 **Elev. Start Reach:** ____ **English:** X **Metric:** ____
Reach Length: 519 **Permanent:** ____ **Basin Survey:** Y **Reference:** Y N **Overall Reliability:** 1 2 3 4 5

Channel Type: F4b **Reviewed Channel Type:** ____ **Reviewed by:** ____ **Date:** ____

1) Thread:
- X single no side channels
- ____ single w/ side channels
- ____ multiple channels

2) Entrenchment: Measured: X Estimate: ____
/ 26.0 / 27.6 / 26.0 / 24.6 / 21.7 / 27.4 / 20.4 /
/ 21.2 / 25.5 / 23 / BF widths / 24.34 / avg. BFW
- 23 bankfull width @ station
- 1.99 max bankfull depth
- 29.0 floodprone width (width @ 2X max BF)
- 1.26 entrenchment ratio (FPW/ BFW@ station)

3) W/D Ratio: Measured: X Estimate: ____
- 13.83 computed bankfull area
- .6 avg. BF depth (BFA/BFW@station) (Arithmetic)
- 38.3 width/depth ratio (BFW@station/avg.BFD)

4) Sinuosity: Measured: Y Estimate: ____
- 519 stream length (thalweg)
- 452 valley length (straight line between thalweg pts.)
- 1.15 sinuosity (stream length/valley length)

~~1.1~~ 60

5) Gradient: Measured: X Estimate: ____
- 3.7 / 1.9 / 1.85 / 1.5 elevation change 1.3 3.5 2.7
- 119 / 50 / 50 / 70 distance 22 58 90
- .03 / .04 / .04 / .02 gradient .06 .06 .03
- .035=.04 average reach gradient

3.5 / 60 = .06

6) Particle size distribution: Measured: X Estimate: ____
- 64-128 dominant size class (mm) 26.3 %Grand Total
- 32-64 D 50 (mm)

comments: ____

7) *Depositional Pattern:*
- ____ point bars
- ____ point bars w/mid-channel bars
- ____ many side-channel bars
- X side or diagonal bars
- ____ channel composed of bars/islands
- ____ none

8) *Bed Features:*
- ____ cascade
- ____ step-pool
- ____ plane bed/glide
- X pool-riffle
- ____ other: ____

Photos:
- # 16 description: downstream @ station
- # 17 description: upstream @ station
- # ____ description: ____
- # ____ description: ____
- # ____ description: ____
- # ____ description: ____
- # ____ description: ____

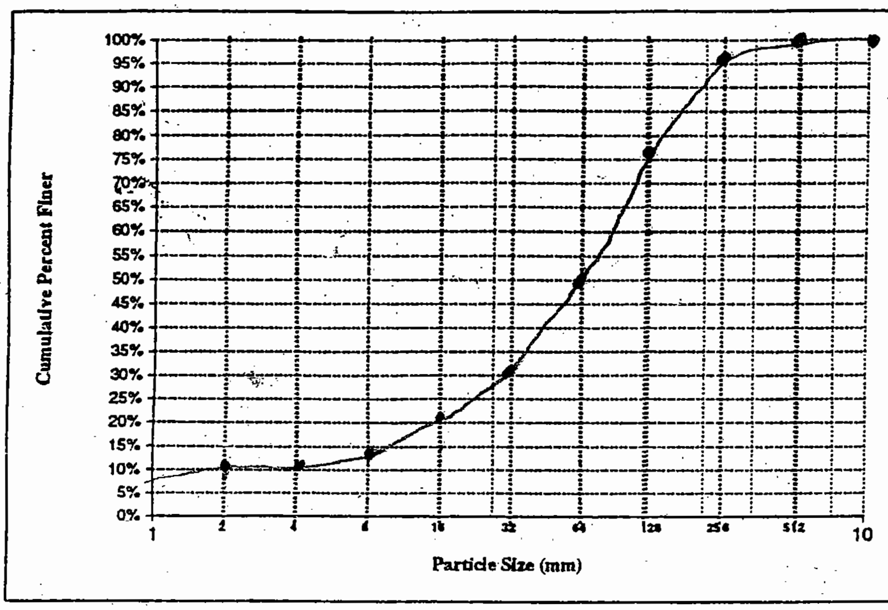
Distance (from L.Pin)	Width	Elevation	BF depth (E - BFE)	Area (WxBFD)
1	.25		0	0
2	.5		.1	.05
3	↓		.2	.1
4			.3	.15
5			.39	.20
6			.53	.27
7			.8	.4
8			1.02	.51
9			1.11	.56
10			1.24	.62
11			1.33	.67
12			1.41	.71
13			1.62	.81
14			1.55	.78
15			1.44	.72
16			1.76	.88
17			1.72	.86
18			1.83	.92
19			1.99	1.0
20			1.99	1.0
21			1.87	.94
22			1.86	.93
23	↓		1.5	.75
24	.5		0	0
				13.83

Stream Notes: ____

Map Attached: Y N

size (mm)	Particle	#	Pool 20	Riffle 80	Total	% Class	%Cu
0-.062	silt	0			11	9.7	9.7
.062-2	sand	1			2	1.8	11.5
2-4	v. fine gravel	2			0	0	11.5
4-8	fine gravel	3			3	2.6	14.1
8-16	med. gravel	4			8	7.0	21.1
16-32	course gravel	5			12	10.5	31.6
32-64	v. course gravel	6			22	19.3	50.9
64-128	small cobble	7			30	26.3	77.2
128-256	large cobble	8			22	19.3	96.5
256-512	small boulder	9			4	3.5	100
512-1024	med. boulder	10			0	0	100
1024-4096	large boulder	11			0	0	100
4096+	bedrock	12			0	0	100

114 **Grand Total**



Stability Notes:

CHANNEL STABILITY

UPPER BANKS	EXCELLENT		GOOD		FAIR		POOR	
1. landform slope of floodprone area	upper bank slope < 30%	2	upper bank slope 30-40%	4	upper bank slope 40-60%	6	upper bank slope 60+%	8
2. mass wasting (existing or potential)	no evidence of past, or potential for future wasting into channels	3	infrequent and/or very small, mostly healed, low future potential	6	moderate number and size with some raw and others available at high flows	9	numerous or large, erode at all flow levels or imminent danger of same	12
3. debris accumulation in floodprone area (debris & limbs)	mostly long/large debris, potential for log jam formation is low	2	mostly short/lg debris, potential for log jam formation is slight	4	mostly short/small debris occasional dense log jam with trash accumulations	6	all short/small debris many dense log jams with trash accumulation	8
4. floodprone area resistant to bankfull flows (veg. & rocks)	90+% plant, lg. debris, boulder armoring with deep, dense rooting	3	70-90% plant, lg. debris boulder armoring with deep dense rooting	6	50-70% plant, lg debris, or boulder armoring with shallow/dense soil rooting	9	< 50% plant, lg debris, boulder armoring with little rooting of soils	12
LOWER BANKS & CHANNEL								
5. channel capacity (floodprone area accessable to BF flows)	ample capacity, peakflow contained, width/depth ratio < 10	1	adequate, overbank flows rare, riffle, w/d 10-15	2	barely contains present peakflow, floods evident, riffle, w/d 15-25	3	inadequate for peakflow, floods common, w/d >25	4
6. bank rock content	65+% boulders >12" dia. some angular rock/bldrs	2	40-65% rounded boulders mostly 6-12" dia	4	20-40% round cobble, most 3-6" dia and some gravel	6	< 20% rock content, most rock is 1-3" gravel	8
7. obstructions, flow deflectors and sediment traps	bldrs/debris abundant, one main channel, flow uniform, sed. traps < 1/2 full	2	bldrs/debris common, one main channel with few flow deflectors, sed. traps 3/4 full	4	bldrs/debris common, one migrating channel, many bedload deposits, sed. sed. traps full	6	bldrs/debris uncommon, migrating channels, many bedload deposits, sed. traps full	8
8. bank cutting	little or none evident, no sloughing present	4	common at outcurves and constrictions, some sloughing present	8	common throughout, raw banks, overhangs and sloughing are present	12	nearly continuous, rawbanks, mats and rootwads present in stream	16
9. depositional bars	few bars, vegetated with annuals, rare fresh sand gravel deposits on bars	4	bars growing, some unvegetated, sand/gravel bar deposits frequent	8	gravel bars unvegetated new sand/gravel bars common, few cobble channel bars	12	gravel/cobble channel bars extensive w/ no vegetation widespread sand deposits	16
CHANNEL BOTTOM								
10. rock angularity	irregular shapes, rough surfaces, sharp edges	1	rectangular shapes, round edges, some smooth surface	2	cube shape w/ all edges rounded, mostly smooth	3	nearly all stones round ball shape and smooth	4
11. rock brightness	all stones dark colored on top, clean bottoms	1	many stones dark colored, up to 35% clean surfaces	2	35-65% clean surfaces, color nearly same as rock bottoms	3	65+% clean surfaces, no color difference on rock	4
12. particle packing	assorted sizes tightly packed and/or overlapped	2	moderately packed with some overlapping	4	lightly packed assortment, little particle overlapping	6	no packing, easily moved no particle overlap	8
13. percent stable bottom materials	no change in channel rock assortment, 80-100% stable materials	4	scattered bright rocks indicate assmt change, 50-80% stable materials	8	individual bright rocks common throout, 20-50% stable materials	12	rock assortment skewed/ changed throout, 0-20% stable materials	16
14. scouring & deposition	less than 5% of bottom affected by scour/ deposition (bright bottom patches)	6	5-30% affected, scour at constrictions and steep grades, some pool deposition	12	30-50% affected, deposits common and pools filling very wide/shallow channel	18	> 50% of channel changed yearly, abandon channel deposits evident	24
15. clinging vegetation (moss & algae)	abundant in dense mats in all areas, moss and summer algae "fronds"	1	common, "fronds" mostly in pools & low velocity areas, moss in all areas	2	spotty in backwaters only, "fronds" and moss uncommon mostly rock slime	3	"fronds" and moss rare, rock slime mostly slow water, all riffles clean	4

Total reach score = col. E 7 + col. G 20 + col. F 52 + col. P 4 = 83

Stream: Tubby CR. #16 Survey crew: Thompson, Jungst
Reach: 16 reference: Y/N Rosgen channel type: F4b
Date: 8-9-04 Units: (English) / metric
Elevation(ft) Riparian width (est) ____ (ft)
REACH LENGTH: 519
RIFFLE BANKFULL WIDTHS (10)

26.0	27.6	26.0	24.6	21.7
27.4	20.4	21.2	25.5	

AVERAGE RIFFLE WIDTH – ____
REACH LENGTH (avg x 20) – ____
–channels <10' } MEASURE ALL RIFFLES; MEASURE ALL POOLS
–channels >10' } MEASURE EVERY OTHER RIFFLE; MEASURE ALL POOLS

POOLS

Max Depth	Pool tail Max Depth	% Pool tail fines (<7mm)	Pool Width	Pool Length
4.25	.5	10%	22.5	30
2.4	.9	5%	20.2	37
2.3	.35	60%	15	20

RIFFLES

UNSTABLE (ft) LEFT BANK	UNSTABLE (ft) RIGHT BANK	RIFFLE LENGTH (ft)
Ø	Ø	165
Ø	Ø	105
Ø	Ø	84
Ø	Ø	128

191
WST

% pocket pools in reach – 5% Σ POOL LENGTH – 87 (ft)
Pool Frequency– (reach length / # pools) – 1 pool / 173 (ft)
AVERAGE % FINES IN POOL TAILS – 25%

Σ RIFFLE LENGTH – 432
% stable banks in riffles – 100%
Width / depth ratio - RIFFLE – ____

LARGE WOODY DEBRIS

TYPE:	live > bfw		dead > bfw			live < bfw		dead < bfw	
Diameter:	*** > 6"	< 6"	*** > 6"	<6"		>6"	<6"	>6"	<6"
Rootwad		|	||||					||	
Embedded			|||	||					|
Suspended		|||	卌 ||	||||					
Recruiting	|||	|||							
Ramp			||||	|||				|	||
Misc. Agg.			卌 ||| 卌 ||						

bfw = bankfull width
LWD FREQUENCY = (REACH LENGTH) / (TOTAL NUMBER OF PIECES WITH *** IN columns) = ____

GRADIENT
Pool/Riffle sets.

Δelev	stream distance	% gradient

(Δelev / dist)(100) = %gradient
Rosgen reach gradient = ____%

MISC COMMENTS:
SNORKEL SURVEY COMPLETED ? ____ PICTURES: (frame #) ____ / ____ / ____ / ____
CORE SAMPLES COLLECTED ? Y/N % FINES ____ CAMERA # ____

CHANNEL IMPACTS: (circle if applicable) grazing / timber harvest / roads / debris removal / other ____

Comments: ____

WRC code: ____
Riparian width (ft) ____
Riparian habitat type: ____
Valley bottom unit: ____
Geology: ____

Revised 2/97

1

APPENDIX I: KOOTENAI NATIONAL FOREST WATERSHED FIELD DATA including ROSGEN CHANNEL CLASSIFICATION INFO

Stream Name: Libby Cr #17 **Reach ID:** 17 **HUC #:** ____
Crew: Thompson, Tungst, Ague **Date:** 8-9-04 **Elev. Start Reach:** ____ **English:** ____ **Metric:** ____
Reach Length: 587 **Permanent:** ____ **Basin Survey:** X **Reference:** Y N **Overall Reliability:** 1 2 3 4 5

Channel Type: B3C **Reviewed Channel Type:** ____ **Reviewed by:** ____ **Date:** ____

1) Thread:
- X single no side channels
- ___ single w/ side channels
- ___ multiple channels

135
+84
275
93
587

2) Entrenchment: Measured: ____ Estimate: ____
/25 /28 /20.6 /16.8 /17.2 /24 /27 /
/21.8 / 15.2 / 26.5 / **BF widths** / 22.18 / **avg. BFW**

- 26.5 **bankfull width @ station**
- .96 **max bankfull depth**
- 48.1 **floodprone width** (width @ 2X max BF)
- 1.8 **entrenchment ratio** (FPW/ BFW @ station)

3) W/D Ratio: Measured: ____ Estimate: ____
- 6.28 computed bankfull area
- .24 **avg. BF depth** (BFA/BFW@station) (Arithmetic)
- 110.42 **width/depth ratio** (BFW@station/avg.BFD)

4) Sinuosity: Measured: ____ Estimate: ____
- 587 **stream length** (thalweg)
- 512 **valley length** (straight line between thalweg pts.)
- 1.1 **sinuosity** (stream length/valley length)

5) Gradient: Measured: ____ Estimate: ____
- .2 / 1.45 / 3 / .2 **elevation change** 1.4 0
- 130 / 85 / 110 / 150 **distance** 52 60
- .015 / .017 / .027 / .013 **gradient** .027 0
- .017 = 1.7 **average reach gradient**

6) Particle size distribution: Measured: ____ Estimate: ____
- ~~128~~ cobble dominant size class (mm) 29.4 %Grand Total
- 128 **D 50** (mm)

comments: ____

7) Depositional Pattern:
- ___ point bars
- ___ point bars w/mid-channel bars
- X many side-channel bars
- ___ side or diagonal bars
- ___ channel composed of bars/islands
- ___ none

8) Bed Features:
- ___ cascade
- ___ step-pool
- ___ plane bed/glide
- X pool-riffle
- ___ other: ____

Distance (from L.Pin)	Width	Elevation	BF depth (E - BFE)	Area (WxBFD)
1	.25		0	0
2	.5		.24	.12
3			.22	.11
4		BFE see pic.	.04	.02
5			.04	.02
6			.2	.1
7			.27	.14
8			.14	.07
9			.46	.23
10			.5	.25
11			.56	.28
12			.57	.29
13			.55	.28
14			.58	.29
15			.66	.33
16			.75	.38
17			.88	.44
18			.96	.48
19			.87	.44
20			.9	.45
21			.4	.20
22			.58	.29
23			.84	.42
24			.79	.40
25			.5	.25
26	.25		0	0
				6.28

Stream Notes: * Large split in stream 135' from top of reach due to huge pile of blow down/logging slash
* 95' below log jam channel becomes 1 main channel

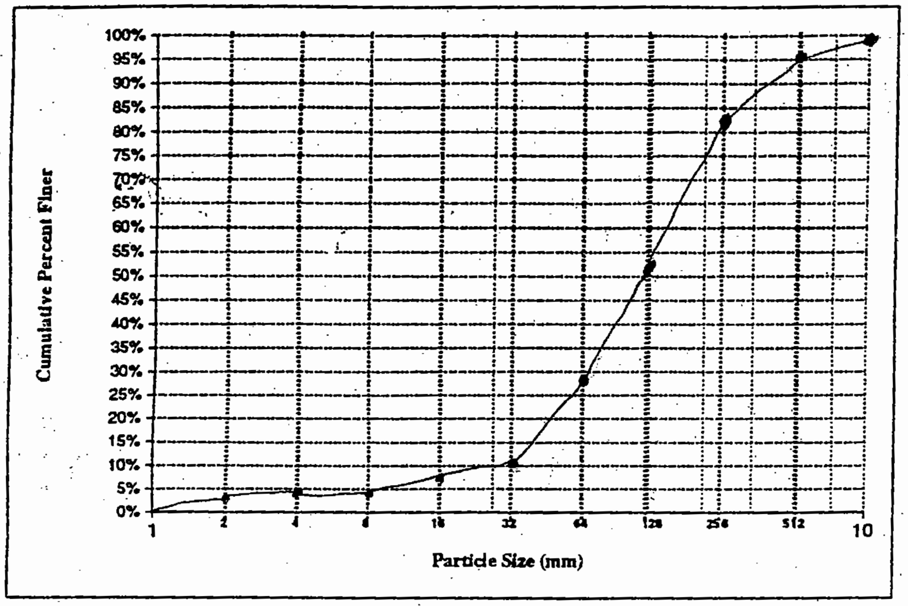
Photos: # [illegible] description: [redacted]
15 description: downstream
14 description: upstream
____ description: ____
____ description: ____
____ description: ____
____ description: ____

Map Attached: Y N

PEBBLE COUNT INFORMATION

size (mm)	Particle	#	Pool 32	Riffle 70	Total	%Class	%
0-.062	silt	0			4	3	
.062-2	sand	1			2	1.6	4.
2-4	v. fine gravel	2			0	0	4.6
4-8	fine gravel	3			3	2.4	7.0
8-16	med. gravel	4			4	3	10.0
16-32	course gravel	5			22	17.5	27.5
32-64	v. course gravel	6			31	24.6	52.1
64-128	small cobble	7			37	29.4	81.5
128-256	large cobble	8			17	13.5	95
256-512	small boulder	9			6	4.8	99.8
512-1024	med. boulder	10					
1024-4096	large boulder	11					
4096+	bedrock	12					

126 **Grand Total**



Stability Notes:

CHANNEL STABILITY

UPPER BANKS	EXCELLENT		GOOD		FAIR		POOR	
1. landform slope of floodprone area	upper bank slope < 30%	2	upper bank slope 30-40%	4	upper bank slope 40-60%	(6)	upper bank slope 60+%	8
2. mass wasting (existing or potential)	no evidence of past, or potential for future wasting into channels	3	infrequent and/or very small, mostly healed, low future potential	(6)	moderate number and size with some raw and others available at high flows	9	numerous or large, erode at all flow levels or imminent danger of same	12
3. debris accumulation in floodprone area (debris & limbs)	mostly long/large debris, potential for log jam formation is low	2	mostly short/lg debris, potential for log jam formation is slight	(4)	mostly short/small debris occasional dense log jam with trash accumulations	6	all short/small debris many dense log jams with trash accumulation	8
4. floodprone area resistant to bankfull flows (veg. & rocks)	90+% plant, lg. debris, boulder armoring with deep, dense rooting	3	70-90% plant, lg. debris boulder armoring with deep dense rooting	(6)	50-70% plant, lg debris, or boulder armoring with shallow/dense soil rooting	9	< 50% plant, lg debris, boulder armoring with little rooting of soils	12
LOWER BANKS & CHANNEL								
5. channel capacity (floodprone area accessable to BF flows)	ample capacity, peakflow contained, width/depth ratio < 10	1	adequate, overbank flows rare, riffle, w/d 10-15	2	barely contains present peakflow, floods evident, riffle, w/d 15-25	3	inadequate for peakflow, floods common, w/d >25	4
6. bank rock content	65+% boulders >12" dia. some angular rock/bldrs	2	40-65% rounded boulders mostly 6-12" dia	(4)	20-40% round cobble, most 3-6" dia and some gravel	6	< 20% rock content, most rock is 1-3" gravel	8
7. obstructions, flow deflectors and sediment traps	bldrs/debris abundant, one main channel, flow uniform, sed. traps < 1/2 full	(2)	bldrs/debris common, one main channel with few flow deflectors, sed. traps 3/4 full	4	bldrs/debris common, one migrating channel, many bedload deposits, sed. sed. traps full	6	bldrs/debris uncommon, migrating channels, many bedload deposits, sed. traps full	8
8. bank cutting	little or none evident, no sloughing present	(4)	common at outcurves and constrictions, some sloughing present	8	common throughout, raw banks, overhangs and sloughing are present	12	nearly continuous, rawbanks, mats and rootwads present in stream	16
9. depositional bars	few bars, vegetated with annuals, rare fresh sand gravel deposits on bars	4	bars growing, some unvegetated, sand/gravel bar deposits frequent	(8)	gravel bars unvegetated new sand/gravel bars common, few cobble channel bars	12	gravel/cobble channel bars extensive w/ no vegetation widespread sand deposits	16
CHANNEL BOTTOM								
10. rock angularity	irregular shapes, rough surfaces, sharp edges	(1)	rectangular shapes, round edges, some smooth surface	2	cube shape w/ all edges rounded, mostly smooth	3	nearly all stones round ball shape and smooth	4
11. rock brightness	all stones dark colored on top, clean bottoms	(1)	many stones dark colored, up to 35% clean surfaces	2	35-65% clean surfaces, color nearly same as rock bottoms	3	65+% clean surfaces, no color difference on rock	4
12. particle packing	assorted sizes tightly packed and/or overlapped	2	moderately packed with some overlapping	(4)	lightly packed assortment, little particle overlapping	6	no packing, easily moved no particle overlap	8
13. percent stable bottom materials	no change in channel rock assortment, 80-100% stable materials	4	scattered bright rocks indicate assmt change, 50-80% stable materials	(8)	individual bright rocks common throout, 20-50% stable materials	12	rock assortment skewed/ changed throout, 0-20% stable materials	16
14. scouring & deposition	less than 5% of bottom affected by scour/ deposition (bright bottom patches)	6	5-30% affected, scour at constrictions and steep grades, some pool deposition	12	30-50% affected, deposits common and pools filling very wide/shallow channel	(18)	> 50% of channel changed yearly, abandon channel deposits evident	24
15. clinging vegetation (moss & algae)	abundant in dense mats in all areas, moss and summer algae "fronds"	1	common, "fronds" mostly in pools & low velocity areas, moss in all areas	2	spotty in backwaters only, "fronds" and moss uncommon mostly rock slime	(3)	"fronds" and moss rare, rock slime mostly slow water, all riffles clean	4

Total reach score = col. E ____ + col. G ____ + col. F ____ + col. P ____ = ______

Stream: Libby Creek
Reach: 17 reference: Y/N
Date: 8/9/04
Elevation(ft)
REACH LENGTH:

Survey crew: Thompson, Jungst, Agve
Rosgen channel type:
Units: English / metric
Riparian width (est) 200 (ft)

RIFFLE BANKFULL WIDTHS (10)

25	28	20.6	16.5	17.2
24	27	21.8	15.2	26.5

AVERAGE RIFFLE WIDTH = 22.18
REACH LENGTH (avg x 20) = 587
--channels <10' } MEASURE ALL RIFFLES; MEASURE ALL POOLS
--channels >10' } MEASURE EVERY OTHER RIFFLE; MEASURE ALL POOLS

POOLS

Max Depth	Pool tail Max Depth	% Pool tail fines (<7mm)	Pool Width	Pool Length
1.75	.2	25%	13	10
1.6	.45	20%	12	25
1.8	.40	10%	11	35
2.3	.3	40%	20	47
2.9	.65	10%	13.2	73

190

RIFFLES

UNSTABLE (ft) LEFT BANK	UNSTABLE (ft) RIGHT BANK	RIFFLE LENGTH (ft)
0	0	209
0	0	35
0	0	115
0	0	38

397

% pocket pools in reach = ~~||||~~ ~~||||~~ ||
Σ POOL LENGTH = 190 (ft)
Pool Frequency = (reach length / # pools) = 1 pool / 117.4 (ft)
AVERAGE % FINES IN POOL TAILS = 21%

Σ RIFFLE LENGTH = 397
% stable banks in riffles = 100
Width / depth ratio - RIFFLE = 110.42

LARGE WOODY DEBRIS

TYPE: Diameter:	live > bfw *** > 6"	live > bfw < 6"	dead > bfw *** > 6"	dead > bfw < 6"		live < bfw > 6"	live < bfw < 6"	dead < bfw > 6"	dead < bfw < 6"
Rootwad			~~||||~~	||||				~~||||~~	
Embedded			~~||||~~	|				|||	
Suspended			~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~	~~||||~~ ||					
Recruiting	~~||||~~ ~~||||~~								
Ramp			~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~						
Misc. Agg			~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~						

bfw = bankfull width

GRADIENT
Pool/Riffle sets.

Δelev	stream distance	% gradient
.2	130	1.5%
1.45	85	1.7%
.3	110	2.7%
.2	150	1.3

(Δelev / dist)(100) = %gradient
Rosgen reach gradient = 1.7 %

1.4 | 52 | 2
0 | 60 | 6

LWD FREQUENCY = (REACH LENGTH) / (TOTAL NUMBER OF PIECES WITH *** IN columns) = 6.3

MISC COMMENTS:
SNORKEL SURVEY COMPLETED ? ______
CORE SAMPLES COLLECTED ? Y/N % FINES ______
PICTURES: (frame #) 15, 16, ,
CAMERA # ______

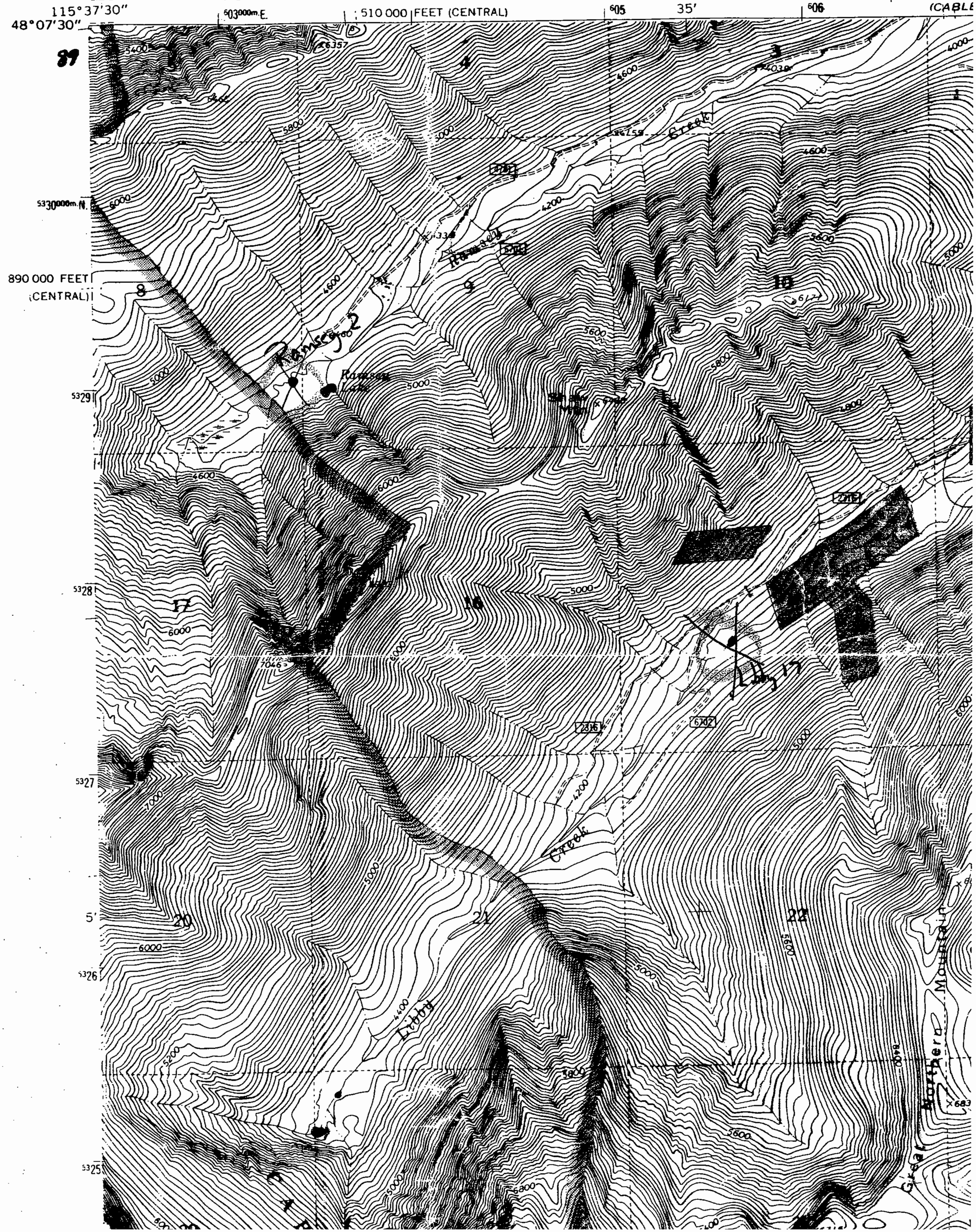
CHANNEL IMPACTS: (circle if applicable) grazing / timber harvest / roads / debris removal / other ______

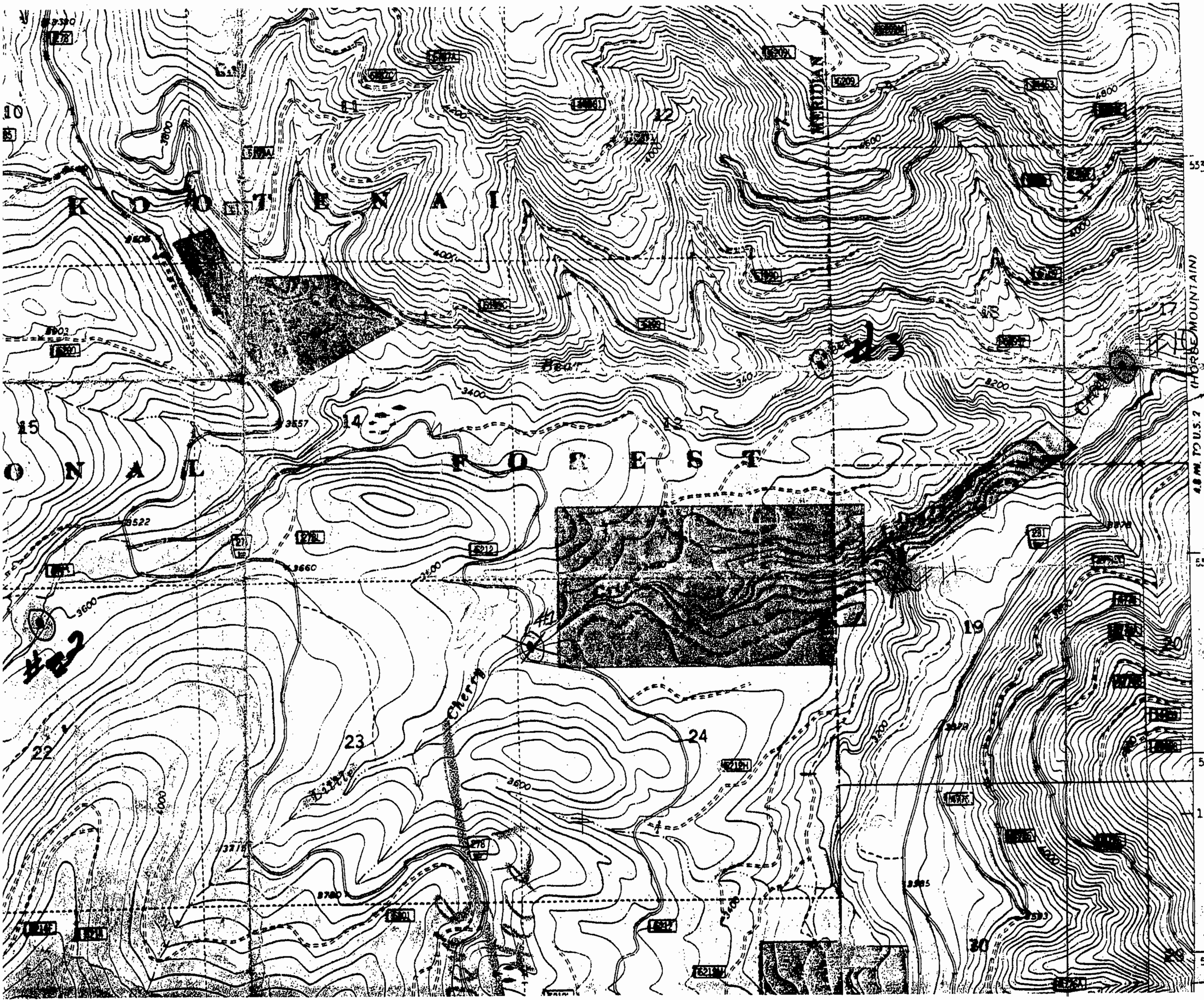
Comments: ______

WRC code:
Riparian width (ft) 200
Riparian habitat type:
Valley bottom unit:
Geology:

Revised 2/97

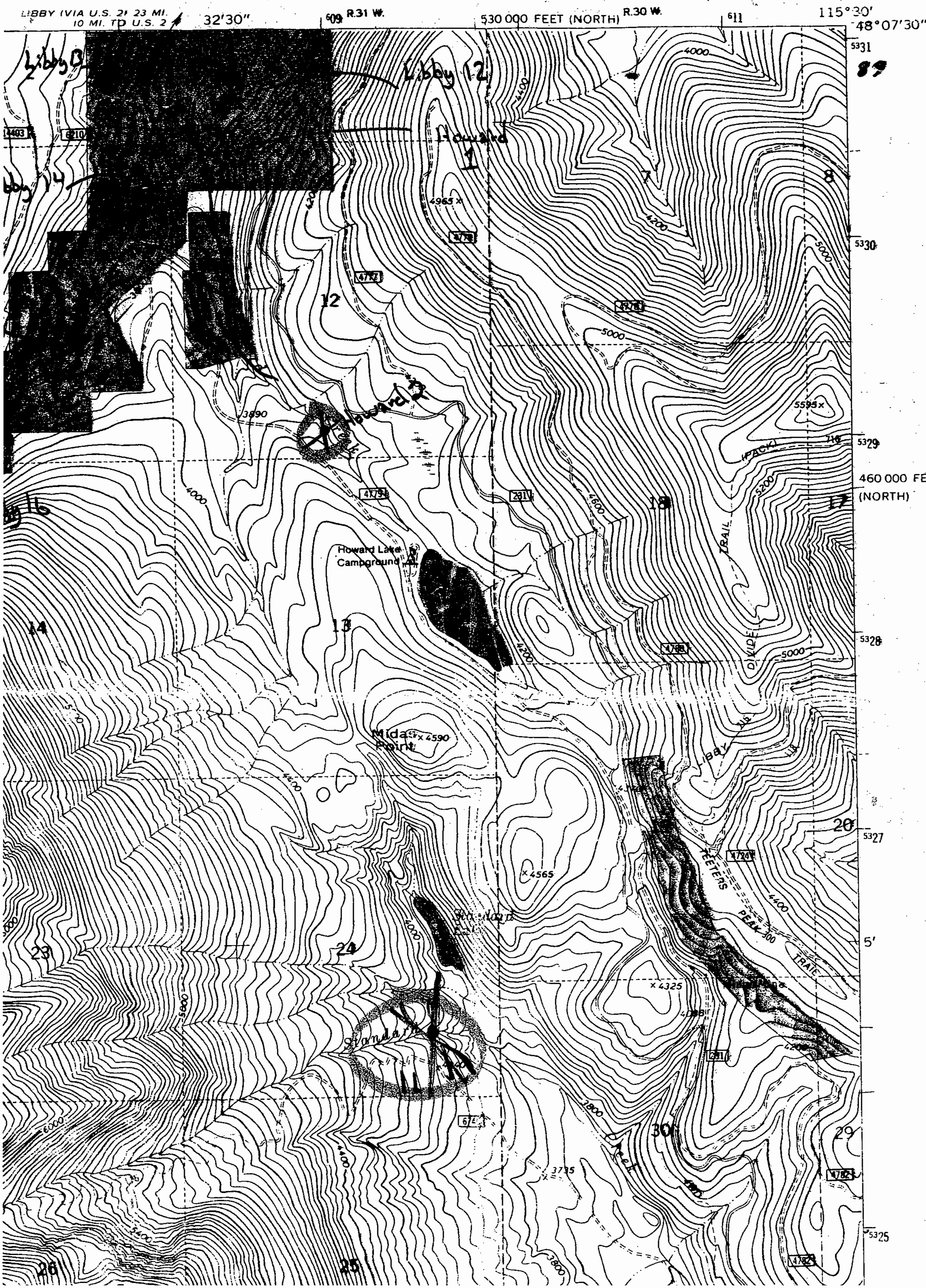
GEOLOGICAL SURVEY
MODIFIED FOR USDA FOREST SERVICE USE





KOOTENAI
ONAL
FOREST
MERIDIAN
4.8 MI. TO U.S. 2 (HORSE MOUNTAIN)
5339
5337
5336
5335
10'
Bear
Cherry
10
11
12
14
15
19
22
23
24
30

7.5 MINUTE SERIES (TOPOGRAPHIC)



KOOTENAI NATIONAL FOREST WATERSHED FIELD DATA
including ROSGEN CHANNEL CLASSIFICATION INFO

Stream Name: Ramsey **Reach ID:** #1 **HUC #:** ____
Crew: May Reed **Date:** 7-20-98 **Elev. Start Reach:** 5166 **English:** ✓ **Metric:** ____
Reach Length: 450 **Permanent:** ✓ **Basin Survey:** ____ **Reference:** (Y) N **Overall Reliability:** (1) 2 3 4 5
Channel Type: B2 **Reviewed Channel Type:** B3 **Reviewed by:** [signature] **Date:** 7-22-0?

1) **Thread:**
✓ single no side channels
____ single w/ side channels
____ multiple channels

2) **Entrenchment:** Measured: X Estimate: ____
/ 24.2 / 23.4 / 24.8 / 25.0 / 21.8 / 19.9 / 23.2 /
/ 20.2 / 19.1 / 23.0 / **BF widths** / 22.46 / **avg. BFW**
23.0 **bankfull width @ station**
2.10 **max bankfull depth**
32.7 **floodprone width** (width @ 2X max BF)
1.42 **entrenchment ratio** (FPW/ BFW@ station)

3) **W/D Ratio:** Measured: X Estimate: ____
30.291 computed bankfull area
1.317 **avg. BF depth** (BFA/BFW@station) (Arithmetic)
17.46 **width/depth ratio** (BFW@station/avg.BFD)

4) **Sinuosity:** Measured: X Estimate: ____
450 **stream length** (thalweg)
371 **valley length** (straight line between thalweg pts.)
1.21 **sinuosity** (stream length/valley length)

5) **Gradient:** Measured: X Estimate: ____
2.5 / 1.4 / 2.8 / 3.3 **elevation change**
120 / 105 / 115 / 110 **distance**
____ / ____ / ____ / ____ **gradient**
.022 **average reach gradient**

6) **Particle size distribution:** Measured: ✓ Estimate: ____
m. boulder 256-512 dominant size class (mm) 29 %Grand Total
175mm **D 50** (mm)
comments: ____

7) *Depositional Pattern:*
____ point bars
✓ point bars w/mid-channel bars
____ many side-channel bars
____ side or diagonal bars
____ channel composed of bars/islands
____ none

8) *Bed Features:*
____ cascade
____ step-pool
____ plane bed/glide
✓ pool-riffle
____ other: ____

Distance (from L.Pin)	Width	Elevation	BF depth (E - BFE)	Area (WxBFD)
0	1.15		0	0
2.3	2.3		1.15	2.645
4.6	2.3		1.12	2.576
6.9	2.3		1.36	3.128
9.2	2.3		1.46	3.358
11.5	2.3		1.90	4.370
13.8	2.3		1.54	3.542
16.1	2.3		2.10	4.830
18.4	2.3		1.08	2.484
20.7	2.3		1.16	2.668
23.0	1.15		.60	.690
				30.291

Stream Notes: ____

Photos: # 10 description: downstream
11 description: upstream
____ description: ____
____ description: ____
____ description: ____
____ description: ____
____ description: ____

Map Attached: Y N

Kootenai National Forest -- Libby Ranger District

LEVEL III FISH HABITAT SURVEY

Stream: Ramsey #1

Reach: #2 reference: Y/N

Date: 7-20-98

Elevation(ft) 5166

REACH LENGTH:

Survey crew: Mary Reed

Rosgen channel type: B2

Units: English / metric

Riparian width (est) ____ (ft)

RIFFLE BANKFULL WIDTHS (10)

24.2	23.4	24.8	25.0	21.8
19.9	23.2	20.2	19.1	23.0

AVERAGE RIFFLE WIDTH - 22.46

REACH LENGTH (avg x 20) - 450

--channels <10' } MEASURE ALL RIFFLES; MEASURE ALL POOLS

--channels >10' } MEASURE EVERY OTHER RIFFLE; MEASURE ALL POOLS

1.24

POOLS

Max Depth	Pool tail Max Depth	% Pool tail fines (<7mm)	Pool Width	Pool Length
2.8	1.30	0	19.6	31
2.3	1.20	0	10.6	19
2.1	1.40	0	6.5	17

RIFFLES

UNSTABLE (ft) LEFT BANK	UNSTABLE (ft) RIGHT BANK	RIFFLE LENGTH (ft)
0	0	145
0	0	274

% pocket pools in reach - 30%

Σ POOL LENGTH - 67 (ft)

Pool Frequency-- (reach length / # pools) = 1 pool / 150 (ft)

AVERAGE % FINES IN POOL TAILS - 0%

Σ RIFFLE LENGTH - 419

% stable banks in riffles - 100

Width / depth ratio - RIFFLE - 17.46

14

450 / 470 450 2200 1800 400

LARGE WOODY DEBRIS

TYPE:	live > bfw		dead > bfw				live < bfw		dead < bfw	
Diameter:	*** >6"	<6"	*** >6"	<6"		>6"	<6"	>6"	<6"
Rootwad	• ••		•						
Embedded			••	•					
Suspended		•	☒	••••					
Recruiting	••	•							
Ramp			☒	☒					
Misc.									

bfw = bankfull width

LWD FREQUENCY = (REACH LENGTH) / (TOTAL NUMBER OF PIECES WITH *** IN columns) = 15.51

450/29

GRADIENT

Pool/Riffle sets.

Δelev	stream distance	% gradient
2.5	120	
1.4	105	
2.8	115	
3.3	110	

(Δelev / dist)(100) = %gradient

Rosgen reach gradient = 2.2 %

MISC COMMENTS:

SNORKEL SURVEY COMPLETED ? ______

CORE SAMPLES COLLECTED ? Y/N % FINES ______

PICTURES: (frame #) 10 / 11 / / /

CAMERA # ______

CHANNEL IMPACTS: (circle if applicable) grazing / timber harvest / roads / debris removal / other ______

WRC code:

Riparian width (ft)

Riparian habitat type:

Valley bottom unit:

Geology:

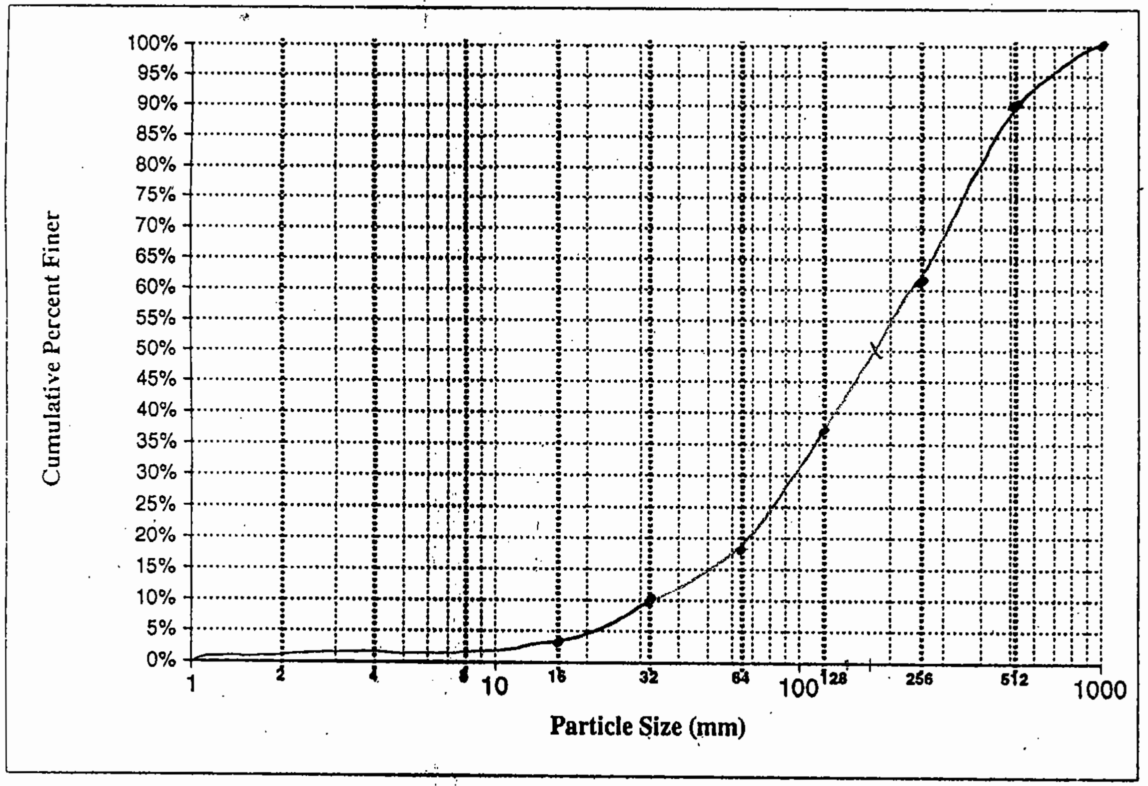
Comments:

Revised 2/97

Ramsey
#2
7-20-98

Particle	#	Pool	size (mm)	Riffle	Total	%Class	%Cum.
silt	0		0-.062		0	0	
sand	1		.062-2		0	0	
v. fine gravel	2		2-4		0	0	
fine gravel	3		4-8		0	0	
med. gravel	4		8-16		3	3	3
course gravel	5		16-32		7	7	10
v. course gravel	6		32-64		8	8	18
small cobble	7		64-128		20	19	37
large cobble	8		128-256		26	24	61
small boulder	9		256-512		31	29	90
med. boulder	10		512-1024		11	10	100
large boulder	11		1024-4096				
bedrock	12		4096+				

106 **Grand Total**



Stability Notes:

D50 = 175 mm

LIBBY RANGER DISTRICT

STREAM CHANNEL CLASSIFICATION DATA (ROSGEN 1994)

Reviewed Channel B2C [initials] 7-22-03

STREAM Ramsey Cr DATE 7-9-97

REACH ID #20 CREW Steele, May, Thompson

CHANNEL TYPE B2C REVIEWED BY PH

1)THREAD-

Single Without Side Channels	[X]
Single With Side Channels	[ ]
Multiple Channels	[ ]

2)ENTRENCHMENT-

Bankfull Widths 18.0 / 16.3 / 14.7 / 15.5 / 13.5 / 14.4 / 13.8 / 15.9 / 14.5 / 15.6

Bankfull Width(@ station) 15.9 Average bankfull width 15.2

Floodprone width (@ station x-section) 35.3

Entrenchment ratio (floodprone width / bankfull width @ station) 2.22

3)W/D RATIO-

Bankfull Depths .4 / .6 / 1.15 / 1.3 / 1.28 / 1.26 / 1.15 / .7 / .92 / 0

Average Bankfull Depth .88

Width to Depth Ratio (BF width @ station) / (Average BF Depth) 18.1

4)SINUOSITY-

Stream Length (measured along thalweg) 310

Reach Length ("straight line" distance) 295

Sinuosity (Stream Length) / (Reach Length) 1.05

5)GRADIENT- MEASURED AT WATER SURFACE

Elevation Change	3.1	/ Distance	187	Gradient(%)	1.66%
Elevation Change	1.7	/ Distance	123	Gradient(%)	1.38%
Elevation Change		/ Distance		Gradient(%)	
Elevation Change		/ Distance		Gradient(%)	

AVERAGE REACH GRADIENT (%) 1.55%

6)PARTICLE SIZE DISTRIBUTION-

Dominant size class (mm) 256-512 Small boulder

D 50 (mm) 450

Comments

7)DEPOSITIONAL PATTERN-

Point Bars	[X]
Point Bars With Few Mid-Channel Bars	[ ]
Many Side-Channel Bars	[ ]
Side Or Diagonal Bars	[ ]
Channel Composed of Bars/Islands	[ ]

8)BED FEATURES-

Cascade	[ ]
Step- Pool	[X]
Plane Bed/Glide	[ ]
Pool-Riffle	[ ]
Other (ie Transition, Beaver Dams etc)	[ ]

COMMENTS: (Write on back of form) Field Map (Attach or draw on back of form)

Revised 2/97

Very Old Timber Harvest

Kootenai National Forest -- Libby Ranger District
LEVEL III FISH HABITAT SURVEY

Stream: Ramsey Cr
Reach: #2 reference: Y/N
Date: 7-9-97
Elevation(ft) ________
REACH LENGTH: ________

Survey crew: Steele, May, Thompson
Rosgen channel type: B2 C
Units: English / metric
Riparian width (est) ________ (ft)

RIFFLE BANKFULL WIDTHS (10)

18.0	14.7	13.5	13.8	14.5
16.3	15.5	14.4	15.9	15.6

AVERAGE RIFFLE WIDTH = 15.2
REACH LENGTH (avg x 20) = 310
--channels <10' } MEASURE ALL RIFFLES; MEASURE ALL POOLS
--channels >10' } MEASURE EVERY OTHER RIFFLE; MEASURE ALL POOLS

POOLS

Max Depth	Pool tail Max Depth	% Pool tail fines (<7mm)	Pool Width	Pool Length
2.8	.8	10%	10.0	14.2

RIFFLES

UNSTABLE (ft) LEFT BANK	UNSTABLE (ft) RIGHT BANK	RIFFLE LENGTH (ft)
0	0	26
0	0	270

% pocket pools in reach = 5% ∑ POOL LENGTH = 14.2 (ft)
Pool Frequency = (reach length / # pools) = 1 pool / 310 (ft)
AVERAGE % FINES IN POOL TAILS = 10%

∑ RIFFLE LENGTH = 296
% stable banks in riffles = 100%
Width / depth ratio - RIFFLE = 18.1

LARGE WOODY DEBRIS

TYPE:	live > bfw		dead > bfw				live < bfw		dead < bfw	
Diameter:	*** >6"	<6"	*** >6"	<6"			>6"	<6"	>6"	<6"
Rootwad										
Embedded										
Suspended										
Recruiting										
Ramp										
Misc.										

bfw = bankfull width

GRADIENT
Pool/Riffle sets.

Δelev	stream distance	% gradient
3.1	187	1.66
1.7	123	1.38

(Δelev / dist)(100) = %gradient
Rosgen reach gradient = 1.55 %

LWD FREQUENCY = (REACH LENGTH) / (TOTAL NUMBER OF PIECES WITH *** IN columns) = ________

MISC COMMENTS:
SNORKEL SURVEY COMPLETED ? N
CORE SAMPLES COLLECTED ? Y/N (N circled) % FINES /
PICTURES: (frame #) / / /
CAMERA # ________

CHANNEL IMPACTS: (circle if applicable) grazing / timber harvest (circled) / roads / debris removal / other ________

Comments: ________

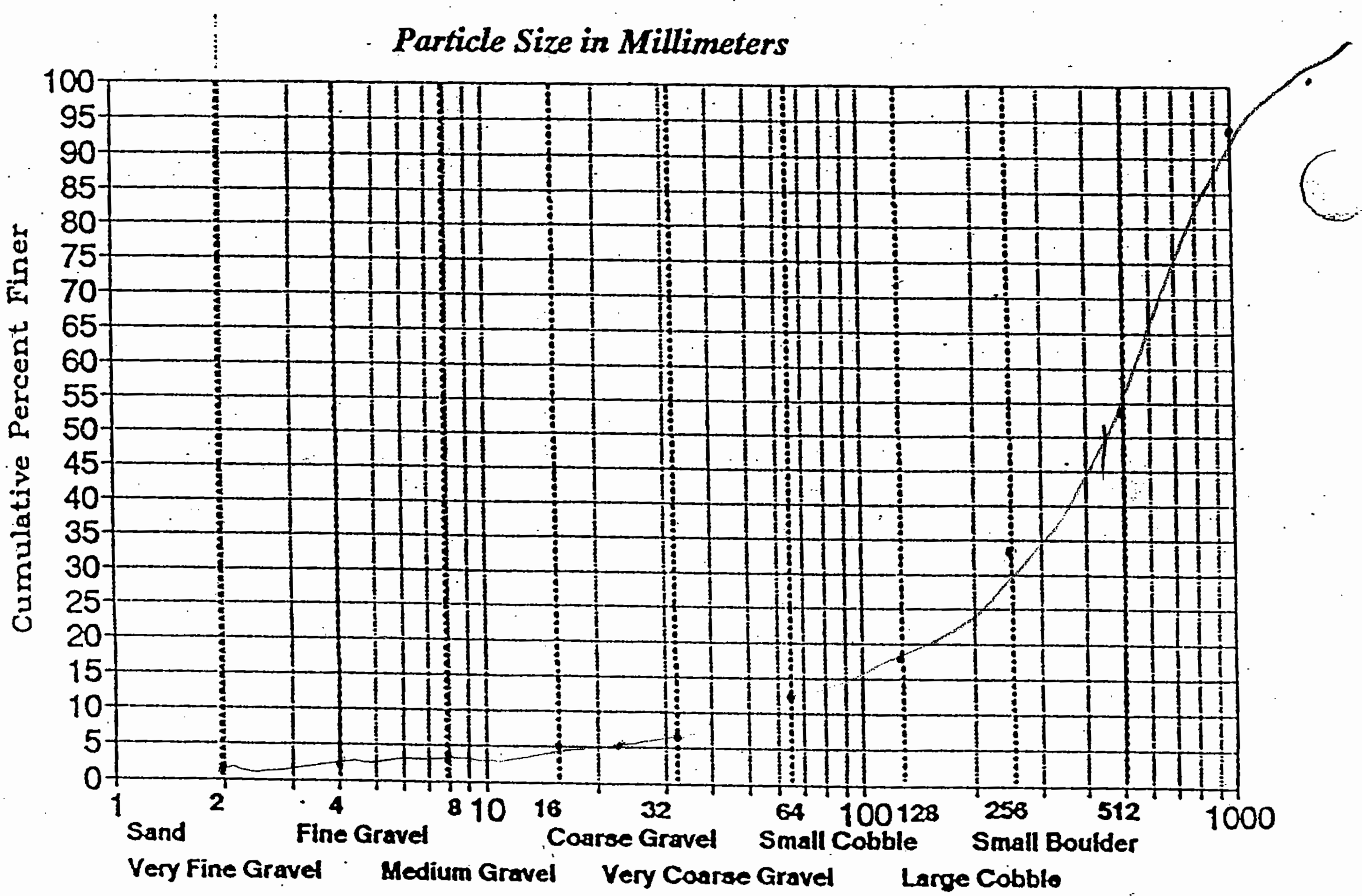
VRC code: ________
Riparian width (ft) ________
Riparian habitat type: ________
Valley bottom unit: ________
Geology: ________

Revised 2/97

PEBBLE COUNT INFORMATION

Size (mm)	Particle	Pool	Riffle	Total	% class	Cumm. %
0 - 2	silt - crse sand		∷	4	3	3
2 - 4	v. fine gravel		:	2	1	4
4 - 8	fine gravel		·	1	1	5
8 - 16	med. gravel		··	2	1	6
16 - 32	course gravel	·	⊓	7	6	12
32 - 64	v. course gravel	··	∷	6	5	17
64 - 128	small cobble	·	⊠ ⊠	21	17	34
128 - 256	large cobble	∷	⊠ ⊠ ∷	26	20	54
256 - 512	small boulder	⊠ ··	⊠ ⊠ ⊠ ⊐	49	39	93
512 - 1024	medium boulder	∷	∴	9	7	100
1024 +	large boulder			127	100%	

D50=450



[redacted]

[redacted]

STREAM NAME: Ramsey Creek D-5

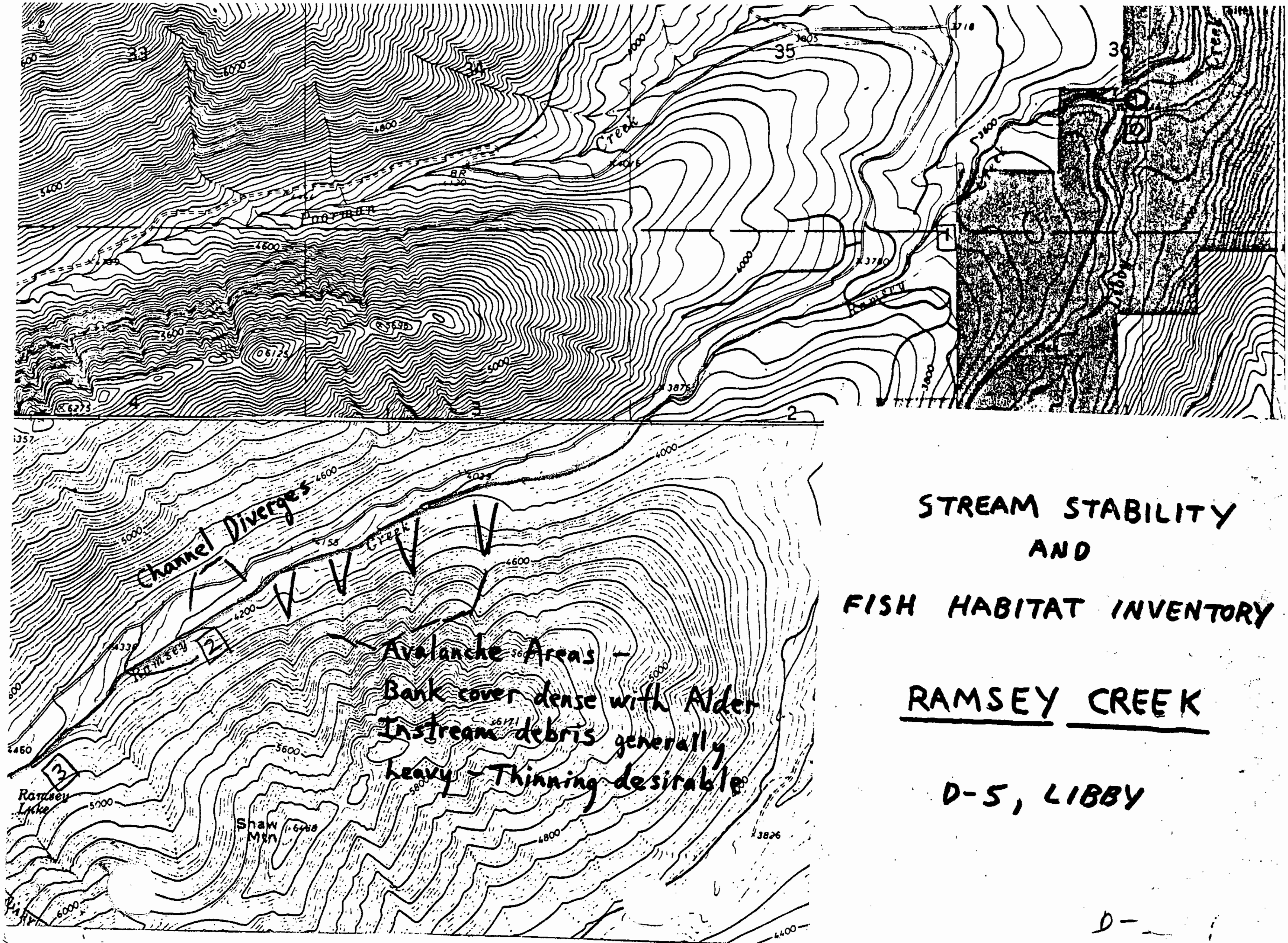
RECEIVING WATER: Libby Creek → Kootenai River

KNOWN FISHERIES:

Resident rainbow and bull trout.

LIMITING FACTORS AND SENSITIVITIES:

ADDITIONAL COMMENTS:



STREAM STABILITY
AND
FISH HABITAT INVENTORY

RAMSEY CREEK

D-5, LIBBY

D-

STREAM NUMBER & NAME: Ramsey STATIONS: 0-1 DATE: 6.14.78

AVG. WIDTH: 15' * AVG. DEPTH: + + = 1' * VELOCITY: 5 fps *

4

VOL 94 cfs * TEMPERATURE: 5°C * GRADIENT: 5% *

STABILITY RATING: 65 (good) TURBIDITY: (Clear) - Milky - Muddy

% POOL: 15 % RIFFLE: 85 % RUN: ___ % GLIDE: ___

POOL CLASSES: % CLASS 1: 10 % CLASS 2: 0 % CLASS 3: 10 % CLASS 4: 80

BOTTOM MATERIALS:	Very Abundant (>70%)	Abundant (41 to 70%)	Common (11 to 40%)	Present (<10%)	None 0
Organic Debris:				✓	
Clay/Silt:				✓	
Sand:				✓	
Fine Gravel (0.1 to 1"):				✓	
Coarse Gravel (1 to 3"):			✓		
Small Rubble (3 to 6"):			✓		
Large Rubble (6 to 12"):		✓			
Boulders (>12"):		✓			
Bed Rock:			✓		
AQUATIC VEGETATION:				✓	

INSTREAM COVER: - Good (-) Fair - Poor - None

Cover Types (Indicate relative importance A>C>P)
- Logs P
- Rocks A
- Bottom Color C
- Undercut Banks P
- Water Color —
- Choppy Surface A
- Overhanging Vegetation: C

BANK COVER: - (Good) - Fair - Poor - None

Major Plant Species:
- A Cedar, Alder, R. Maple,
- C Cottonwood, Sub-Alpine Fir, Honeysuckle, Fairybells, Water Hemlock
- P Larch, Hemlock, G. Fir, D. Fir, red-stemmed dogwood, devil's club, ferns, mosses

FISH FOOD ORGANISMS: >25/ft² 16-25/ft² (6-15/ft²) 1-5/ft² None

Food Types (Indicate relative abundance A>C>P): Caddisflies C Mayflies: P Stoneflies: P Diptera — Snails: — Leeches: P Others: —

SPAWNING HABITAT: Very Good - Good - Fair - (Poor) - None

% Gravel: >50% 35-50% 20-34% 10-19% <10%

Velocity (in gravel areas) ←— 0.5 to 3 fps —→ <0.5 or >3 fps

Water Depth (in gravel areas): ←— 0.3 to 3 ft. —→ <0.3 or >3 fps

Are there silt or sand deposits in/on the spawning gravels? Yes

VALLEY BOTTOM TYPE: >300 ft. 100-300 ft. ✓ <100 ft.

LAND FORM GRADIENT: <5% 5-10% (11-20%) 21-30% 30%

LIMITING FACTORS: Swift current, lack of pools/spawning grounds, limited food supply, lack of water breaks

ADDITIONAL OBSERVATIONS: Good age class diversity in Riparian zone

INVESTIGATOR: M. Rhodes, A. Bratkovich

* = Estimates

D-5

[illegible] Cr.
Station 0-1
6·14·78

R-1 STREAM CHANNEL STABILITY FIELD EVALUATION FORM

Item Rated	Stability Indicators by Classes							
	EXCELLENT		GOOD		FAIR		POOR	
UPPER BANKS								
Landform Slope	Bank slope gradient <30%	(2) circled	Bank slope gradient 30-40%	(4)	Bank slope gradient 40-60%	(6)	Bank slope gradient 60% +	[illegible]
Mass Wasting (Existing or Potential)	No evidence of past or potential for future mass wasting into channels.	(3)	Infrequent and/or very small. Mostly healed over. Low future potential.	(6) circled	Moderate frequency & size, with some raw spots eroded by water during high flows.	(9)	Frequent or large, causing sediment nearly yearlong OR imminent danger of same.	[illegible]
Debris Jam Potential (Floatable Objects)	Essentially absent from immediate channel area.	(2)	Present but mostly small twigs and limbs.	(4) circled	Present, volume and size are both increasing.	(6)	Moderate to heavy amounts, predominantly larger sizes.	[illegible]
Bank Protection from Vegetation	90% + plant density. Vigor and variety suggests a deep, dense root mass.	(3) 4 circled	70-90% density. Fewer plant species or lower vigor suggests a less dense or deep root mass.	(6)	50-70% density. Lower vigor and still fewer species form a somewhat shallow and discontinuous root mass.	(9)	<50% density plus fewer species & less vigor indicate poor, discontinuous, and shallow root mass.	[illegible]
LOWER BANKS								
Channel Capacity	Ample for present plus some increases. Peak flows contained. W/D ratio <7.	(1)	Adequate. Overbank flows rare. Width to Depth (W/D) ratio 8-15.	(2) circled	Barely contains present peaks. Occasional overbank floods. W/D ratio 15-25.	(3)	Inadequate. Overbank flows common. W/D ratio >25.	
Bank Rock Content	65% + with large, angular boulders 12" + numerous.	(2)	40 to 65%, mostly small boulders to cobble 6-12".	(4) 3 circled	20 to 40%, with most in the 3-6" diameter class.	(6)	<20% rock fragments of gravel sizes, 1-3" or less.	
Obstructions Flow Deflectors Sediment Traps	Rocks, old logs firmly embedded. Flow pattern of pool & riffles stable without cutting or deposition.	(2)	Some present, causing erosive cross currents and minor pool filling. Obstructions and deflectors newer and less firm.	(4) 3 circled	Moderately frequent, moderately unstable obstructions & deflectors move with high water causing bank cutting and filling of pools.	(6)	Frequent obstructions and deflectors cause bank erosion yearlong. Sed. traps full, channel migration occuring.	
Cutting	Little or none evident. Infrequent raw banks less than 6" high generally.	(4)	Some, intermittently at outcurves & constrictions. Raw banks may be up to 12".	(8) 7 circled	Significant. Cuts 12"-24" high. Root mat overhangs and sloughing evident.	(12)	Almost continuous cuts, some over 24" high. Failure of overhangs frequent.	[illegible]
Deposition	Little or no enlargement of channel or point bars.	(4)	Some new increase in bar formation, most from coarse gravels.	(8) 6 circled	Moderate deposition of new gravel & coarse sand on old and some new bars.	(12)	Extensive deposits of predominately fine particles. Accelerated bar development.	[illegible]
BOTTOM								
Rock Angularity	Sharp edges and corners, plane surfaces roughened.	(1)	Rounded corners & edges, surfaces smooth & flat.	(2) circled	Corners & edges well rounded in two dimensions.	(3)	Well rounded in all dimensions, surfaces smooth.	
Brightness	Surfaces dull, darkened, or stained. Gen. not "bright".	(1)	Mostly dull but may have up to 35% bright surfaces.	(2)	Mixture, 50-50% dull and bright, ± 15%, ie 35-65%.	(3) circled	Predominately bright, 65% +, exposed or scoured surfaces.	
Consolidation or Particle Packing	Assorted sizes tightly packed and/or overlapping.	(2)	Moderately packed with some overlapping.	(4) circled	Mostly a loose assortment with no apparent overlap.	(6)	No packing evident. Loose assortment, easily moved.	
Bottom Size Distribution & Percent Stable Materials	No change in sizes evident. Stable materials 80-100%.	(4)	Distribution shift slight. Stable materials 50-80%.	(8) circled	Moderate change in sizes. Stable materials 20-50%.	(12)	Marked distribution change. Stable materials 0-20%.	[illegible]
Scouring and Deposition	Less than 5% of the bottom affected by scouring and deposition.	(6) 8 circled	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.	(12)	30-50% affected. Deposits & scour at obstructions, constrictions, and bends. Some filling of pools.	(18)	More than 50% of the bottom in a state of flux or change nearly yearlong.	[illegible]
Clinging Aquatic Vegetation (Moss & Algae)	Abundant. Growth largely moss like, dark green, perennial. In swift water too.	(1)	Common. Algal forms in low velocity & pool areas. Moss here too and swifter waters.	(2)	Present but spotty, mostly in backwater areas. Seasonal blooms make rocks slick.	(3) circled	Perennial types scarce or absent. Yellow-green, short term bloom may be present.	
	COLUMN TOTALS →	14	→	45	→	6	→	

Add the values in each column for a total reach score here. (E. 14 + G. 45 + F. 6 + P. 0 = 65).

Reach score of: <38=Exellent, 39-76=Good, 77-114=Fair, 115+=Poor.

F[illegible] 1 2500-5 (6[illegible]

OVER

Stream Name: Ramsey Creek **Reach:** 0-1 **Date:** 6/14/

Width: 15 ft. (estimate) **Depth:** 1 foot (estimate) **Velocity:** 5 fps (est.) **Volume:** 94

Gradient: 8% (estimate) **Temperature:** 5°c (est.) **Turbidity:** Clear (es

Bottom Materials:

Boulders (>12") and large rubble were the major components of the channel bottom. Bed rock was also commo and contributed to the stability (good) of this reach. Fine and course gravels were generally present only in the larger pools and occassional on the stream edges. The gravels were accompanied with silt/sand deposit

Streambank Vegetation:

Good Age-class and species diversity in riparian zone. major overstory component was mature Cedar with Alder and red maple dense along the stream banks. Cottonwood and Sub-Alpine Fir were common overstory. Clumps of honeysuckle & water hemlock were common on the upper banks

Channel Stability: Stability was good to very good largely due to the boulder and bed rock component in the channel bottom providing for a h percentage of stable materials. Scouring and deposition was minor. Channel Capacity was adequate with very good bank protection due to diversi and density of vegetative cover.

Aquatic Habitats:

Resident habitat rated only moderate due to lac of quality pools and good instream cover. Spawning habitat was poor due to lack of fine and course gravels. The combination of high H_2O vel lack of water breaks, and steeper gradient was not condusive to gravel deposition in this reach.

Management Considerations:

1) Quality pools were limited, but more quality pools could be produced by the introduction of downed timber. The bank rock content, bank vegetation, and low frequenty of bank overflows indicate that such imprivements should be pos A 15% increase in pools would be desireable, Spawning habitat would also im rove but this alteration. A field evaluation should be undertaken to establish ific improvements.

2) The riparian zone appeared to be in a good condition and does not need alterat at this time. The sensitive zone for this reach extends approximately 60 feet from e bank. Field inspection will clarity this area.

STREAM NUMBER & NAME: Ramsey Creek STATIONS: 1-2 DATE: 6-14-78

AVG. WIDTH: 20' * AVG. DEPTH: + + = 1 FT. * (4) VELOCITY: 4 FT/SEC

VOLUME: 100 cfs TEMPERATURE: 8° C * GRADIENT: 3% *

STABILITY RATING: 77 (FAIR) TURBIDITY: [Clear] - Milky - Muddy

% POOL: 50 % RIFFLE: 50 % RUN: — % GLIDE: —

POOL CLASSES: % CLASS 1: 10 % CLASS 2: 35 % CLASS 3: 50 % CLASS 4: 5

BOTTOM MATERIALS:	Very Abundant (>70%)	Abundant (41 to 70%)	Common (11 to 40%)	Present (<10%)	None 0
Organic Debris:			✓		
Clay/Silt:				✓	
Sand:				✓	
Fine Gravel (0.1 to 1"):			✓		
Coarse Gravel (1 to 3"):			✓		
Small Rubble (3 to 6"):			✓		
Large Rubble (6 to 12"):		✓			
Boulders (>12"):		✓			
Bed Rock:				✓	
AQUATIC VEGETATION:			✓		

INSTREAM COVER: - [Good] - Fair - Poor - None

Cover Types (Indicate relative importance A>C>P)
Logs A Rocks C Bottom Color C
Undercut Banks P Water Color —
Choppy Surface C Overhanging Vegetation: P

BANK COVER: - Good [-] Fair - Poor - None

Major Plant Species: A - Cedar, Ferns, Devils Club
C - Spruce, WP, Cottonwood, Soloman Seal, Bead-lily, Trillium, Goldenthr
P - DF, Larch, GF, moss, Red Maple, Thimbleberry

FISH FOOD ORGANISMS: >25/ft² 16-25/ft² [6-15/ft²] 1-5/ft² None

Food Types: Caddisflies A Mayflies: C Stoneflies: P Diptera ____
(Indicate relative abundance A>C>P) Snails: ____ Leeches: ____ Others: ____

SPAWNING HABITAT: Very Good - Good - Fair - [Poor] - None

% Gravel >50% 35-50% 20-34% [10-19%] <10%

Velocity (in gravel areas) ←——— 0.5 to 3 fps ———→ <0.5 or >3 fps
Water Depth (in gravel areas): ←——— 0.3 to 3 ft. ———→ <0.3 or >3 fps
Are there silt or sand deposits in/on the spawning gravels? YES

VALLEY BOTTOM TYPE: >300 ft. — 100-300 ft. ✓ — <100 ft.

LAND FORM GRADIENT: <5% [5-10%] 11-20% 21-30% 30%

LIMITING FACTORS: Lack of Spawning Beds, Divergent Channel with clay-silt deposit Gravels

ADDITIONAL OBSERVATIONS:
Overmature Riparian Zone - High blowdown potential in this area.
Instream debris heavy in areas - Thinning desirable (See Map)

INVESTIGATOR: M. Rhodes, A. Bratkovich

* = Estimates

Ramsey Creek.
Reach 1-2
6-14-78

R-1 STREAM CHANNEL STABILITY FIELD EVALUATION FORM

Item Rated	EXCELLENT		GOOD		FAIR		POOR	
UPPER BANKS								
Landform Slope	Bank slope gradient <30%	(2) circled	Bank slope gradient 30-40%	(4)	Bank slope gradient 40-60%	(6)	Bank slope gradient 60% +	(8)
Mass Wasting (Existing or Potential)	No evidence of past or potential for future mass wasting into channels.	(3)	Infrequent and/or very small. Mostly healed over. Low future potential.	(6) circled	Moderate frequency & size, with some raw spots eroded by water during high flows.	(9)	Frequent or large, causing sediment nearly yearlong OR imminent danger of same.	(12)
Debris Jam Potential (Floatable Objects)	Essentially absent from immediate channel area.	(2)	Present but mostly small twigs and limbs.	(4)	Present, volume and size are both increasing.	(6)	Moderate to heavy amounts, predominantly larger sizes.	(8)
Bank Protection from Vegetation	90% + plant density. Vigor and variety suggests a deep, dense root mass.	(3)	70-90% density. Fewer plant species or lower vigor suggests a less dense or deep root mass.	(6) 5 circled	50-70% density. Lower vigor and still fewer species form a somewhat shallow and discontinuous root mass.	(9)	<50% density plus fewer species & less vigor indicate poor, discontinuous, and shallow root mass.	(12)
LOWER BANKS								
Channel Capacity	Ample for present plus some increases. Peak flows contained. W/D ratio <7.	(1)	Adequate. Overbank flows rare. Width to Depth (W/D) ratio 8-15.	(2)	Barely contains present peaks. Occasional overbank floods. W/D ratio 15-25.	(3) circled	Inadequate. Overbank flows common. W/D ratio >25.	(4)
Bank Rock Content	65% + with large, angular boulders 12" + numerous.	(2)	40 to 65%, mostly small boulders to cobble 6-12".	(4) circled	20 to 40%, with most in the 3-6" diameter class.	(6)	<20% rock fragments of gravel sizes, 1-3" or less.	(8)
Obstructions Flow Deflectors Sediment Traps	Rocks, old logs firmly embedded. Flow pattern of pool & riffles stable without cutting or deposition.	(2)	Some present, causing erosive cross currents and minor pool filling. Obstructions and deflectors newer and less firm.	(4)	Moderately frequent, moderately unstable obstructions & deflectors move with high water causing bank cutting and filling of pools.	(6) 5 circled	Frequent obstructions and deflectors cause bank erosion yearlong. Sed. traps full, channel migration occuring.	(8)
Cutting	Little or none evident. Infrequent raw banks less than 6" high generally.	(4)	Some, intermittently at outcurves & constrictions. Raw banks may be up to 12".	(8) 7 circled	Significant. Cuts 12"-24" high. Root mat overhangs and sloughing evident.	(12)	Almost continuous cuts, some over 24" high. Failure of overhangs frequent.	(16)
Deposition	Little or no enlargement of channel or point bars.	(4)	Some new increas in bar formation, most from coarse gravels.	(8)	Moderate deposition of new gravel & coarse sand on old and some new bars.	(12) 9 circled	Extensive deposits of predominately fine particles. Accelerated bar development.	(16)
BOTTOM								
Rock Angularity	Sharp edges and corners, plane surfaces roughened.	(1)	Rounded corners & edges, surfaces smooth & flat.	(2) circled	Corners & edges well rounded in two dimensions.	(3)	Well rounded in all dimensions, surfaces smooth.	(4)
Brightness	Surfaces dull, darkened, or stained. Gen. not "bright".	(1)	Mostly dull but may have up to 35% bright surfaces.	(2) circled	Mixture, 50-50% dull and bright, ± 15%, ie 35-65%.	(3)	Predominately bright, 65% +, exposed or scoured surfaces.	(4)
Consolidation or Particle Packing	Assorted sizes tightly packed and/or overlapping.	(2)	Moderately packed with some overlapping.	(4) circled	Mostly a loose assortment with no apparent overlap.	(6)	No packing evident. Loose assortment, easily moved.	(8)
Bottom Size Distribution & Percent Stable Materials	No change in sizes evident. Stable materials 80-100%.	(4)	Distribution shift slight. Stable materials 50-80%.	(8)	Moderate change in sizes. Stable materials 20-50%.	(12) 9 circled	Marked distribution change. Stable materials 0-20%.	(16)
Scouring and Deposition	Less than 5% of the bottom affected by scouring and deposition.	(6)	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.	(12) 10 circled	30-50% affected. Deposits & scour at obstructions, constrictions, and bends. Some filling of pools.	(18)	More than 50% of the bottom in a state of flux or change nearly yearlong.	(24)
Clinging Aquatic Vegetation (Moss & Algae)	Abundant. Growth largely moss like, dark green, perennial. In swift water too.	(1)	Common. Algal forms in low velocity & pool areas. Moss here too and swifter waters.	(2) circled	Present but spotty, mostly in backwater areas. Seasonal blooms make rocks slick.	(3)	Perennial types scarce or absent. Yellow-green, short term bloom may be present.	(4)
COLUMN TOTALS →		2		42		26		

Add the values in each column for a total reach score here. (E. 2 + G. 42 + F. 26 + P. 7 = 77).

Re[illegible] score of: <38=Exellent, 39-76=Good, 77-114=Fair (boxed), 115+=Poor.

OVER

Stream Name: Ramsey Creek   Reach: 1 to 2   Date: 6/14/

Width: 20 FT. (est.)   Depth: 1 FT. (est.)   Velocity: 4 FT/SEC (est)   Volume: 100 (es

Gradient: 5% (est.)   Temperature: 8°C (est)   Turbidity: CLEAR

Bottom Materials: Large rubble and boulders were the major channel bottom materials with bedrock common in a couple area's. Fine and course gravels were present only intermittantly along this reach. Organic deb mostly in the form of logs were common in the stream bed. Clay/silt and sand deposits were present.

Streambank Vegetation: Bank cover was moderate along this reach. The cover type was generally large, mature cedar with Ferns and Devils Club underneath. Spruce, WP, Cottonwood were common in the overstory - as was Bead-lily, Soloman seal, Trillium, & Golden thread along the banks. DF, GF, Larch & Red maple were also sited. Alder was dense and the primary bank component in the Avalanche areas (See MA

Channel Stability: this reach received a 77 (FAIR-GOOD) stability rating. Heavy blowdown of mature timber in the upper most part of this reach has caused a diverging channel fo approx. 1/8 mile. Debris jam potential (predominantly larger sizes) is heavy in area. (Particularly the Avalanche areas - See map). Occasional overbank floods and bank cutti was observed.

Aquatic Habitats: Resident habitat received a very high rating mainly due to the 50-50 Pool-riffle ratio, quality pools, and good instream cover in the form of logs.

Spawning habitat received a moderate rating but in general was poor due to low amounts of fine & course gravels. It should be not that at the upper most end of reach 1-2, directly below the point whe the bridge & road cross the stream, a large amount of gravel has been deposited along a 50' section of the stream. This looked very desira for spawning, although atypical of the reach.

Management Considerations:

1) The riparian zone is an overmature cedar/spruce stand with little deciduous bank vegetation. Selective cutting in this area would be desireable to increase the divers of the vegetation. The sensitive zone for this reach extends out approximately 70-90 fee

2) Silt is deposited on the spawning gravels which will inhibit spawning succ L[illegible] can be done to correct this expect by removing excessive blowdown in the channel.

3) There is excessive blowdown in the stream at the indicated points. Some thinning of this debris would be desireable to decrease stream braiding. The channel splits near station 2 due to blowdown.

STREAM NUMBER & NAME: RAMSEY CREEK STATIONS: 2-3 + DATE: 6-14-78

AVG. WIDTH: 18' * AVG. DEPTH: + + = 1.5' * VELOCITY: 4 fps *
4

VOLUME: 135 cfs TEMPERATURE: 5° C * GRADIENT: 9%

STABILITY RATING: 62 TURBIDITY: [Clear] - Milky - Muddy

% POOL: 50 % RIFFLE: 50 % RUN: ____ % GLIDE: ____

POOL CLASSES: % CLASS 1: 25 % CLASS 2: 30 % CLASS 3: 35 % CLASS 4: 10

BOTTOM MATERIALS:	Very Abundant (>70%)	Abundant (41 to 70%)	Common (11 to 40%)	Present (<10%)	None 0
Organic Debris:				✓	
Clay/Silt:				✓	
Sand:				✓	
Fine Gravel (0.1 to 1"):			✓		
Coarse Gravel (1 to 3"):			✓		
Small Rubble (3 to 6"):			✓		
Large Rubble (6 to 12"):			✓		
Boulders (>12"):		✓			
Bed Rock:		✓			
AQUATIC VEGETATION:		✓			

INSTREAM COVER: - [Good] - Fair - Poor - None

Cover Types (Indicate relative importance A>C>P)
Logs C Rocks C Bottom Color High C
Undercut Banks P Water Color —
Choppy Surface A Overhanging Vegetation: P

COVER: - [Good] - Fair - Poor - None

Major Plant Species:
A - Hemlock, Ferns, moss, beadlily, cedar
C - Spruce, WP, Alder, small-yellow violet, devil's club
P - sub-alpine Fir, Cottonwood, mensesii, red maple

FISH FOOD ORGANISMS: >25/ft² 16-25/ft² 6-15/ft² [1-5/ft²] None

Food Types: Caddisflies C Mayflies: P Stoneflies: — Diptera —
(Indicate relative abundance A>C>P) Snails: — Leeches: — Others: ____

SPAWNING HABITAT: Very Good - Good - Fair - [Poor] - None

% Gravel >50% 35-50% 20-34% [10-19%] <10%

Velocity (in gravel areas) ←— 0.5 to 3 fps —→ <0.5 or >3 fps
Water Depth (in gravel areas): ←— 0.3 to 3 ft. —→ <0.3 or >3 fps
Are there silt or sand deposits in/on the spawning gravels? YES

VALLEY BOTTOM TYPE: >300 ft. 100-300 ft. <100 ft. ✓

LAND FORM GRADIENT: <5% 5-10% 11-20% [21-30%] >30%

LIMITING FACTORS: High water velocity, lack of spawning gravels

ADDITIONAL OBSERVATIONS: slight increase in gradient @ lower end of reach

INVESTIGATOR:
BRATKOVICH
RHODES

* = Estimates

Reach 3-4 · 6·14·78

R-1 STREAM CHANNEL STABILITY FIELD EVALUATION FORM

Item Rated	Stability Indicators by Classes							
	EXCELLENT		GOOD		FAIR		POOR	
UPPER BANKS								
Landform Slope	Bank slope gradient <30%	(2)	Bank slope gradient 30-40%	(4) [circled]	Bank slope gradient 40-60%	(6)	Bank slope gradient 60% +	(8
Mass Wasting (Existing or Potential)	No evidence of past or potential for future mass wasting into channels.	(3)	Infrequent and/or very small. Mostly healed over. Low future potential.	(6) [circled]	Moderate frequency & size, with some raw spots eroded by water during high flows.	(9)	Frequent or large, causing sediment nearly yearlong OR imminent danger of same.	(12
Debris Jam Potential (Floatable Objects)	Essentially absent from immediate channel area.	(2)	Present but mostly small twigs and limbs.	(4) 5	Present, volume and size are both increasing.	(6)	Moderate to heavy amounts, predominantly larger sizes.	(8
Bank Protection from Vegetation	90% + plant density. Vigor and variety suggests a deep, dense root mass.	(3) 5	70-90% density. Fewer plant species or lower vigor suggests a less dense or deep root mass.	(6)	50-70% density. Lower vigor and still fewer species form a somewhat shallow and discontinuous root mass.	(9)	<50% density plus fewer species & less vigor indicate poor, discontinuous, and shallow root mass.	(12
LOWER BANKS								
Channel Capacity	Ample for present plus some increases. Peak flows contained. W/D ratio <7.	(1)	Adequate. Overbank flows rare. Width to Depth (W/D) ratio 8-15.	(2) [circled]	Barely contains present peaks. Occasional overbank floods. W/D ratio 15-25.	(3)	Inadequate. Overbank flows common. W/D ratio >25.	(4
Bank Rock Content	65% + with large, angular boulders 12" + numerous.	(2) 3	40 to 65%, mostly small boulders to cobble 6-12".	(4)	20 to 40%, with most in the 3-6" diameter class.	(6)	<20% rock fragments of gravel sizes, 1-3" or less.	(8
Obstructions Flow Deflectors Sediment Traps	Rocks, old logs firmly embedded. Flow pattern of pool & riffles stable without cutting or deposition.	(2) 3	Some present, causing erosive cross currents and minor pool filling. Obstructions and deflectors newer and less firm.	(4)	Moderately frequent, moderately unstable obstructions & deflectors move with high water causing bank cutting and filling of pools.	(6)	Frequent obstructions and deflectors cause bank erosion yearlong. Sed. traps full, channel migration occuring.	(8
Cutting	Little or none evident. Infrequent raw banks less than 6" high generally.	(4) 6	Some, intermittently at outcurves & constrictions. Raw banks may be up to 12".	(8)	Significant. Cuts 12"-24" high. Root mat overhangs and sloughing evident.	(12)	Almost continuous cuts, some over 24" high. Failure of overhangs frequent.	(16
Deposition	Little or no enlargement of channel or point bars.	(4) 6	Some new increas in bar formation, most from coarse gravels.	(8)	Moderate deposition of new gravel & coarse sand on old and some new bars.	(12)	Extensive deposits of predominately fine particles. Accelerated bar development.	(16
BOTTOM								
Rock Angularity	Sharp edges and corners, plane surfaces roughened.	(1)	Rounded corners & edges, surfaces smooth & flat.	(2) [circled]	Corners & edges well rounded in two dimensions.	(3)	Well rounded in all dimensions, surfaces smooth.	(4
Brightness	Surfaces dull, darkened, or stained. Gen. not "bright".	(1)	Mostly dull but may have up to 35% bright surfaces.	(2) [circled]	Mixture, 50-50% dull and bright, ± 15%, ie 35-65%.	(3)	Predominately bright, 65% +, exposed or scoured surfaces.	(4
Consolidation or Particle Packing	Assorted sizes tightly packed and/or overlapping.	(2) [circled]	Moderately packed with some overlapping.	(4)	Mostly a loose assortment with no apparent overlap.	(6)	No packing evident. Loose assortment, easily moved.	(8
Bottom Size Distribution & Percent Stable Materials	No change in sizes evident. Stable materials 80-100%.	(4) 6	Distribution shift slight. Stable materials 50-80%.	(8)	Moderate change in sizes. Stable materials 20-50%.	(12)	Marked distribution change. Stable materials 0-20%.	(16
Scouring and Deposition	Less than 5% of the bottom affected by scouring and deposition.	(6) 8	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.	(12)	30-50% affected. Deposits & scour at obstructions, constrictions, and bends. Some filling of pools.	(18)	More than 50% of the bottom in a state of flux or change nearly yearlong.	(24
Clinging Aquatic Vegetation (Moss & Algae)	Abundant. Growth largely moss like, dark green, perennial. In swift water too.	(1)	Common. Algal forms in low velocity & pool areas. Moss here too and swifter waters.	(2) [circled]	Present but spotty, mostly in backwater areas. Seasonal blooms make rocks slick.	(3)	Perennial types scarce or absent. Yellow-green, short term bloom may be present.	(4
	COLUMN TOTALS →	39	→	23	→	0	→	0

Add the values in each column for a total reach score here. (E. 37 + G. 21 + F. 3 + P. 0 = 62).

Reach cf: <38=Exellent, 39-76=Good [circled], 77-114=Fair, 115+=Poor.

Form 2500-5 (6-7

OVER

Stream Name: Ramsey Creek Reach: 2 to 3+ Date: 6/11/7

Width: 18 FT. (Est.) Depth: 1.5 FT. (Est.) Velocity: 4 fps (Est) Volume: 135 (Est

Gradient: 9% (Est) Temperature: 5°c (Est) Turbidity: CLEAR

Bottom Materials: Channel bottom is comprised mainly of boulder and bed rock with large and small rubble common. Fine and course gravels were limited in quantity with clay/silt - sand deposits present. Aquatic vegetation was abundant being present mostly on the bedrock in the stream bottom.

Streambank Vegetation: Good bank cover along this reach. A mature hemlock, cedar overstory with Ferns and beadlily on the forest floor. Alder and devil's club was common along the banks with Spruce & WP also common in the overstory. Sub-alpine Fir, Cottonwood, red maple, & menseseii were also sited

Channel Stability: Rated at 62 (GOOD - VERY GOOD). High percentage of bed rock and boulders with 80% stable bottom materials. Cutting and Deposition was minimal. Bank rock content was very good with boulders being numerous. Plant density on stream banks was good.

Aquatic Habitats: Resident Habitat rated high (22). Good pool - riffle ratio (50-50) with many quality pools. Instream cover good largely due to deep pools and choppy surface (A slight cascade area exists at lower end of reach - This did not appear to be a fish block). Bank cover showed good plant density. Fish Food organisms were minimal probably due to boulder - bedrock content and high H_2O velocity.

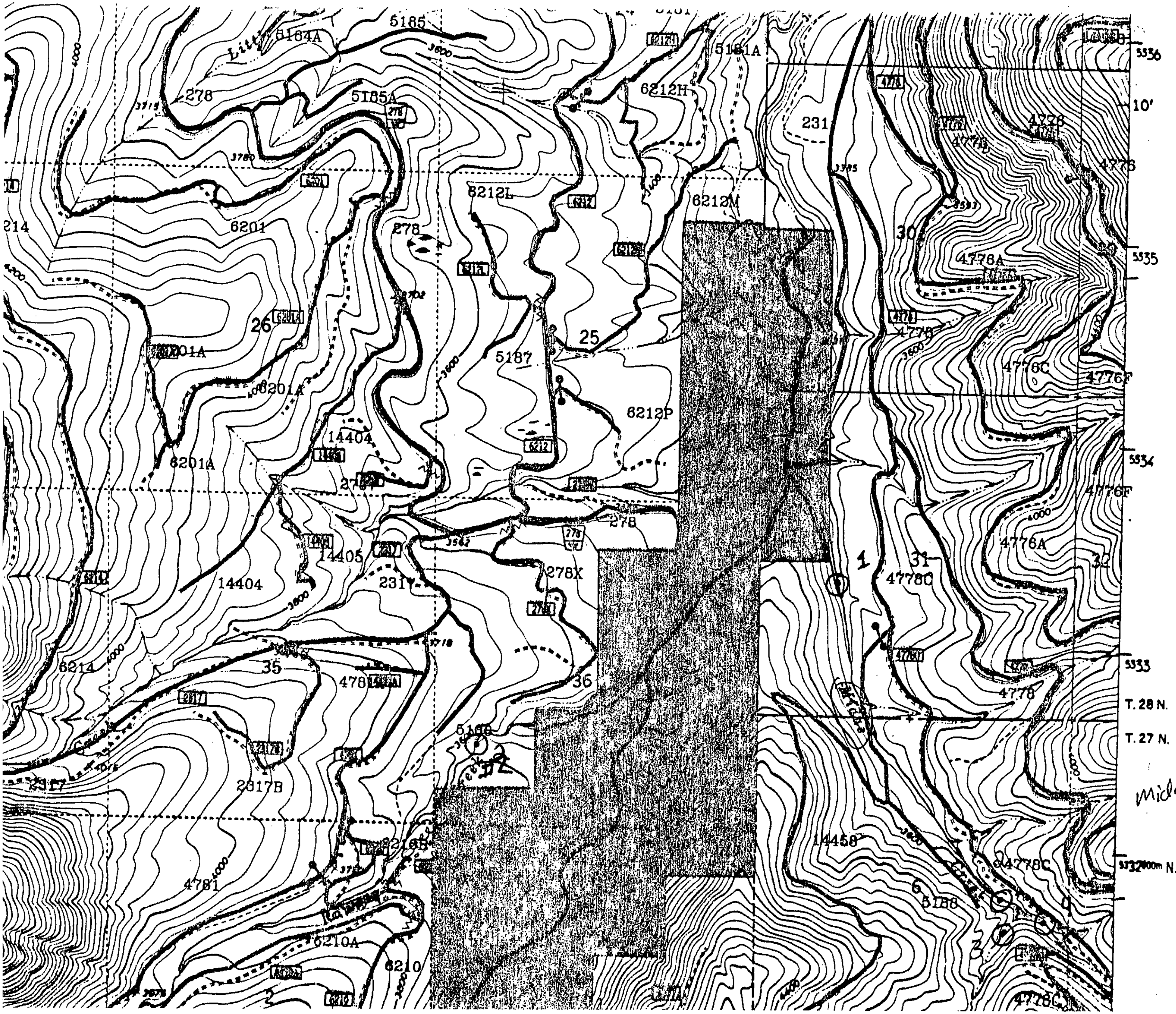
Spawning Habitat rated moderate (11) but was generally poor due to minimal spawning gravels. The combination of high H_2O velocity & volume along with the steep gradient (9%) was not condusive to gravel deposition in this reach.

Management Considerations:

1) The riparian zone appeared healthy and does not need management at this time. The sensitive zone extends to approximately 100 FT from either bank.

2) Instream food organism were limited but management could not increase the sup

3) The reach was in a cascading condition so its suitability rating may be overestimated.


5185
5184A
278
5185A
6201
214
26
6201A
14404
14405
14404
231
35
4781
2317
2317B
4781
6210A
6210
6214
6212L
6212H
5181A
6212M
278
5187
25
6212P
278
278X
36
5188
231
30
4776A
4776
4776C
4776F
4776A
31
4778C
32
4778
14458
6
5188
4778C
5336
10'
5335
5334
5333
T. 28 N.
T. 27 N.
5332000m N.

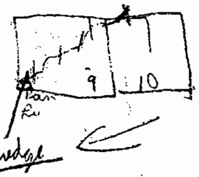
Midas 1 → 4

Ramsey Creek 7/21/77

T 27N R31W S. Sec. 10 & 9

FLOW - 10-15

Barriers



1. [illegible]

2. [illegible]

3. [illegible] dam

— snuch
downfall braided channel — lower
about 10 [illegible]

Channel stability poor in upper part of Sect. 9 — good - rest of way

Bank Cover — fair-poor

Substrate 20-40% boulder
30-60% rubble } Sect 10 + first half of 9
5% gravel

① Ramsey CR [illegible]

Temp - 53° [illegible]

Flow = 200 ft

Channel Stability [illegible]

Bank Cover - fair [illegible] [illegible] poor [illegible]

Substrate - 15% Boulder
70% Rubble
10% Gravel
5% Sand

Spawning gravel - <5%

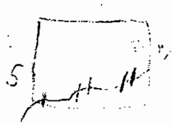
Pool development - fair

7/21/77 Ramsey Creek

T27N R31W S 3

FLOW 15 [illegible]

BARRIERS



① [illegible]

② [illegible]

③ [illegible]

④ [illegible]

⑤ [illegible]

Channel [illegible] — [illegible] 3 jams

Bank [illegible] — Poor

Substrate 70-95% [illegible] + rubble

[illegible] 1-2% — [illegible]

[illegible] — fair

T27N R31W S. 2

Spawning gravel

2-3% in lower half of 9+10

15-20% in upper half of 9

sorted above silt jams

Pool development - fair

Chan

flag

from end

Pool development - good

No special problems

LIBBY RANGER DISTRICT

STREAM CHANNEL CLASSIFICATION DATA (ROSGEN 1994)

STREAM Parman 1 DATE 8/6/97
REACH ID #2 CREW Weir Dick Steele
CHANNEL TYPE F3b REVIEWED BY DA 7/1/03

F3b

1)THREAD-

- Single Without Side Channels [X]
- Single With Side Channels [ ]
- Multiple Channels [ ]

2)ENTRENCHMENT-

Bankfull Widths 23.5/24.8/28.7/29.1/17.9/24.8/18.3/24/24.1/22.2

Bankfull Width(@ station) 22.2 Average bankfull width 23.74

Floodprone width (@ station x-section) 27.0

Entrenchment ratio (floodprone width / bankfull width @ station) 1.3

3)W/D RATIO-

Bankfull Depths 0/1.75/1.05/1.45/2.0/2.1/2.2/2.15/2.0/.75

Average Bankfull Depth 1.45

Width to Depth Ratio (BF width @ station) / (Average BF Depth) 15.3

4)SINUOSITY-

252 37.2 57

Stream Length (measured along thalweg) 489

Reach Length ("straight line" distance) 346.8

Sinuosity (Stream Length) / (Reach Length) 1.4

5)GRADIENT-

MEASURED AT WATER SURFACE

Elevation Change 1.9 1.5	/ Distance 42 88	Gradient(%) 4.5 1.7
Elevation Change 2.4	/ Distance 55	Gradient(%) 4.4
Elevation Change .6	/ Distance 30	Gradient(%) 2.0
Elevation Change 2.9 2.0 2.3	/ Distance 105 62 107	Gradient(%) 2.8 3.2 2.1

AVERAGE REACH GRADIENT (%) 2.8

6)PARTICLE SIZE DISTRIBUTION-

Dominant size class (mm) 64-128 small cobble

D 50 (mm) 70

Comments

7)DEPOSITIONAL PATTERN-

- Point Bars [ ]
- Point Bars With Few Mid-Channel Bars [ ]
- Many Side-Channel Bars [ ]
- Side Or Diagonal Bars [ ]
- Channel Composed of Bars/Islands [ ]

8)BED FEATURES-

- Cascade [ ]
- Step- Pool [ ]
- Plane Bed/Glide [ ]
- Pool-Riffle [X]
- Other (ie Transition, Beaver Dams etc) [ ]

COMMENTS: (Write on back of form) Field Map (Attach or draw on back of form)

Revised 2/97

Kootenai National Forest ... Libby Ranger District
LEVEL III FISH HABITAT SURVEY

Stream: Poorman #2
Reach: reference: Y/N
Date: 8-6-97
Elevation(ft)
REACH LENGTH: 346.8

Survey crew: Wess Pick Steele
Rosgen channel type: F3b
Units: English / metric
Riparian width (est) (ft)

RIFFLE BANKFULL WIDTHS (10)

23.5	24.8	28.7	29.1	17.9
24.0	18.3	24	24.1	22.2

AVERAGE RIFFLE WIDTH = 23.74
REACH LENGTH (avg x 20) = 474.8 (489)
--channels <10' } MEASURE ALL RIFFLES; MEASURE ALL POOLS
--channels >10' } MEASURE EVERY OTHER RIFFLE; MEASURE ALL POOLS

POOLS

Max Depth	Pool tail Max Depth	% Pool tail fines (<7mm)	Pool Width	Pool Length
2.4	.8	0	12	27

RIFFLES

UNSTABLE (ft) LEFT BANK	UNSTABLE (ft) RIGHT BANK	RIFFLE LENGTH (ft)
0	0	72
0		42
0	0	105
0	0	62
0	0	107
0	0	48
0	0	30

% pocket pools in reach = 5
∑ POOL LENGTH = 27 (ft)
Pool Frequency = (reach length / # pools) = 1 pool / 489 (ft)
AVERAGE % FINES IN POOL TAILS = 0

∑ RIFFLE LENGTH = 462
% stable banks in riffles = 100
Width / depth ratio - RIFFLE = 15.3

LARGE WOODY DEBRIS

TYPE: Diameter:	live > bfw *** > 6"	live > bfw < 6"	dead > bfw *** > 6"	dead > bfw < 6"		live < bfw > 6"	live < bfw < 6"	dead < bfw > 6"	dead < bfw < 6"
Rootwad									
Embedded			•••						
Suspended		•	⊠ •••	•				•••	
Recruiting	••	•				•		••	
Ramp			⊠			•		••••	••••
Misc.									

bfw = bankfull width

GRADIENT 1.9 42 4.5
Pool/Riffle sets.

Δelev	stream distance	% gradient
1.5	88	1.7
2.4	55	4.4
.6	30	2.0
2.9	105	2.8

(Δelev / dist)(100) = %gradient
Rosgen reach gradient = 2.8 %

2.0 62 3.2
2.3 107 2.1

LWD FREQUENCY = (REACH LENGTH) / (TOTAL NUMBER OF PIECES WITH *** IN columns) = 27

MISC COMMENTS:
SNORKEL SURVEY COMPLETED ?
CORE SAMPLES COLLECTED ? Y/N % FINES
PICTURES: (frame #) / / /
CAMERA #

CHANNEL IMPACTS: (circle if applicable) grazing / timber harvest / roads / debris removal / other

Comments: You spotted Log jams

NRC code:
Riparian width (ft)
Riparian habitat type:
Valley bottom unit:
Geology:

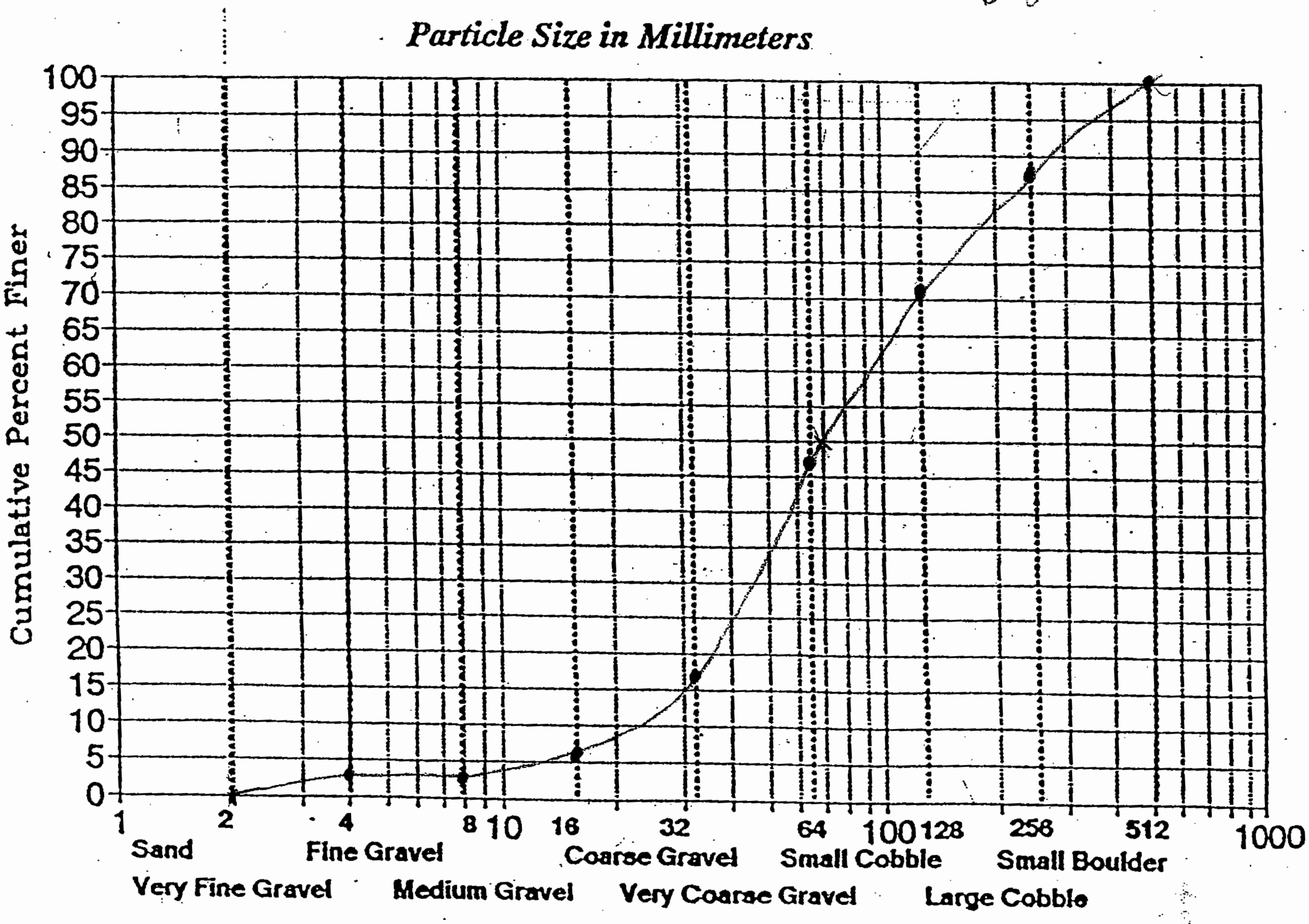
Revised 2/97

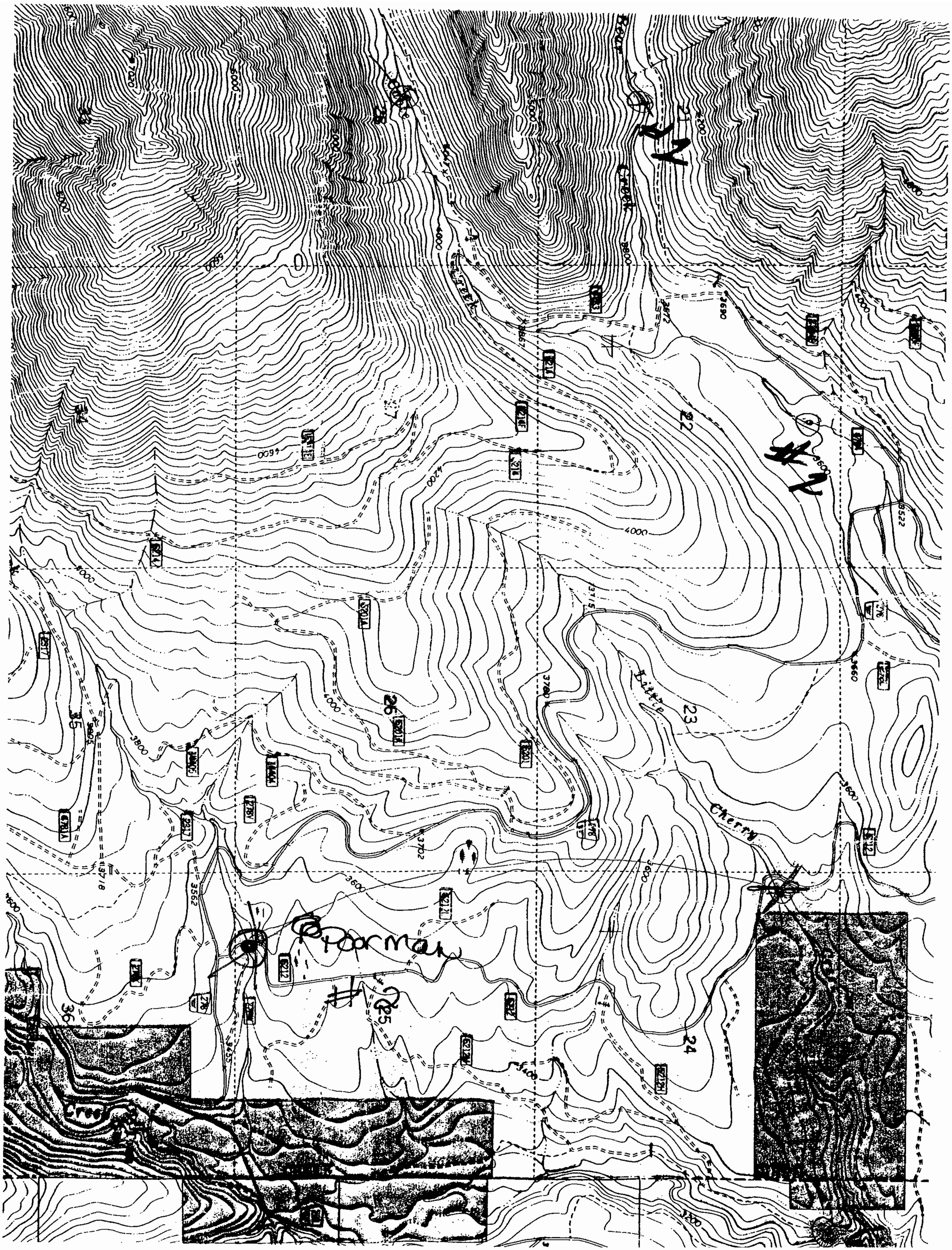
Little Cherry #1 ← ?

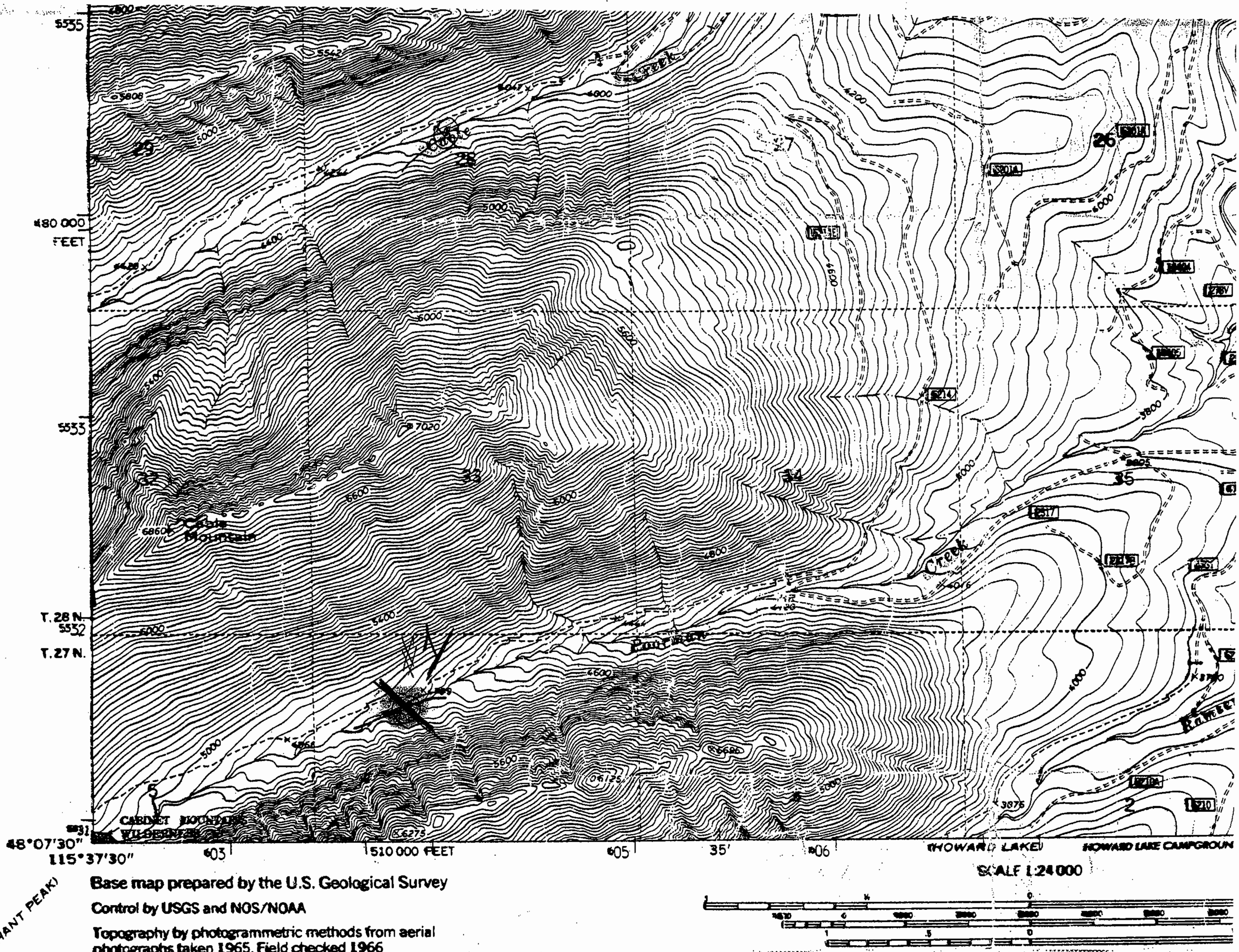
PEBBLE COUNT INFORMATION

Size (mm)	Particle	Pool	Riffle	Total	% class	Cumm. %
0 - 2	silt - crse sand			0		
2 - 4	v. fine gravel		∴	3	3.1	3.1
4 - 8	fine gravel			0		3.1
8 - 16	med. gravel		∴	3	3.1	6.2
16 - 32	course gravel			11	11.5	17.7
32 - 64	v. course gravel			25	26.0	43.7
64 - 128	small cobble			27	28.1	71.8
128 - 256	large cobble			16	16.7	88.5
256 - 512	small boulder			11	11.5	100
512 - 1024	medium boulder					
1024 +	large boulder			/96		

$D_{50} = 70$ small cobble




Bear
Creek
Little
Cherry
#1
#2
4000
3600
3800



Base map prepared by the U.S. Geological Survey

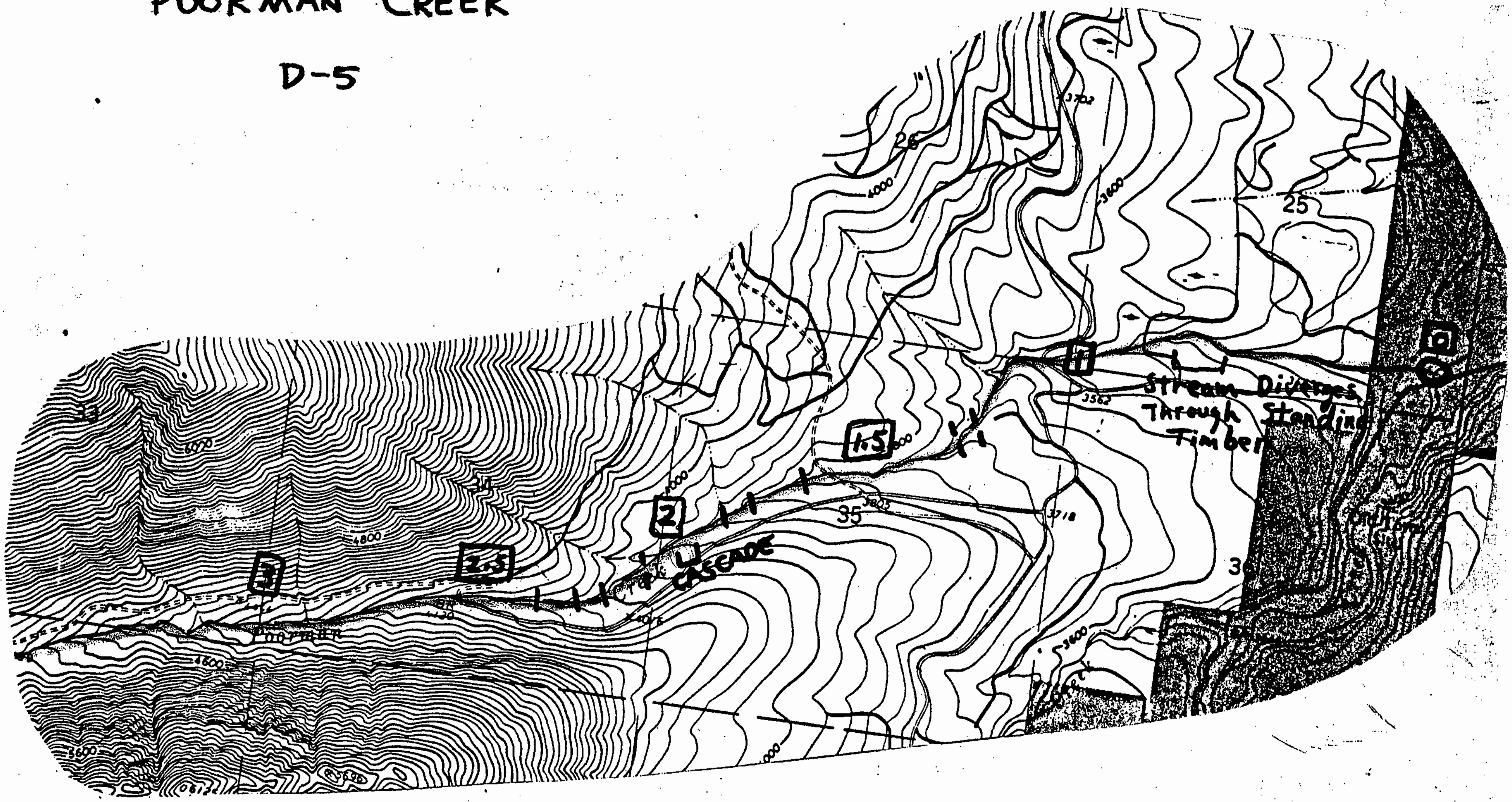
Control by USGS and NOS/NOAA

Topography by photogrammetric methods from aerial photographs taken 1965. Field checked 1966

S.REAM STABILITY
AND
FISH HABITAT INVENTORY
for

POORMAN CREEK

D-5



STREAM NUMBER & NAME: Poorman STATIONS: 0-1 DATE: 6-13-78

AVG. WIDTH: 20' * AVG. DEPTH: + + = .83' * VELOCITY: 3 fps *

VOL 62 cfs TEMPERATURE: 4 5°C * GRADIENT: 3% *

STABILITY RATING: 77 (Fair) TURBIDITY: (Clear) - Milky - Muddy

% POOL: 30 % RIFFLE: 70 % RUN: — % GLIDE: —

POOL CLASSES: % CLASS 1: 50 % CLASS 2: 15 % CLASS 3: 5 % CLASS 4: 30

BOTTOM MATERIALS:	Very Abundant (>70%)	Abundant (41 to 70%)	Common (11 to 40%)	Present (<10%)	None 0
Organic Debris:				✓	
Clay/Silt:				✓	
Sand:			✓		
Fine Gravel (0.1 to 1"):			✓		
Coarse Gravel (1 to 3"):			✓		
Small Rubble (3 to 6"):			✓		
Large Rubble (6 to 12"):		✓			
Boulders (>12"):			✓		
Bed Rock:				✓	
AQUATIC VEGETATION:			✓		

INSTREAM COVER: - (Good) - Fair - Poor - None

Cover Types (Indicate relative importance A>C>P)

Logs C Rocks A Bottom Color C

Undercut Banks P Water Color —

Choppy Surface A Overhanging Vegetation: C

BANK COVER: - (Good) - Fair - Poor - None

Major Plant Species:
A Cedar, R. Maple, Alder, ferns
C Larch, W Pine, D. Fir, Spruce, fairybells, devil's club, bead lily
P Cottonwood, red-stemmed dogwood, mosses, trillium

FISH FOOD ORGANISMS: (>25/ft²) 16-25/ft² 6-15/ft² 1-5/ft² None

Food Types: Caddisflies A Mayflies: C Stoneflies: C Diptera P ?

(Indicate relative abundance A>C>P) Snails: — Leeches: — Others: —

SPAWNING HABITAT: Very Good - Good - Fair - (Poor) - None

% Gravel >50% 35-50% 20-34% 10-19% <10%

Velocity (in gravel areas) ←— 0.5 to 3 fps —→ <0.5 or >3 fps

Water Depth (in gravel areas): ←— 0.3 to 3 ft. —→ <0.3 or >3 fps

Are there silt or sand deposits in/on the spawning gravels? Yes

VALLEY BOTTOM TYPE: ✓ >300 ft. 100-300 ft. <100 ft.

LAND FORM GRADIENT: (<5%) 5-10% 11-20% 21-30% >30%

LIMITING FACTORS: lack of water breaks, divergent channels with some deposition of silt,

ADDITIONAL OBSERVATIONS: seepage in some areas, overmature trees in riparian zone

INVESTIGATOR: Rhodes / Bratkovich

* = Estimates

D-5

Poorman
6·13·78

R-1 STREAM CHANNEL STABILITY FIELD EVALUATION FORM

Item Rated	Stability Indicators by Classes: EXCELLENT		GOOD		FAIR		POOR	
UPPER BANKS								
Landform Slope	Bank slope gradient <30%	(2) circled	Bank slope gradient 30-40%	(4)	Bank slope gradient 40-60%	(6)	Bank slope gradient 60% +	(8)
Mass Wasting (Existing or Potential)	No evidence of past or potential for future mass wasting into channels.	(3)	Infrequent and/or very small. Mostly healed over. Low future potential.	(6) crossed out, 5 circled	Moderate frequency & size, with some raw spots eroded by water during high flows.	(9)	Frequent or large, causing sediment nearly yearlong OR imminent danger of same.	(12)
Debris Jam Potential (Floatable Objects)	Essentially absent from immediate channel area.	(2)	Present but mostly small twigs and limbs.	(4)	Present, volume and size are both increasing.	(6) circled	Moderate to heavy amounts, predominantly larger sizes.	(8)
Bank Protection from Vegetation	90% + plant density. Vigor and variety suggests a deep, dense root mass.	(3), 4 circled	70-90% density. Fewer plant species or lower vigor suggests a less dense or deep root mass.	(6)	50-70% density. Lower vigor and still fewer species form a somewhat shallow and discontinuous root mass.	(9)	<50% density plus fewer species & less vigor indicate poor, discontinuous, and shallow root mass.	(12)
LOWER BANKS								
Channel Capacity	Ample for present plus some increases. Peak flows contained. W/D ratio <7.	(1)	Adequate. Overbank flows rare. Width to Depth (W/D) ratio 8-15.	(2)	Barely contains present peaks. Occasional overbank floods. W/D ratio 15-25.	(3) circled	Inadequate. Overbank flows common. W/D ratio >25.	(4)
Bank Rock Content	65% + with large, angular boulders 12" + numerous.	(2)	40 to 65%, mostly small boulders to cobble 6-12".	(4) circled	20 to 40%, with most in the 3-6" diameter class.	(6)	<20% rock fragments of gravel sizes, 1-3" or less.	(8)
Obstructions Flow Deflectors Sediment Traps	Rocks, old logs firmly embedded. Flow pattern of pool & riffles stable without cutting or deposition.	(2)	Some present, causing erosive cross currents and minor pool filling. Obstructions and deflectors newer and less firm.	(4) circled	Moderately frequent, moderately unstable obstructions & deflectors move with high water causing bank cutting and filling of pools.	(6)	Frequent obstructions and deflectors cause bank erosion yearlong. Sed. traps full, channel migration occuring.	(8)
Cutting	Little or none evident. Infrequent raw banks less than 6" high generally.	(4)	Some, intermittently at outcurves & constrictions. Raw banks may be up to 12".	(8) circled	Significant. Cuts 12"-24" high. Root mat overhangs and sloughing evident.	(12)	Almost continuous cuts, some over 24" high. Failure of overhangs frequent.	(16)
Deposition	Little or no enlargement of channel or point bars.	(4)	Some new increas in bar formation, most from coarse gravels.	(8) circled	Moderate deposition of new gravel & coarse sand on old and some new bars.	(12)	Extensive deposits of predominately fine particles. Accelerated bar development.	(16)
BOTTOM								
Rock Angularity	Sharp edges and corners, plane surfaces roughened.	(1)	Rounded corners & edges, surfaces smooth & flat.	(2) circled	Corners & edges well rounded in two dimensions.	(3)	Well rounded in all dimensions, surfaces smooth.	(4)
Brightness	Surfaces dull, darkened, or stained. Gen. not "bright".	(1)	Mostly dull but may have up to 35% bright surfaces.	(2) circled	Mixture, 50-50% dull and bright, ± 15%, ie 35-65%.	(3)	Predominately bright, 65% +, exposed or scoured surfaces.	(4)
Consolidation or Particle Packing	Assorted sizes tightly packed and/or overlapping.	(2)	Moderately packed with some overlapping.	(4) circled	Mostly a loose assortment with no apparent overlap.	(6)	No packing evident. Loose assortment, easily moved.	(8)
Bottom Size Distribution & Percent Stable Materials	No change in sizes evident. Stable materials 80-100%.	(4)	Distribution shift slight. Stable materials 50-80%.	(8)	Moderate change in sizes. Stable materials 20-50%.	(12) crossed out, 10 circled	Marked distribution change. Stable materials 0-20%.	(16)
Scouring and Deposition	Less than 5% of the bottom affected by scouring and deposition.	(6)	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.	(12) circled	30-50% affected. Deposits & scour at obstructions, constrictions, and bends. Some filling of pools.	(18)	More than 50% of the bottom in a state of flux or change nearly yearlong.	(24)
Clinging Aquatic Vegetation (Moss & Algae)	Abundant. Growth largely moss like, dark green, perennial. In swift water too.	(1)	Common. Algal forms in low velocity & pool areas. Moss here too and swifter waters.	(2)	Present but spotty, mostly in backwater areas. Seasonal blooms make rocks slick.	(3) circled	Perennial types scarce or absent. Yellow-green, short term bloom may be present.	(4)
COLUMN TOTALS →		6		49		22		0

Add the values in each column for a total reach score here. (E. 6 + G. 49 + F. 22 + P. 0 = 77).

Reach score of: <38=Exellent, 39-76=Good, 77-114=Fair (circled), 115+=Poor.

Stream Name: Poorman Creek **Reach:** O-1 **Date:** 6·13·

Width: 20' * **Depth:** .83' * **Velocity:** 3 fps * **Volume:** 6

Gradient: 3% * **Temperature:** 5-6°C * **Turbidity:** CLEAR

Bottom Materials: Large rubble is most abundant (~ 50%) with boulders in the "high common" range; fine/coarse gravel and small rubble next in frequency (common ~ 25%); some bedrock is present, along with organic debris and clay/silt; aquatic vegetation is in "low common range (~ 10-12%), along with sand.

Streambank Vegetation: Rated "good" with 80-90% plant density and good diversity of species; Cedar, R. maple, Alder, and Ferns are abundant; Larch, W. Pine, D. Fir, Spruce, devil's club, Queencup, and Fairy bells (?) common; Cottonwood, red-osier dogwood, mosses, and trillium are present; good to excellent root mass density

Channel Stability: Rated "fair" to "good" (77) with large rubble and boulders contributing to stability; bottom size distribution slight to moderate change in sizes with ~ 50-55% stable materials; debris jam potential is present and on the upswing; most indicators in the "good" range (see R-1 form)

Aquatic Habitats: Pool/Riffle ratio fairly good at 30-70 with a high % (50%) class I pools; class II and III pools present at 15% and 5% respectively. Instream cover rated "good" - rocks and choppy surface abundant with logs, bottom color, and overhanging vegetation common. Bank Cover rated "good" with 85-90% plant density and good diversity; Cedar, R. Maple, Alder, Ferns are abundant Larch, W. Pine, D. Fir, Spruce, fairybells, devil's club, Queencup are common; Cottonwood, R. dogwood, trillium, and mosses are present. Food organisms are abundant at >25/ft.² with abundant caddisflie and common mayflies and stoneflies. Resident habitat rated "Very High" (24) with food organisms a major contributing factor. Spawning habitat "Poor" (10-19% : see habitat form) and overall rating is "moderate" (12)

Management Considerations: ① Although pool/riffle ratio is good (with predominant Class I pools), lower end of reach could use more water breaks; large rubble and boulders responsible for most of the pools observed in upper half of reach;
② sensative zone 40 feet

STREAM NUMBER & NAME: Poorman STATIONS: #1 – 1.5 DATE: 6·13·78

AVG. WIDTH: 18′ * AVG. DEPTH: + + = 1′ * (4) VELOCITY: 3 fps *

V[illegible]: 67.5 cfs TEMPERATURE: 5° C * GRADIENT: 5% *

STABILITY RATING: Fair (86) TURBIDITY: (Clear) - Milky - Muddy

% POOL: 40 % RIFFLE: 60 % RUN: ____ % GLIDE: ____

POOL CLASSES: % CLASS 1: 5 % CLASS 2: 20 % CLASS 3: 35 % CLASS 4: 40

BOTTOM MATERIALS:	Very Abundant (>70%)	Abundant (41 to 70%)	Common (11 to 40%)	Present (<10%)	None 0
Organic Debris:				✓	
Clay/Silt:				✓	
Sand:			✓		
Fine Gravel (0.1 to 1"):			✓		
Coarse Gravel (1 to 3"):			✓		
Small Rubble (3 to 6"):		✓			
Large Rubble (6 to 12"):		✓			
Boulders (>12"):			✓		
Bed Rock:				✓	
AQUATIC VEGETATION:				✓	

INSTREAM COVER: - (Good) - Fair - Poor - None

Cover Types (Indicate relative importance A>C>P)
- Logs: A
- Rocks: A
- Bottom Color: C
- Undercut Banks: C
- Water Color: —
- Choppy Surface: A (low)
- Overhanging Vegetation: P

BANK COVER: - Good (-) Fair - Poor - None

Major Plant Species:
- A: Cedar, wood fern, bead lily
- C: D. Fir, W. P., Hemlock, Spruce, R. Maple, Devil's Club
- P: Cottonwood, Larch, Alder, Red-stemmed dogwood, trillium, fairybel

FISH FOOD ORGANISMS: >25/ft² (16-25/ft²) 6-15/ft² 1-5/ft² None

Food Types (Indicate relative abundance A>C>P):
- Caddisflies: A
- Mayflies: A
- Stoneflies: C
- Diptera: —
- Snails: —
- Leeches: —
- Others: —

SPAWNING HABITAT: Very Good - Good - (Fair) - Poor - None

% Gravel: >50% | 35-50% | 20-34% | 10-19% | <10%

Velocity (in gravel areas) ←——0.5 to 3 fps——→ <0.5 or >3 fps

Water Depth (in gravel areas): ←——0.3 to 3 ft.——→ <0.3 or >3 fps

Are there silt or sand deposits in/on the spawning gravels? Yes

VALLEY BOTTOM TYPE: >300 ft. | ✓ 100-300 ft. | <100 ft.

LAND FORM GRADIENT: <5% | 5-10% | 11-20% | (21-30%) | 30%

LIMITING FACTORS: Partial barriers, undercut banks, stream braiding prominent, mass wasting could be a problem

A[illegible]ONAL OBSERVATIONS: divergent channeling in 3 spots, overmature timber, snags in riparian zone

INVESTIGATOR: M. Rhodes and A. Bratkovich

* = Estimates

Poorman
6.13.78

R-1 STREAM CHANNEL STAB[illegible] [illegible]IELD EVALUATION FORM

Item Rated	Stability Indicators by Classes							
	EXCELLENT		GOOD		FAIR		POOR	
UPPER BANKS								
Landform Slope	Bank slope gradient <30% (3)	(2)	Bank slope gradient 30-40%	(4)	Bank slope gradient 40-60%	(6)	Bank slope gradient 60% +	(8)
Mass Wasting (Existing or Potential)	No evidence of past or potential for future mass wasting into channels.	(3)	Infrequent and/or very small. Mostly healed over. Low future potential.	(6)	Moderate frequency & size, with some raw spots eroded by water during high flows.	(9)	Frequent or large, causing sediment nearly yearlong OR imminent danger of same.	(12)
Debris Jam Potential (Floatable Objects)	Essentially absent from immediate channel area.	(2)	Present but mostly small twigs and limbs.	(4)	Present, volume and size are both increasing.	(7)	Moderate to heavy amounts, predominantly larger sizes.	(8)
Bank Protection from Vegetation	90% + plant density. Vigor and variety suggests a deep, dense root mass.	(3)	70-90% density. Fewer plant species or lower vigor suggests a less dense or deep root mass.	(5)	50-70% density. Lower vigor and still fewer species form a somewhat shallow and discontinuous root mass.	(9)	<50% density plus fewer species & less vigor indicate poor, discontinuous, and shallow root mass.	(12)
LOWER BANKS								
Channel Capacity	Ample for present plus some increases. Peak flows contained. W/D ratio <7.	(1)	Adequate. Overbank flows rare. Width to Depth (W/D) ratio 8-15.	(2)	Barely contains present peaks. Occasional overbank floods. W/D ratio 15-25.	(3)	Inadequate. Overbank flows common. W/D ratio >25.	(4)
Bank Rock Content	65% + with large, angular boulders 12" + numerous.	(2)	40 to 65%, mostly small boulders to cobble 6-12".	(4)	20 to 40%, with most in the 3-6" diameter class.	(6)	<20% rock fragments of gravel sizes, 1-3" or less.	(8)
Obstructions Flow Deflectors Sediment Traps	Rocks, old logs firmly embedded. Flow pattern of pool & riffles stable without cutting or deposition.	(2)	Some present, causing erosive cross currents and minor pool filling. Obstructions and deflectors newer and less firm.	(4)	Moderately frequent, moderately unstable obstructions & deflectors move with high water causing bank cutting and filling of pools.	(5)	Frequent obstructions and deflectors cause bank erosion yearlong. Sed. traps full, channel migration occuring.	(8)
Cutting	Little or none evident. Infrequent raw banks less than 6" high generally.	(4)	Some, intermittently at outcurves & constrictions. Raw banks may be up to 12".	(8)	Significant. Cuts 12"-24" high. Root mat overhangs and sloughing evident.	(10)	Almost continuous cuts, some over 24" high. Failure of overhangs frequent.	(16)
Deposition	Little or no enlargement of channel or point bars.	(4)	Some new increas in bar formation, most from coarse gravels.	(8)	Moderate deposition of new gravel & coarse sand on old and some new bars.	(9)	Extensive deposits of predominately fine particles. Accelerated bar development.	(16)
BOTTOM								
Rock Angularity	Sharp edges and corners, plane surfaces roughened.	(1)	Rounded corners & edges, surfaces smooth & flat.	(2)	Corners & edges well rounded in two dimensions.	(3)	Well rounded in all dimensions, surfaces smooth.	(4)
Brightness	Surfaces dull, darkened, or stained. Gen. not "bright".	(1)	Mostly dull but may have up to 35% bright surfaces.	(2)	Mixture, 50-50% dull and bright, ± 15%, ie 35-65%.	(3)	Predominately bright, 65% +, exposed or scoured surfaces.	(4)
Consolidation or Particle Packing	Assorted sizes tightly packed and/or overlapping.	(2)	Moderately packed with some overlapping.	(4)	Mostly a loose assortment with no apparent overlap.	(6)	No packing evident. Loose assortment, easily moved.	(8)
Bottom Size Distribution & Percent Stable Materials	No change in sizes evident. Stable materials 80-100%.	(4)	Distribution shift slight. Stable materials 50-80%.	(8)	Moderate change in sizes. Stable materials 20-50%.	(9)	Marked distribution change. Stable materials 0-20%.	(16)
Scouring and Deposition	Less than 5% of the bottom affected by scouring and deposition.	(6)	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.	(10)	30-50% affected. Deposits & scour at obstructions, constrictions, and bends. Some filling of pools.	(18)	More than 50% of the bottom in a state of flux or change nearly yearlong.	(24)
Clinging Aquatic Vegetation (Moss & Algae)	Abundant. Growth largely moss like, dark green, perennial. In swift water too.	(1)	Common. Algal forms in low velocity & pool areas. Moss here too and swifter waters.	(2)	Present but spotty, mostly in backwater areas. Seasonal blooms make rocks slick.	(3)	Perennial types scarce or absent. Yellow-green, short term bloom may be present.	(4)
COLUMN TOTALS →		3		25		58		0

Add the values in each column for a total reach score here. (E. 3 + G. 25 + F. 58 + P. 0 = 86).

Reach score of: <38=Excellent, 39-76=Good, 77-114=Fair, 115+=Poor.

Form R-1 2500-5 (6-7[illegible]

OVER

Stream Name: Poorman Creek **Reach:** 1 - 1.5 **Date:** 6-13-78

Width: 18' * **Depth:** 1' * **Velocity:** 3 fps **Volume:** 68c

Gradient: 5% * **Temperature:** 5-6°c * **Turbidity:** CLEAR

Bottom Materials: Large rubble (55%) and small rubble (40%) abundant; followed by coarse gravel and boulders in the "high common" range; organic debris is present (~10%); sand and fine gravel are 20-40%; aquatic vegetation is present (~10%)

Streambank Vegetation: Rated "fair" to "good" with moderate plant density and diversity; Cedar, ferns, and queencup are abundant; D. Fir, W. Pine, W. Hemlock, Spruce, R. Maple, and devil's club are common; Cottonwood, Larch, alder, R. dogwood, trillium, fairybells, and mosses are present

Channel Stability: Rated "Fair" (86); mass-wasting, debris jam potential, bank-cutting, deposition, and bottom size distribution are all significant; all of these items fall into "fair" range (58 out of 86 possible points)

Aquatic Habitats: Pool / Riffle ratio satisfactory at 40-60, with all pool class represented (Class I - 5%, II - 20%, and III - 35%). Instream cover rated "good" - logs, rocks, and choppy surface are abundant, with undercut banks and bottom color common. Bank cover rated "fair" to "good," with moderate plant density and diversity (species in above notes). Food organisms are good: 16-25/ft.², with caddisflies and mayflies abundant, stoneflies are common. Spawning areas are "Fair" (20-34%), with some silt observed in these areas. Overall Resident habitat rated "very high" (23) with bank cover the only weak-rated item. Overall spawning habitat is rated "Moderate" (12)

Management Considerations: ① Overmature timber and snags in riparian zone should be thinned, since the pool/riffle ratio is acceptable and a fair amount of blowdowns are already present in channel; ② undercut banks are contributing to mass-waste problems - channel should be evaluated for possible gabien installations; ③ Sensative zone 80 - 90 feet

STREAM NUMBER & NAME: POORMAN CREEK STATIONS: 1.5 - 2 DATE: 6-12-7

AVG. WIDTH: 20' * AVG. DEPTH: $\frac{15+16+9}{4}$ = .83' = 10" VELOCITY: 3.7 FT/SEC

E: 76.7 cfs TEMPERATURE: 5°C * GRADIENT: 3% *

STABILITY RATING: 71 TURBIDITY: [Clear] - Milky - Muddy

% POOL: 15 % RIFFLE: 85 % RUN: — % GLIDE: —

POOL CLASSES: % CLASS 1: — % CLASS 2: — % CLASS 3: 20 % CLASS 4: 80

BOTTOM MATERIALS:	Very Abundant (>70%)	Abundant (41 to 70%)	Common (11 to 40%)	Present (<10%)	None 0
Organic Debris:				✓	
Clay/Silt:				✓	
Sand:				✓	
Fine Gravel (0.1 to 1"):			✓		
Coarse Gravel (1 to 3"):			✓		
Small Rubble (3 to 6"):		✓			
Large Rubble (6 to 12"):		✓			
Boulders (>12"):			✓		
Bed Rock:					✓
AQUATIC VEGETATION:			✓		

INSTREAM COVER: - Good - [Fair] - Poor - None

Cover Types (Indicate relative importance A>C>P)
Logs P Rocks A Bottom Color C
Undercut Banks Water Color
Choppy Surface A Overhanging Vegetation: P

BANK COVER: - [Good] - Fair - Poor - None

Major Plant Species: A - Hemlock, Cedar, Wood Fern, Devilsclub
C - spruce, mosses
P - WP, DF, GF, Cottonwood, Fairybells

FISH FOOD ORGANISMS: >25/ft² [16-25/ft²] 6-15/ft² 1-5/ft² None

Food Types: (Indicate relative abundance A>C>P) Caddisflies A Mayflies: P Stoneflies: C Diptera P
Snails: Leeches: Others:

SPAWNING HABITAT: Very Good - Good - Fair - [Poor] - None

% Gravel >50% 35-50% 20-34% [10-19%] <10%

Velocity (in gravel areas) ← 0.5 to 3 fps → <0.5 or >3 fps
Water Depth (in gravel areas): ← 0.3 to 3 ft. → <0.3 or >3 fps
Are there silt or sand deposits in/on the spawning gravels? YES

VALLEY BOTTOM TYPE: >300 ft. 100-300 ft. ✓ <100 ft.

LAND FORM GRADIENT: <5% [5-10%] 11-20% 21-30% 30%

LIMITING FACTORS: Debris Jams (Barriers), Stream braiding, No quality Pools

ADDITIONAL OBSERVATIONS: Large amount of overmature timber falling into stream, Surface water seepage in areas
- Great Diversity of Food Organisms

* = Estimates

INVESTIGATOR: BRATKOVICH

USDA-FOREST SERVICE

POORMAN CR.
Reach 1.5

R-1 STREAM CHANNEL STABILITY FIELD EVALUATION FORM

Item Rated	EXCELLENT		GOOD		FAIR		POOR	
I. UPPER BANKS								
Landform Slope	Bank slope gradient <30%	(2)	Bank slope gradient 30-40%	(3) (4)	Bank slope gradient 40-60%	(6)	Bank slope gradient 60% +	(8)
Mass Wasting (Existing or Potential)	No evidence of past or potential for future mass wasting into channels.	(3)	Infrequent and/or very small. Mostly healed over. Low future potential.	5 (6)	Moderate frequency & size, with some raw spots eroded by water during high flows.	(9)	Frequent or large, causing sediment nearly yearlong OR imminent danger of same.	(12)
Debris Jam Potential (Floatable Objects)	Essentially absent from immediate channel area.	(2)	Present but mostly small twigs and limbs.	(4)	Present, volume and size are both increasing.	(6)	Moderate to heavy amounts, predominantly larger sizes.	(8)
Bank Protection from Vegetation	90% + plant density. Vigor and variety suggests a deep, dense root mass.	(3)	70-90% density. Fewer plant species or lower vigor suggests a less dense or deep root mass.	5 (6)	50-70% density. Lower vigor and still fewer species form a somewhat shallow and discontinuous root mass.	(9)	<50% density plus fewer species & less vigor indicate poor, discontinuous, and shallow root mass.	(12)
II. LOWER BANKS								
Channel Capacity	Ample for present plus some increases. Peak flows contained. W/D ratio <7.	(1)	Adequate. Overbank flows rare. Width to Depth (W/D) ratio 8-15.	(2)	Barely contains present peaks. Occasional overbank floods. W/D ratio 15-25.	(3)	Inadequate. Overbank flows common. W/D ratio >25.	(4)
Bank Rock Content	65% + with large, angular boulders 12" + numerous.	(2)	40 to 65%, mostly small boulders to cobble 6-12".	(4)	20 to 40%, with most in the 3-6" diameter class.	(6)	<20% rock fragments of gravel sizes, 1-3" or less.	(8)
Obstructions Flow Deflectors Sediment Traps	Rocks, old logs firmly embedded. Flow pattern of pool & riffles stable without cutting or deposition.	(2)	Some present, causing erosive cross currents and minor pool filling. Obstructions and deflectors newer and less firm.	(4)	Moderately frequent, moderately unstable obstructions & deflectors move with high water causing bank cutting and filling of pools.	(6)	Frequent obstructions and deflectors cause bank erosion yearlong. Sed. traps full, channel migration occuring.	(8)
Cutting	Little or none evident. Infrequent raw banks less than 6" high generally.	(4)	Some, intermittently at outcurves & constrictions. Raw banks may be up to 12".	6 (8)	Significant. Cuts 12"-24" high. Root mat overhangs and sloughing evident.	(12)	Almost continuous cuts, some over 24" high. Failure of overhangs frequent.	(16)
Deposition	Little or no enlargement of channel or point bars.	(4)	Some new increase in bar formation, most from coarse gravels.	(8)	Moderate deposition of new gravel & coarse sand on old and some new bars.	(12)	Extensive deposits of predominately fine particles. Accelerated bar development.	(16)
III. BOTTOM								
Rock Angularity	Sharp edges and corners, plane surfaces roughened.	(1)	Rounded corners & edges, surfaces smooth & flat.	(2)	Corners & edges well rounded in two dimensions.	(3)	Well rounded in all dimensions, surfaces smooth.	(4)
Brightness	Surfaces dull, darkened, or stained. Gen. not "bright".	(1)	Mostly dull but may have up to 35% bright surfaces.	(2)	Mixture, 50-50% dull and bright, ± 15%, ie 35-65%.	(3)	Predominately bright, 65% +, exposed or scoured surfaces.	(4)
Consolidation or Particle Packing	Assorted sizes tightly packed and/or overlapping.	(2)	Moderately packed with some overlapping.	(4)	Mostly a loose assortment with no apparent overlap.	(6)	No packing evident. Loose assortment, easily moved.	(8)
Bottom Size Distribution & Percent Stable Materials	No change in sizes evident. Stable materials 80-100%.	(4)	Distribution shift slight. Stable materials 50-80%.	6 (8)	Moderate change in sizes. Stable materials 20-50%.	(12)	Marked distribution change. Stable materials 0-20%.	(16)
Scouring and Deposition	Less than 5% of the bottom affected by scouring and deposition.	(6)	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.	10 (12)	30-50% affected. Deposits & scour at obstructions, constrictions, and bends. Some filling of pools.	(18)	More than 50% of the bottom in a state of flux or change nearly yearlong.	(24)
Clinging Aquatic Vegetation (Moss & Algae)	Abundant. Growth largely moss like, dark green, perennial. In swift water too.	(1)	Common. Algal forms in low velocity & pool areas. Moss here too and swifter waters.	(2)	Present but spotty, mostly in backwater areas. Seasonal blooms make rocks slick.	(3)	Perennial types scarce or absent. Yellow-green, short term bloom may be present.	(4)
	COLUMN TOTALS →		→		→		→	

Add the values in each column for a total reach score here. (E. 0 + G. 59 + F. 12 + P. 0 = 71).

Reach score of: <38=Excellent, 39-76=Good, 77-114= Fair, 115+=Poor.

R1-2500-5 (6/73)

OVER

Stream Name: Poorman Creek **Reach:** 1.5 - 2 **Date:** 6.12.78

Width: 20' * **Depth:** .83' * **Velocity:** 3-4 fps* **Volume:** 77 cfs

Gradient: 3% * **Temperature:** 5-6°c * **Turbidity:** CLEAR

Bottom Materials: Large and small rubble are abundant; boulders are "high common" (35-40%), with fine/coarse gravels and aquatic vegetation all ~ 10-12%; organic debris, clay/silt, and sand are present (8-10%); no bedrock observed

Streambank Vegetation: Rated "good" with moderate density and diversity; W. Hemlock, Cedar, Ferns, and devil's club are abundant; spruce and mosses are common; and W. Pine, D. Fir, G Fir, Cottonwood, and Fairy bells are present

Channel Stability: Rated "good" (71) with most indicators in the "good" column (59 out of 71 total points); debris jam potential present and increasing; 3 barriers in this reach at ~ 1.6, 1.7, and 1.8; bank rock content 40-65% in 6-12" range

Aquatic Habitats: Pool/Riffle ratio below satisfactory (15-85) with class I and II pools lacking. Instream cover rated "fair" with rocks and choppy surface abundant, bottom color common, and logs and overhanging vegetation are present. Bank cover is "good" with moderate density and diversity (species listed above). Food organisms were good at 16-25/ft.² with abundant caddis flies, common stoneflies, and present mayflies. Spawning habitat is "poor" (10-19%) with silt noted on spawning grounds. Overall Resident habitat rating is "moderate" (18), as is the overall spawning habitat (11)

Management Considerations: ① Three barriers observed in this reach that should be thinned down - they do not contribute to pool formation; reach lacks quality pools - pool/riffle ratio should be improved; ② resident and spawning habitat moderate, resident habitat would improve with addition of class I and II pools; ③ large amount of overmature timber falling into and across channel; ④ sensative zone 50 feet

STREAM NUMBER & NAME: POORMAN CREEK STATIONS: 2 - 2.5 DATE: 6-12-78

AVG. WIDTH: 20' * AVG. DEPTH: + + /4 = 1.5' * VELOCITY: 5 FT/SEC *

[illegible]E: 187.5 cfs TEMPERATURE: 5°C * GRADIENT: 10% *

STABILITY RATING: 59 TURBIDITY: [Clear] - Milky - Muddy

% POOL: 50 % RIFFLE: 50 % RUN: — % GLIDE: —

POOL CLASSES: % CLASS 1: 10 % CLASS 2: 20 % CLASS 3: 40 % CLASS 4: 30

BOTTOM MATERIALS:	Very Abundant (>70%)	Abundant (41 to 70%)	Common (11 to 40%)	Present (<10%)	None 0
Organic Debris:				✓	
Clay/Silt:					✓
Sand:				✓	
Fine Gravel (0.1 to 1"):				✓	
Coarse Gravel (1 to 3"):				✓	
Small Rubble (3 to 6"):			✓		
Large Rubble (6 to 12"):		✓			
Boulders (>12"):			✓		
Bed Rock:		✓			
AQUATIC VEGETATION:			✓		

INSTREAM COVER: - [Good] - Fair - Poor - None

Cover Types (Indicate relative importance A>C>P)
Logs C Rocks A Bottom Color C
Undercut Banks ____ Water Color ____
Choppy Surface A Overhanging Vegetation: P

B[illegible]K COVER: - [Good] - Fair - Poor - None

Major Plant Species: A - Hemlock, Alder, Bead Lily, mosses, Cedar
C - WP, spruce, Twisted stalk, Trillium
P - GF, DF, willow, Red maple, Pyrola, Ferns, Huckleb[illegible]

FISH FOOD ORGANISMS: >25/ft² 16-25/ft² [6-15/ft²] 1-5/ft² None

Food Types: (Indicate relative abundance A>C>P) Caddisflies C Mayflies: C Stoneflies: C Diptera P
Snails: ____ Leeches: ____ Others: ____

SPAWNING HABITAT: Very Good - Good - Fair - Poor - [None]

% Gravel >50% 35-50% 20-34% 10-19% [<10%]

Velocity (in gravel areas) ←— 0.5 to 3 fps —→ <0.5 or >3 fps
Water Depth (in gravel areas): ←— 0.3 to 3 ft. —→ <0.3 or >3 fps
Are there silt or sand deposits in/on the spawning gravels? YES

VALLEY BOTTOM TYPE: >300 ft. 100-300 ft. <100 ft. ✓

LAND FORM GRADIENT: <5% 5-10% 11-20% 21-30% [>30%]

LIMITING FACTORS: Debris Jams - Barriers, Steep Falls, No Spawning Habitat
High H_2O Velocity

[ADDI]TIONAL OBSERVATIONS:
Many overmature trees could be falling in near future in riparian ZONE

INVESTIGATOR: BRATKOVICH

* = Estimates

POORMAN CR.
Reach 2 - 2.5

R-1 STREAM CHANNEL STA FIELD EVALUATION FORM

Item Rated	Stability Indicators by Classes							
UPPER BANKS	EXCELLENT		GOOD		FAIR		POOR	
Landform Slope	Bank slope gradient <30%	(2) circled	Bank slope gradient 30-40%	(4)	Bank slope gradient 40-60%	(6)	Bank slope gradient 60% +	(8)
Mass Wasting (Existing or Potential)	No evidence of past or potential for future mass wasting into channels.	(3)	Infrequent and/or very small. Mostly healed over. Low future potential.	(6)	Moderate frequency & size, with some raw spots eroded by water during high flows.	(9) circled	Frequent or large, causing sediment nearly yearlong OR imminent danger of same.	(12)
Debris Jam Potential (Floatable Objects)	Essentially absent from immediate channel area.	(2)	Present but mostly small twigs and limbs.	(4)	Present, volume and size are both increasing.	(6) circled	Moderate to heavy amounts, predominantly larger sizes.	(8)
Bank Protection from Vegetation	90% + plant density. Vigor and variety suggests a deep, dense root mass.	(3)	70-90% density. Fewer plant species or lower vigor suggests a less dense or deep root mass. 5 (circled)	(6)	50-70% density. Lower vigor and still fewer species form a somewhat shallow and discontinuous root mass.	(9)	<50% density plus fewer species & less vigor indicate poor, discontinuous, and shallow root mass.	(12)
LOWER BANKS								
Channel Capacity	Ample for present plus some increases. Peak flows contained. W/D ratio <7.	(1) circled	Adequate. Overbank flows rare. Width to Depth (W/D) ratio 8-15.	(2)	Barely contains present peaks. Occasional overbank floods. W/D ratio 15-25.	(3)	Inadequate. Overbank flows common. W/D ratio >25.	(4)
Bank Rock Content	65% + with large, angular boulders 12" + numerous.	(2) circled	40 to 65%, mostly small boulders to cobble 6-12".	(4)	20 to 40%, with most in the 3-6" diameter class.	(6)	<20% rock fragments of gravel sizes, 1-3" or less.	(8)
Obstructions Flow Deflectors Sediment Traps	Rocks, old logs firmly embedded. Flow pattern of pool & riffles stable without cutting or deposition.	(2)	Some present, causing erosive cross currents and minor pool filling. Obstructions and deflectors newer and less firm.	(4) circled	Moderately frequent, moderately unstable obstructions & deflectors move with high water causing bank cutting and filling of pools.	(6)	Frequent obstructions and deflectors cause bank erosion yearlong. Sed. traps full, channel migration occuring.	(8)
Cutting	Little or none evident. Infrequent raw banks less than 6" high generally.	(4) circled	Some, intermittently at outcurves & constrictions. Raw banks may be up to 12".	(8)	Significant. Cuts 12"-24" high. Root mat overhangs and sloughing evident.	(12)	Almost continuous cuts, some over 24" high. Failure of overhangs frequent.	(16)
Deposition	Little or no enlargement of channel or point bars.	(4) circled	Some new increase in bar formation, most from coarse gravels.	(8)	Moderate deposition of new gravel & coarse sand on old and some new bars.	(12)	Extensive deposits of predominately fine particles. Accelerated bar development.	(16)
BOTTOM								
Rock Angularity	Sharp edges and corners, plane surfaces roughened.	(1)	Rounded corners & edges, surfaces smooth & flat.	(2) circled	Corners & edges well rounded in two dimensions.	(3)	Well rounded in all dimensions, surfaces smooth.	(4)
Brightness	Surfaces dull, darkened, or stained. Gen. not "bright".	(1)	Mostly dull but may have up to 35% bright surfaces.	(2) circled	Mixture, 50-50% dull and bright, ± 15%, ie 35-65%.	(3)	Predominately bright, 65% +, exposed or scoured surfaces.	(4)
Consolidation or Particle Packing	Assorted sizes tightly packed and/or overlapping.	(2)	Moderately packed with some overlapping.	(4) circled	Mostly a loose assortment with no apparent overlap.	(6)	No packing evident. Loose assortment, easily moved.	(8)
Bottom Size Distribution & Percent Stable Materials	No change in sizes evident. Stable materials 80-100%.	(4)	Distribution shift slight. Stable materials 50-80%. 6 (circled)	(8)	Moderate change in sizes. Stable materials 20-50%.	(12)	Marked distribution change. Stable materials 0-20%.	(16)
Scouring and Deposition	Less than 5% of the bottom affected by scouring and deposition.	(6) circled	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.	(12)	30-50% affected. Deposits & scour at obstructions, constrictions, and bends. Some filling of pools.	(18)	More than 50% of the bottom in a state of flux or change nearly yearlong.	(24)
Clinging Aquatic Vegetation (Moss & Algae)	Abundant. Growth largely moss like, dark green, perennial. In swift water too.	(1)	Common. Algal forms in low velocity & pool areas. Moss here too and swifter waters.	(2) circled	Present but spotty, mostly in backwater areas. Seasonal blooms make rocks slick.	(3)	Perennial types scarce or absent. Yellow-green, short term bloom may be present.	(4)
COLUMN TOTALS →		19		25		15		0

Add the values in each column for a total reach score here. (E. 19 + G. 25 + F. 15 + P. 0 = 59).

Reach score of: <38=Exellent, **39-76=Good** (boxed), 77-114=Fair, 115+=Poor.

Form R-1 2500-5 (6-73)

OVER

Stream Name: Poorman Creek **Reach:** 2-2.5 **Date:** 6-12-78

Width: 20'* **Depth:** 1.5'* **Velocity:** 5 fps* **Volume:** 187 cfs

Gradient: 9-10%* **Temperature:** 5-6°C* **Turbidity:** CLEAR

Bottom Materials: Bedrock and large rubble are abundant; small rubble and boulders common, as is aquatic vegetation; all others in the present range, except clay/silt - which was not observed

Streambank Vegetation: Rated "good" with Cedar, W. Hemlock, Alder, Queencup, and mosses abundant; W. Pine, spruce, twisted stalk, and trillium are common; G. Fir, D. Fir, willow, R. Maple, Pyrola, Ferns, and huckleberry are present

Channel Stability: Rated "good" (59); mass-wasting is noted as moderate frequency/size, with debris jam potential present and increasing in volume and size; most indicators in the "good" column (25 out of 59 total points); abundant bedrock contributes to stability

Aquatic Habitats: Pool/Riffle ratio good at 50-50 with all pool classes represented (class I - 10%, II - 20%, III 40%). Instream cover rated "good" with rocks and choppy surface abundant, logs and bottom color common. Bank cover also rated "good" with good density and diversity (see species listed above). Food organisms moderate at 6-15/ft.^{2} with caddisflies, mayflies, and stoneflies common. <10% spawning habitat was observed, due probably to deposition of gravels downstream by high velocity waters (5 fps*). Overall Resident habitat rated "high" (22) and overall spawning habitat rated "unsuitable" (8)

Management Considerations: ① Pool/Riffle ratio adequate - pools formed mainly by bedrock and large rubble (dominant bottom materials); ② gradient steep, causing falls, cascades, and swift velocity; ③ potential blow-downs of overmature trees in riparian zone - could be thinned; ④ sensitive zone 90+ feet

STREAM NUMBER & NAME: POORMAN CREEK STATIONS: 2.5 - 3+ DATE: 6-12-78

WIDTH: 20' * AVG. DEPTH: + + = 10" * VELOCITY: 3 FT/SEC

VOLUME: 62 cfs TEMPERATURE: 5° C * GRADIENT: 12% *

STABILITY RATING: 70 TURBIDITY: [Clear] - Milky - Muddy

% POOL: 25 % RIFFLE: 75 % RUN: — % GLIDE: —

POOL CLASSES: % CLASS 1: 5 % CLASS 2: 10 % CLASS 3: 20 % CLASS 4: 65

BOTTOM MATERIALS:	Very Abundant (>70%)	Abundant (41 to 70%)	Common (11 to 40%)	Present (<10%)	None 0
Organic Debris:				✓	
Clay/Silt:				✓	
Sand:				✓	
Fine Gravel (0.1 to 1"):			✓		
Coarse Gravel (1 to 3"):			✓		
Small Rubble (3 to 6"):			✓		
Large Rubble (6 to 12"):		✓			
Boulders (>12"):			✓		
Bed Rock:				✓	
AQUATIC VEGETATION:				✓	

INSTREAM COVER: - Good [-] Fair - Poor - None

Cover Types (Indicate relative importance A>C>P)
Logs C Rocks C Bottom Color C
Undercut Banks P Water Color
Choppy Surface A Overhanging Vegetation: C

BANK COVER: - [Good] - Fair - Poor - None

Major Plant Species: A - Hemlock, Alder, Red Maple, Devilsclub, Wood Fern
C - Cedar, Spruce, Larch, Twisted Stalk, mosses
P - WP, GF, Thimbleberry, Trillium

FISH FOOD ORGANISMS: >25/ft² [16-25/ft²] 6-15/ft² 1-5/ft² None

Food Types: Caddisflies A Mayflies: C Stoneflies: C Diptera
(Indicate relative abundance A>C>P) CONICAL SHAPED CADDISFLIES
Snails: Leeches: Others:

SPAWNING HABITAT: Very Good - Good - Fair [-] Poor - None

% Gravel >50% 35-50% 20-34% 10-19% <10%

Velocity (in gravel areas) ——— 0.5 to 3 fps ——— <0.5 or >3 fps
Water Depth (in gravel areas): ——— 0.3 to 3 ft. ——— <0.3 or >3 fps
Are there silt or sand deposits in/on the spawning gravels? YES

VALLEY BOTTOM TYPE: >300 ft. 100-300 ft. ✓ <100 ft.

LAND FORM GRADIENT: <5% [5-10%] 11-20% 21-30% 30%

LIMITING FACTORS: Debris Jams, Lack of Quality Pools, Limited gravel for spawning, stream braiding

ADDITIONAL OBSERVATIONS:

Very Good species and age-class diversity in riparian ZONE

INVESTIGATOR: BRATKOVICH

* = Estimates

POORMAN CR.
Reach 2.5 - 3

R-1 STREAM CHANNEL STA[BILITY] FIELD EVALUATION FORM

Item Rated	Stability Indicators by Classes							
	EXCELLENT		GOOD		FAIR		POOR	
UPPER BANKS								
Landform Slope	Bank slope gradient <30%	(2)	Bank slope gradient 30-40%	(4) circled	Bank slope gradient 40-60%	(6)	Bank slope gradient 60% +	(8)
Mass Wasting (Existing or Potential)	No evidence of past or potential for future mass wasting into channels.	(3)	Infrequent and/or very small. Mostly healed over. Low future potential.	(6) circled	Moderate frequency & size, with some raw spots eroded by water during high flows.	(9)	Frequent or large, causing sediment nearly yearlong OR imminent danger of same.	(12)
Debris Jam Potential (Floatable Objects)	Essentially absent from immediate channel area.	(2)	Present but mostly small twigs and limbs.	(4)	Present, volume and size are both increasing. 5	(6)	Moderate to heavy amounts, predominantly larger sizes.	(8)
Bank Protection from Vegetation	90% + plant density. Vigor and variety suggests a deep, dense root mass.	(3) circled	70-90% density. Fewer plant species or lower vigor suggests a less dense or deep root mass.	(6)	50-70% density. Lower vigor and still fewer species form a somewhat shallow and discontinuous root mass.	(9)	<50% density plus fewer species & less vigor indicate poor, discontinuous, and shallow root mass.	(12)
LOWER BANKS								
Channel Capacity	Ample for present plus some increases. Peak flows contained. W/D ratio <7.	(1)	Adequate. Overbank flows rare. Width to Depth (W/D) ratio 8-15.	(2) circled	Barely contains present peaks. Occasional overbank floods. W/D ratio 15-25.	(3)	Inadequate. Overbank flows common. W/D ratio >25.	(4)
Bank Rock Content	65% + with large, angular boulders 12" + numerous.	(2)	40 to 65%, mostly small boulders to cobble 6-12".	(4) circled	20 to 40%, with most in the 3-6" diameter class.	(6)	<20% rock fragments of gravel sizes, 1-3" or less.	(8)
Obstructions Flow Deflectors Sediment Traps	Rocks, old logs firmly embedded. Flow pattern of pool & riffles stable without cutting or deposition.	(2)	Some present, causing erosive cross currents and minor pool filling. Obstructions and deflectors newer and less firm.	(4) circled	Moderately frequent, moderately unstable obstructions & deflectors move with high water causing bank cutting and filling of pools.	(6)	Frequent obstructions and deflectors cause bank erosion yearlong. Sed. traps full, channel migration occuring.	(8)
Cutting	Little or none evident. Infrequent raw banks less than 6" high generally.	(4)	Some, intermittently at outcurves & constrictions. Raw banks may be up to 12". 6	(8)	Significant. Cuts 12"-24" high. Root mat overhangs and sloughing evident.	(12)	Almost continuous cuts, some over 24" high. Failure of overhangs frequent.	(16)
Deposition	Little or no enlargement of channel or point bars.	(4)	Some new increas in bar formation, most from coarse gravels.	(8) circled	Moderate deposition of new gravel & coarse sand on old and some new bars.	(12)	Extensive deposits of predominately fine particles. Accelerated bar development.	(16)
BOTTOM								
Rock Angularity	Sharp edges and corners, plane surfaces roughened.	(1)	Rounded corners & edges, surfaces smooth & flat.	(2) circled	Corners & edges well rounded in two dimensions.	(3)	Well rounded in all dimensions, surfaces smooth.	(4)
Brightness	Surfaces dull, darkened, or stained. Gen. not "bright".	(1)	Mostly dull but may have up to 35% bright surfaces.	(2)	Mixture, 50-50% dull and bright, ± 15%, ie 35-65%.	(3) circled	Predominately bright, 65% +, exposed or scoured surfaces.	(4)
Consolidation or Particle Packing	Assorted sizes tightly packed and/or overlapping.	(2)	Moderately packed with some overlapping.	(4) circled	Mostly a loose assortment with no apparent overlap.	(6)	No packing evident. Loose assortment, easily moved.	(8)
Bottom Size Distribution & Percent Stable Materials	No change in sizes evident. Stable materials 80-100%.	(4)	Distribution shift slight. Stable materials 50-80%. 6	(8)	Moderate change in sizes. Stable materials 20-50%.	(12)	Marked distribution change. Stable materials 0-20%.	(16)
Scouring and Deposition	Less than 5% of the bottom affected by scouring and deposition.	(6)	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools. 10	(12)	30-50% affected. Deposits & scour at obstructions, constrictions, and bends. Some filling of pools.	(18)	More than 50% of the bottom in a state of flux or change nearly yearlong.	(24)
Clinging Aquatic Vegetation (Moss & Algae)	Abundant. Growth largely moss like, dark green, perennial. In swift water too.	(1)	Common. Algal forms in low velocity & pool areas. Moss here too and swifter waters.	(2)	Present but spotty, mostly in backwater areas. Seasonal blooms make rocks slick.	(3) circled	Perennial types scarce or absent. Yellow-green, short term bloom may be present.	(4)
COLUMN TOTALS →		3		56		11		

Add the values in each column for a total reach score here. (E. 3 + G. 56 + F. 11 + P. 0 = 70).

Reach score of: <38=Exellent, 39-76=Good (circled) 77-114=Fair, 115+=Poor.

Form R-1 2500-5 (6-73)

OVER

Stream Name: Poorman Creek **Reach:** 2.5 - 3+ **Date:** 6-12-78

Width: 20' * **Depth:** .83' * **Velocity:** 3 fps **Volume:** 62 cfs

Gradient: 12% * **Temperature:** 5-6°C **Turbidity:** CLEAR

Bottom Materials: Large rubble is abundant, followed by "high common" (~40%) small rubble and boulders; fine/coarse gravel are "low common" (~10-12%); all other materials are in the "present" column

Streambank Vegetation: Rated "good" with 90% + plant density and excellent species diversity; W. Hemlock, Alder, R. Maple, Devil's club, and Ferns are abundant; Cedar, Spruce, Larch, Twisted Stalk, and mosses are common; and W. Pine, G. Fir, Thimbleberry, and Trillium are present; dense root mass

Channel Stability: Rated "good" (70); moderate debris jam potential observed, but the remaining indicators in the "good" or "excellent" columns; some scouring and deposition, but nothing serious; banks stable with only minor cutting

Aquatic Habitats: Pool / Riffle ratio adequate at 25%-75%, with all pools classes represented but room for improvement of class I and II pools (in quality and number). Instream cover rated "Fair" to "good" - choppy surface is abundant, with logs, rocks, bottom color, and overhanging vegetation common. Bank cover rated "good" - with excellent species and age-class diversity in riparian zone (see species listed above). Food organisms were plentiful at 16-25/ft.^{2}; caddisflies are abundant (some conical-shaped), mayflies and stoneflies are common. Spawning rated "Poor" to "Fair" (19-20%) with silt on the grounds. Overall Resident habitat rated "high" (22) and the overall spawning habitat rated "moderate" (11)

Management Considerations:

① Very good species and age-class diversity in riparian zone indicates low blowdown potential for near future; ② quality pools present but in limited numbers - water breaks would be helpful; ③ sensative zone 50 feet

LIBBY RANGER DISTRICT
STREAM CHANNEL CLASSIFICATION DATA (ROSGEN 1994)

STREAM LITTLE Cherry CR.
REACH ID #1
CHANNEL TYPE F4b

DATE 8-12-97
CREW Keller - May
REVIEWED BY ____

1)THREAD-

- Single Without Side Channels ☑
- Single With Side Channels ☐
- Multiple Channels ☐

2)ENTRENCHMENT-

Bankfull Widths 11.2 / 10.9 / 10.5 / 11.4 / 12.2 / 12.8 / 10.8 / 11.0 / 9.9 / 9.7

100.2

Bankfull Width(@ station) 9.7 Average bankfull width 11.04
Floodprone width (@ station x-section) 13.0
Entrenchment ratio (floodprone width / bankfull width @ station) 1.34

3)W/D RATIO-

Bankfull Depths 0 / .15 / .58 / .67 / .72 / .80 / .45 / .60 / .50 / .38
Average Bankfull Depth .49
Width to Depth Ratio (BF width @ station) / (Average BF Depth) 19.80

4)SINUOSITY-

Stream Length (measured along thalweg) 225
Reach Length ("straight line" distance) 120
Sinuosity (Stream Length) / (Reach Length) 1.88

5)GRADIENT- MEASURED AT WATER SURFACE

Elevation Change 4.3	/ Distance 170	Gradient(%) 2.53
Elevation Change 1.5	/ Distance 55	Gradient(%) 2.73
Elevation Change	/ Distance	Gradient(%)
Elevation Change	/ Distance	Gradient(%)

221
170
51

AVERAGE REACH GRADIENT (%) 2.58

225

6)PARTICLE SIZE DISTRIBUTION-

Dominant size class (mm) 32 mm course gravel
D 50 (mm) 34 mm v. course gravel
Comments ____

7)DEPOSITIONAL PATTERN-

- Point Bars
- Point Bars With Few Mid-Channel Bars ☐
- Many Side-Channel Bars ☑
- Side Or Diagonal Bars ☐
- Channel Composed of Bars/Islands ☐

8)BED FEATURES-

- Cascade ☐
- Step- Pool ☐
- Plane Bed/Glide ☐
- Pool-Riffle ☑
- Other (ie Transition, Beaver Dams etc) ☐

COMMENTS: (Write on back of form) Field Map (Attach or draw on back of form)
Revised 2/97

Kootenai National Forest -- Libby Ranger District
LEVEL III FISH HABITAT SURVEY

Stream: Little Cherry Cr
Reach: #1 reference: Y/N
Date: 8-12-97
Elevation(ft)
REACH LENGTH:

Survey crew: Keller-May
Rosgen channel type: F4b
Units: English / metric
Riparian width (est) (ft)

RIFFLE BANKFULL WIDTHS (10)

11.2	10.9	10.5	11.4	12.2
12.8	10.8	11.0	9.9	

AVERAGE RIFFLE WIDTH = 11.04
REACH LENGTH (avg x 20) = 225
--channels <10' } MEASURE ALL RIFFLES; MEASURE ALL POOLS
--channels >10' } MEASURE EVERY OTHER RIFFLE; MEASURE ALL POOLS

POOLS

Max Depth	Pool tail Max Depth	% Pool tail fines (<7mm)	Pool Width	Pool Length
1.30	.20	80	11.5	25
.85	.03	20	5.0	20
1.10	.15	60	6.5	25
1.40	.40	0	5.5	11
1.50	.30	30	3.0	20
.60	.05	30	6.0	10

RIFFLES

UNSTABLE (ft) LEFT BANK	UNSTABLE (ft) RIGHT BANK	RIFFLE LENGTH (ft)
0	0	24
0	0	7
0	10	22
0	0	10
0	0	44
0	0	7

.45

+1

45

% pocket pools in reach = 35
Σ POOL LENGTH = 111 (ft)
Pool Frequency = (reach length / # pools) = 1 pool / 37.5 (ft)
AVERAGE % FINES IN POOL TAILS = 36.70

Σ RIFFLE LENGTH = 114
% stable banks in riffles = 91
Width / depth ratio - RIFFLE = 19.80

LARGE WOODY DEBRIS

TYPE: Diameter:	live > bfw *** > 6"	live > bfw < 6"	dead > bfw *** > 6"	dead > bfw <6"		live < bfw >6"	live < bfw <6"	dead<bfw >6"	dead<bfw <6"
Rootwad			•						
Embedded			•• ••						
Suspended			L•	:|					
Recruiting						•• ••	• ••	•	
Ramp			• ••	• ••					
Misc.									

bfw = bankfull width

GRADIENT
Pool/Riffle sets.

Δelev	stream distance	% gradient
4.3	170	2.53
1.5	55	2.73

(Δelev / dist)(100) = %gradient
Rosgen reach gradient = 2.58 %

LWD FREQUENCY = (REACH LENGTH) / (TOTAL NUMBER OF PIECES WITH *** IN columns) = 16.07 (225 / 14)

COMMENTS:
[SNO]RKEL SURVEY COMPLETED ? N
[CORE] SAMPLES COLLECTED ? Y/N % FINES /
PICTURES: (frame #) / / /
CAMERA #

[CHA]NNEL IMPACTS: (circle if applicable) grazing / timber harvest / roads / debris removal / other

Comments:

code:
[ripar]ian width (ft)
[ripar]ian habitat type:
[da]y bottom unit:
[geolo]gy:

[revis]ed 2/97

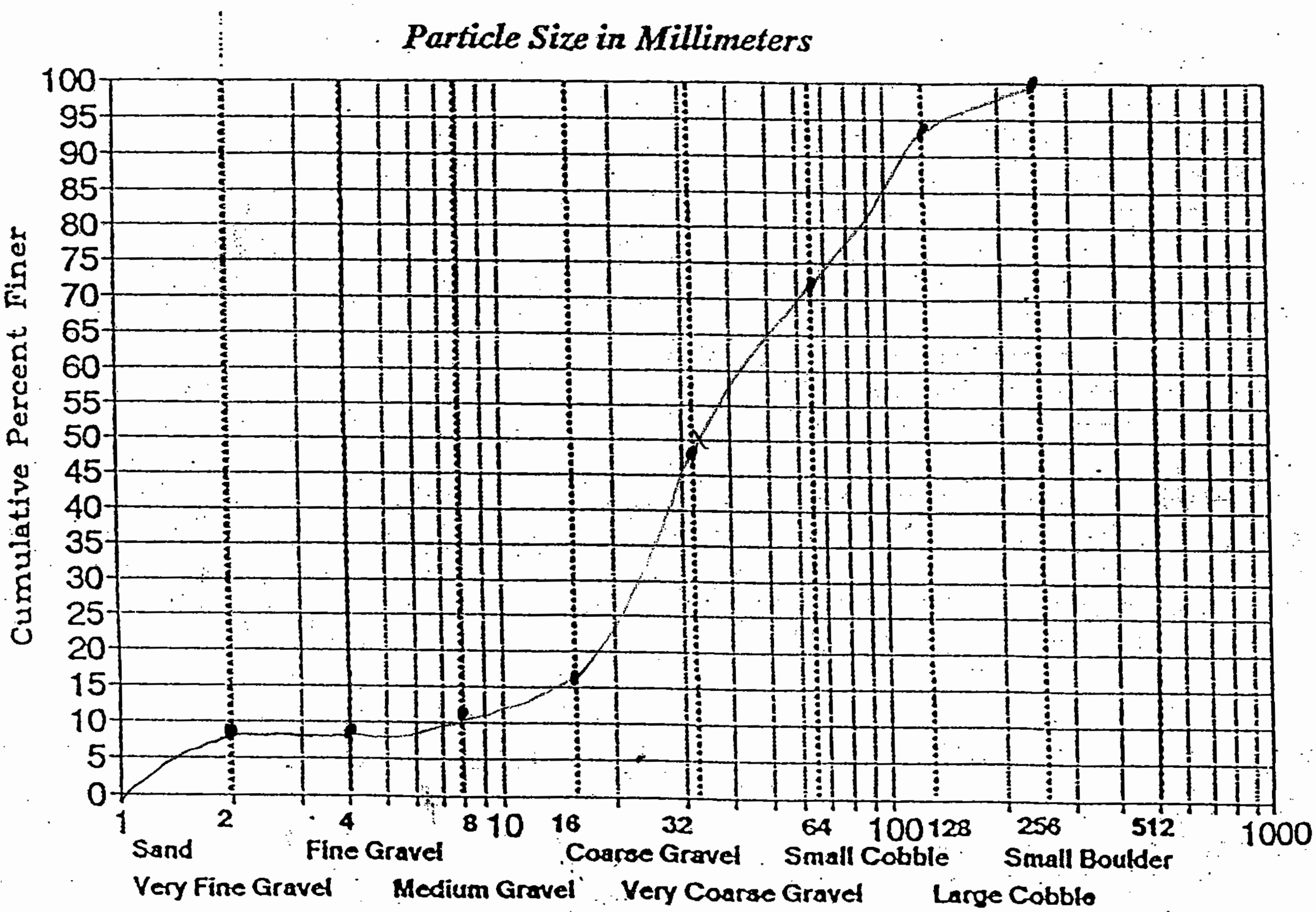
Little, Cherry

#1 8-12-97 Keller May

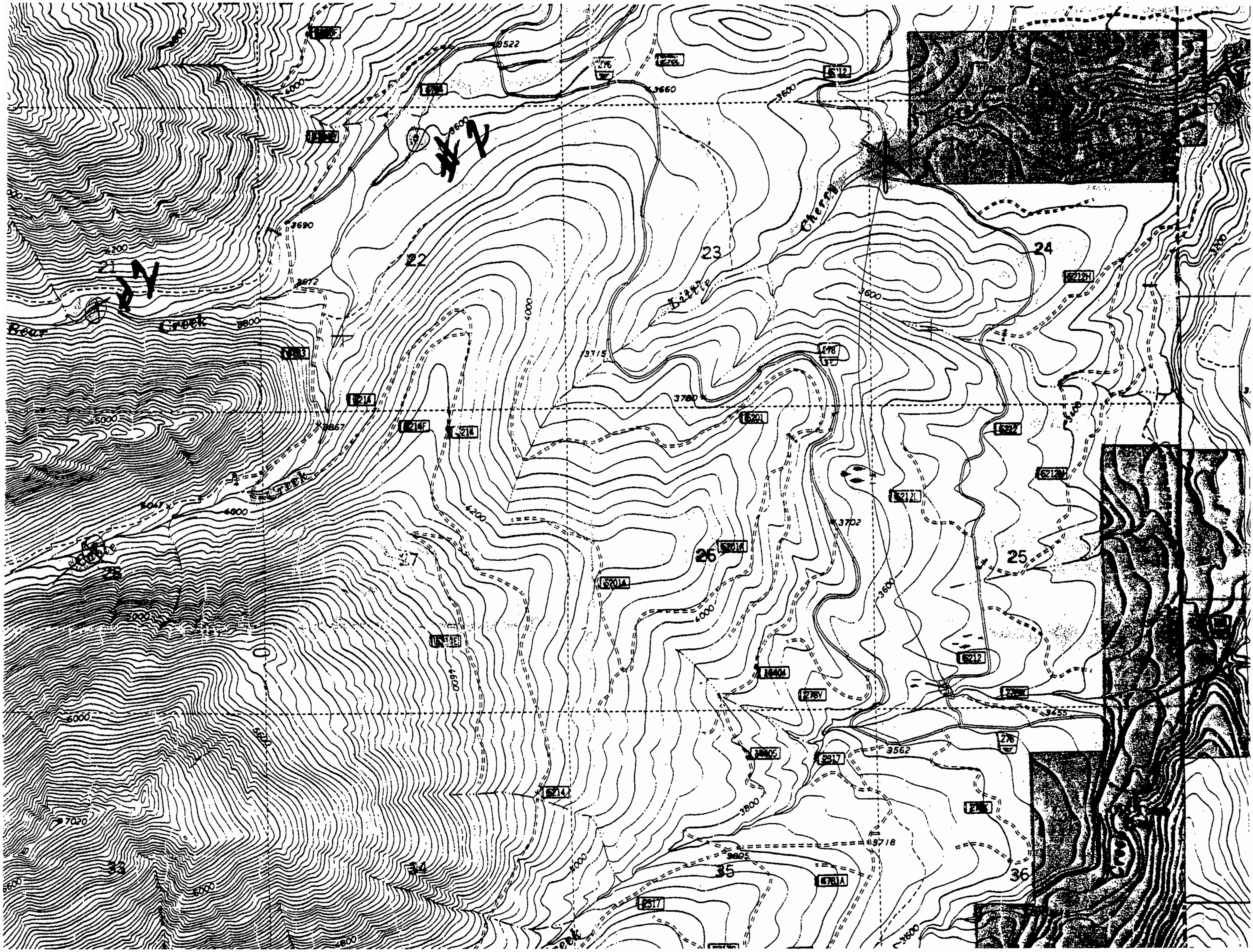
PEBBLE COUNT INFORMATION

Size (mm)	Particle	Pool 49	Riffle 51	Total	% class	Cumm. %
0 - 2	silt - crse sand	:.	⊔	10	9	9
2 - 4	v. fine gravel			0	0	9
4 - 8	fine gravel		:	2	2	11
8 - 16	med. gravel		L:	6	5	16
16 - 32	course gravel	☒☐	☒⊔	35	32	48
32 - 64	v. course gravel	☒::	☒:.	27	24	72
64 - 128	small cobble	☒::	☒	24	22	94
128 - 256	large cobble	::	:.	7	6	100
256 - 512	small boulder					
512 - 1024	medium boulder					
1024 +	large boulder					

111



D ~ 34



Bear Creek
Little Cherry
22
23
24
25
26
33
34
35
36
4000
3600
3800
4200
6000
7020
3522
3660
3690
3672
3867
3715
3780
3702
3562
3455
3716
3805
276
6212
5201
5201A
6214
6214F
278V
2917

STREAM NAME: Little Cherry Creek D-5

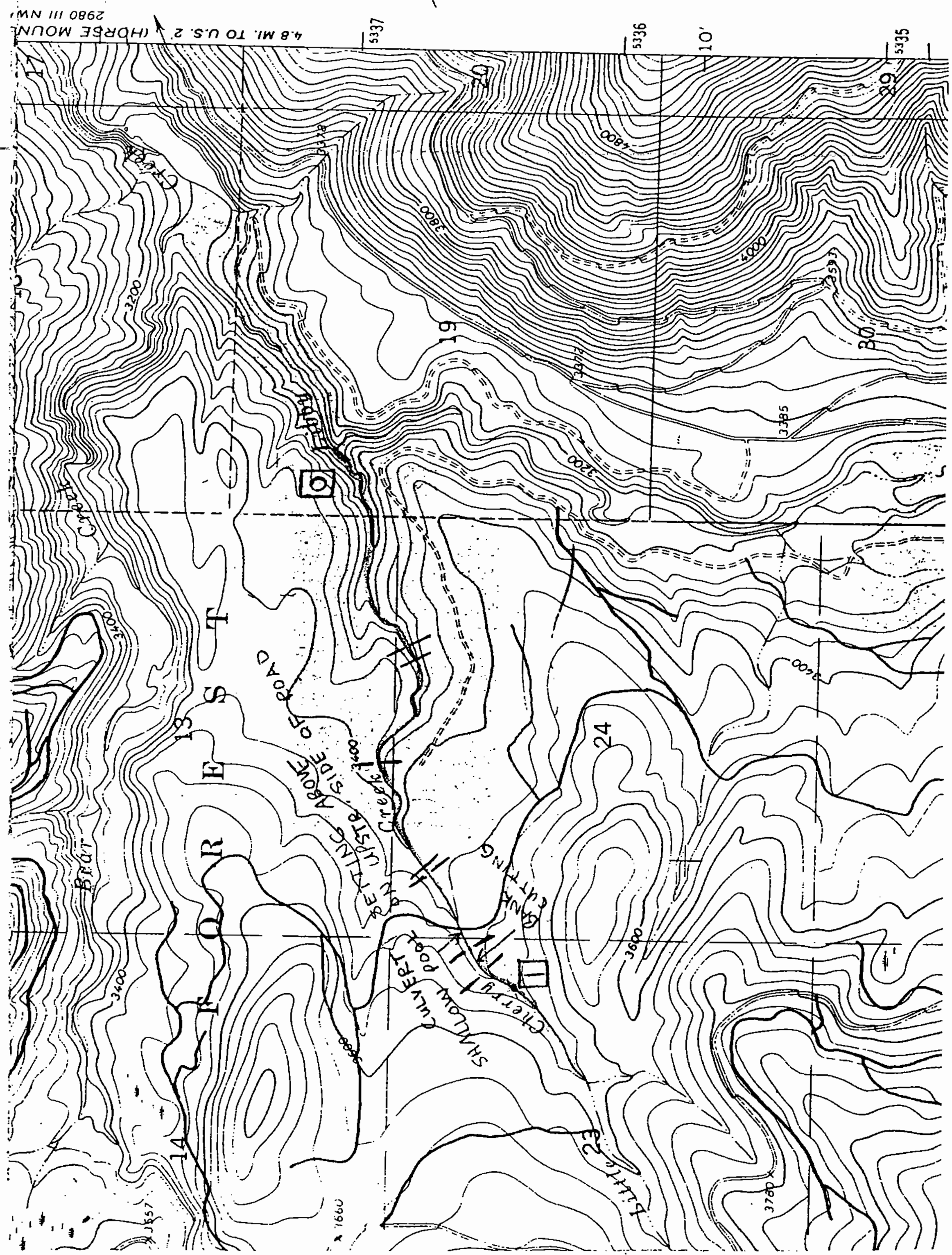
RECEIVING WATER: Libby Creek → Kootenai River

KNOWN FISHERIES:

Resident cutthroat and bull trout.

LIMITING FACTORS AND SENSITIVITIES:

ADDITIONAL COMMENTS:



STREAM STABILITY AND FISH HABITAT INVENTORY

for

LITTLE CHERRY CREEK

STREAM NUMBER & NAME: Little Cherry Creek STATIONS: 0-1 DATE: 9·13·7

AVG. WIDTH: 7' AVG. DEPTH: + + = .41 (÷ 4) VELOCITY: .85 fps

VOLUME: 3.1 cfs TEMPERATURE: 48°F GRADIENT: 7%

STABILITY RATING: 78 TURBIDITY: **[Clear]** - Milky - Muddy

% POOL: 20 % RIFFLE: 80 % RUN: — % GLIDE: —

POOL CLASSES: % CLASS 1: 6 % CLASS 2: 12 % CLASS 3: 22 % CLASS 4: 60

BOTTOM MATERIALS:	Very Abundant (>70%)	Abundant (41 to 70%)	Common (11 to 40%)	Present (<10%)	None 0	
Organic Debris:			✓			4
Clay/Silt:	13		✓			4
Sand:	13		✓			15
Fine Gravel (0.1 to 1"):	17	✓				
Coarse Gravel (1 to 3"):	19	✓				19
Small Rubble (3 to 6"):	17	✓				15
Large Rubble (6 to 12"):	13		✓			14
Boulders (>12"):	6		✓			
Bed Rock:	2			✓		
AQUATIC VEGETATION:			✓			

INSTREAM COVER: - **[Good]** - Fair - Poor - None

Cover Types (Indicate relative importance A>C>P)
Logs C Rocks C Bottom Color C
Undercut Banks C Water Color —
Choppy Surface P Overhanging Vegetation: C

BANK COVER: - **[Good]** - Fair - Poor - None

Major Plant Species:
Ⓐ Cedar, Ferns, Alder
Ⓒ W. Pine, D. Fir, R. Maple, Devil's club, Moses,
Ⓟ Larch, S. Alpine, Twisted Stalk, P. Everlasting, Thimbleberry, Horsetail,

FISH FOOD ORGANISMS: >25/ft² **[16-25/ft²]** 6-15/ft² 1-5/ft² None

Food Types: Caddisflies C Mayflies: C Stoneflies: P Diptera —
(Indicate relative abundance A>C>P) Snails: ___ Leeches: P Others: Water - Striders Ⓟ

SPAWNING HABITAT: Very Good - **[Good]** - Fair - Poor - None

% Gravel >50% 35-50% 20-34% 10-19% <10%

Velocity (in gravel areas) ← 0.5 to 3 fps → <0.5 or >3 fps
Water Depth (in gravel areas): ← 0.3 to 3 ft. → <0.3 or >3 fps
Are there silt or sand deposits in/on the spawning gravels? Yes

VALLEY BOTTOM TYPE: >300 ft. 100-300 ft. ✓ <100 ft.

LAND FORM GRADIENT: <5% 5-10% **[11-20%]** 21-30% 30%

LIMITING FACTORS: Silt observed on spawning areas; unstable bottom materials; some good pools, but there's silt in most of them; a couple of small barriers; lower end of reach steeper gradient

ADDITIONAL OBSERVATIONS: Fish observed throughout reach, from 2" to 6"

INVESTIGATOR: RHODES * = Estimates

Little Cherry Creek
0-1
9.13.78

R-1 STREAM CHANNEL STABILITY FIELD EVALUATION FORM

Item Rated	Stability Indicators by Classes: EXCELLENT		GOOD		FAIR		POOR	
UPPER BANKS								
Landform Slope	Bank slope gradient <30%	(2) circled	Bank slope gradient 30-40%	(4)	Bank slope gradient 40-60%	(6)	Bank slope gradient 60% +	(8)
Mass Wasting (Existing or Potential)	No evidence of past or potential for future mass wasting into channels.	(3) [5 circled]	Infrequent and/or very small. Mostly healed over. Low future potential.	(6)	Moderate frequency & size, with some raw spots eroded by water during high flows.	(9)	Frequent or large, causing sediment nearly yearlong OR imminent danger of same.	(12)
Debris Jam Potential (Floatable Objects)	Essentially absent from immediate channel area.	(2)	Present but mostly small twigs and limbs.	(4) [5 circled]	Present, volume and size are both increasing.	(6)	Moderate to heavy amounts, predominantly larger sizes.	(8)
Bank Protection from Vegetation	90% + plant density. Vigor and variety suggests a deep, dense root mass.	(3) [5 circled]	70-90% density. Fewer plant species or lower vigor suggests a less dense or deep root mass.	(6)	50-70% density. Lower vigor and still fewer species form a somewhat shallow and discontinuous root mass.	(9)	<50% density plus fewer species & less vigor indicate poor, discontinuous, and shallow root mass.	(12)
LOWER BANKS								
Channel Capacity	Ample for present plus some increases. Peak flows contained. W/D ratio <7.	(1)	Adequate. Overbank flows rare. Width to Depth (W/D) ratio 8-15.	(2) circled	Barely contains present peaks. Occasional overbank floods. W/D ratio 15-25.	(3)	Inadequate. Overbank flows common. W/D ratio >25.	(4)
Bank Rock Content	65% + with large, angular boulders 12" + numerous.	(2)	40 to 65%, mostly small boulders to cobble 6-12".	(4) [5 circled]	20 to 40%, with most in the 3-6" diameter class.	(6)	<20% rock fragments of gravel sizes, 1-3" or less.	(8)
Obstructions Flow Deflectors Sediment Traps	Rocks, old logs firmly embedded. Flow pattern of pool & riffles stable without cutting or deposition.	(2)	Some present, causing erosive cross currents and minor pool filling. Obstructions and deflectors newer and less firm.	(4) circled	Moderately frequent, moderately unstable obstructions & deflectors move with high water causing bank cutting and filling of pools.	(6)	Frequent obstructions and deflectors cause bank erosion yearlong. Sed. traps full, channel migration occuring.	(8)
Cutting	Little or none evident. Infrequent raw banks less than 6" high generally.	(4)	Some, intermittently at outcurves & constrictions. Raw banks may be up to 12".	(8) circled	Significant. Cuts 12"-24" high. Root mat overhangs and sloughing evident.	(12)	Almost continuous cuts, some over 24" high. Failure of overhangs frequent.	(16)
Deposition	Little or no enlargement of channel or point bars.	(4)	Some new increase in bar formation, most from coarse gravels.	(8) [9 circled]	Moderate deposition of new gravel & coarse sand on old and some new bars.	(12)	Extensive deposits of predominately fine particles. Accelerated bar development.	(16)
BOTTOM								
Rock Angularity	Sharp edges and corners, plane surfaces roughened.	(1)	Rounded corners & edges, surfaces smooth & flat.	(2) circled	Corners & edges well rounded in two dimensions.	(3)	Well rounded in all dimensions, surfaces smooth.	(4)
Brightness	Surfaces dull, darkened, or stained. Gen. not "bright".	(1)	Mostly dull but may have up to 35% bright surfaces.	(2) circled	Mixture, 50-50% dull and bright, ± 15%, ie 35-65%.	(3)	Predominately bright, 65% +, exposed or scoured surfaces.	(4)
Consolidation or Particle Packing	Assorted sizes tightly packed and/or overlapping.	(2)	Moderately packed with some overlapping.	(4) circled	Mostly a loose assortment with no apparent overlap.	(6)	No packing evident. Loose assortment, easily moved.	(8)
Bottom Size Distribution & Percent Stable Materials	No change in sizes evident. Stable materials 80-100%.	(4)	Distribution shift slight. Stable materials 50-80%.	(8) [10 circled]	Moderate change in sizes. Stable materials 20-50%.	(12)	Marked distribution change. Stable materials 0-20%.	(16)
Scouring and Deposition	Less than 5% of the bottom affected by scouring and deposition.	(6)	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.	(12) circled	30-50% affected. Deposits & scour at obstructions, constrictions, and bends. Some filling of pools.	(18)	More than 50% of the bottom in a state of flux or change nearly yearlong.	(24)
Clinging Aquatic Vegetation (Moss & Algae)	Abundant. Growth largely moss like, dark green, perennial. In swift water too.	(1)	Common. Algal forms in low velocity & pool areas. Moss here too and swifter waters.	(2) circled	Present but spotty, mostly in backwater areas. Seasonal blooms make rocks slick.	(3)	Perennial types scarce or absent. Yellow-green, short term bloom may be present.	(4)
COLUMN TOTALS →		12		66		0		0

Add the values in each column for a total reach score here. (E. 12 + G. 66 + F. 0 + P. 0 = 78

Reach score of: <38=Exellent, 39-76=Good, 77-114=Fair, 115+=Poor.

Form R-1 2500-5 (6-7

Stream Name: Little Cherry Creek **Reach:** 0-1 **Date:** 9-13-7

Width: 7' **Depth:** .41' **Velocity:** .85 fps **Volume:** 3.1 cf

Gradient: 7% **Temperature:** 48°F **Turbidity:** CLEAR

Bottom Materials: Coarse gravel is most abundant, with fine gravel and small rubble at low abundant; clay/silt, sand, and large rubble were listed high common, with organic debris and aquatic veg. common, and boulders low common; bedrock was low present

Streambank Vegetation: Bank cover rated "good," with cedar, ferns, and alder dominating; W. Pine, D. Fir, R. Maple, and D. Club were common - as were mosses on the immediate banks and rock surfaces; Larch, S Alpine, Twisted stalk, Pearly Everlasting, thimbleberry, and horsetail were present.

Channel Stability: Rated "good" at 78 (or "Fair" according to stability form); most bottom materials were small to medium-sized, but low velocity makes these fairly stable materials; moderate scouring and deposition was noted, along with some intermittant bank-cutting; some obstructions and flow deflectors were noted but no big problem as yet.

Aquatic Habitats: Pool/Riffle ratio fair at 20/80%, with all pool sizes noted (only 6% class one); class two and three pools were at 12% and 22% respectively. Instream cover rated "good," with logs, rocks, bottom color, undercut banks, and overhanging vegetation providing common cover. Bank cover rated "good," with cedar, ferns, and alder abundant (see above). Food organisms were moderate at 16-25/ft.² and small to medium-sized caddisflies and mayflies were common, with stoneflies, leeches, and water-striders present in low amounts. Channel stability rated "good" (or "fair" according to form) with low velocity making the smaller bottom materials more stable (3-6" small rubble), and good instream and bank cover adding to stability (see above). Spawning listed as "good" (35-50%). with silt noted; good instream cover and channel stability elevate the overall rating to "very good." Resident habitat was high moderate, with fairly good pools, instream and bank cover, and channel stability favorable

Management Considerations:

① Pool quality is fair and could be improved ② silt noted on spawning grounds and in pools ③ mostly smaller bottom materials (3-6" most stable) not moving too much because of low velocity at present, but will move at peak flows ④ a couple of small barriers were noted

⑤ Sensative Zone ~ 70 feet

R-1 STREAM REACH INVENTORY and CHANNEL STABILITY EVALUATION

LOCATION

Forest Name Kootenai & No. 14 Ranger Dist. Libby D-5 Survey Date 8/14/75

Observer(s) Stan Tubb Stream Name Little Cherry Creek

Reach Description & Other Identification Headwaters to mouth

Aerial Photo No.____ Coordinates & Identification____ P.W.I. W/S No.____

INVENTORY MEASUREMENTS & ESTIMATES*

Stream Size & Discharge — Survey Date: Width 4 Ft.* Ave.Depth .25 Ft. Velocity ____f/s Discharge ____cfs

At Maximum: ____Ft.* ____Ft.* ____f/s* ____cfs*

Gradient____% Sinuosity ratio____ Stream Order____ Turbidity Level____ Stream Stage 2

Channel Flow Pattern____

Soils Description____

Landform and/or Geologic Type____

Vegetative Type____

Number of debris jams &/or fish blocks/mile____. Upstream watershed impacts (Types)____

Size Composition of Bottom Materials (Total to 100%)

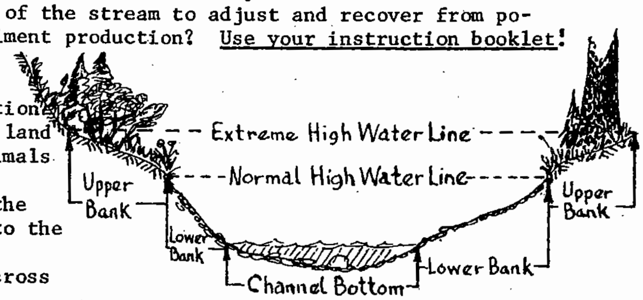
1. Exposed bedrock........... 0 %	5. Small rubble, 3"-6"...... 20 %
2. Large boulders, 3' + Dia.. 1 %	6. Coarse gravel, 1"-3"..... 30 %
3. Small boulders, 1-3'...... 5 %	7. Fine gravel, 0.1"-1"..... 25 %
4. Large rubble, 6"-12"...... 15 %	8. Sand, silt, clay, muck... 4 %

Weather and Other Remarks____

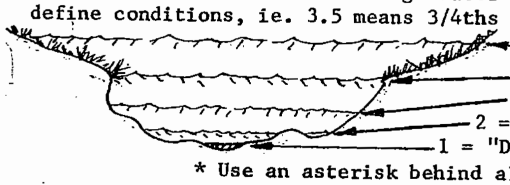
INSTRUCTIONS

Use a separate rating form for each length of stream that appears similar. Complete the inventory items above using maps, aerial photos, and field observations and measurements. On the opposite side of this page, the channel and adjacent flood plain banks are subjectively rated, item by item, following an on-the-ground inspection. Circle only one of the numbers in parentheses for each item rated. If actual conditions fall somewhere between the conditions as described, cross out the number given and below it write in an intermediate value which better expresses the situation. Don't key in on a single indicator or a small group of indicators but use them all for the most diagnostic value. The indicators are inter-related so don't dwell on any one item for long. Do the best you can and the pluses and minuses should balance out. Keep in mind that each item directly or indirectly seeks to answer three basic questions: (1) What are the magnitude of the hydraulic forces at work to detach and transport the various organic and inorganic bank and channel components? (2) How resistent are these components to the recent stream-flow forces exerted on them? (3) What is the capacity of the stream to adjust and recover from potential changes in flow volume and/or increases in sediment production? Use your instruction booklet!

DEFINITION OF TERMS AND ILLUSTRATIONS



Upper Bank - That portion of the topographic cross section from the break in the general slope of the surrounding land to the normal high water line. Terrestrial plants & animals normally inhabit this area.
Lower Banks - The intermittently submerged portion of the channel cross section from the normal high water line to the water's edge during the summer low flow period.
Channel Bottom - The submerged portion of the channel cross section which is totally an aquatic environment.
Stream Stage - The height of water in the channel at the time of rating is recorded on the top half of this page using numbers 1 through 5. These numbers, as shown below, relate to the surface water elevation relative to the normal high water line. A decimal division should be used to more precisely define conditions, ie. 3.5 means 3/4ths of the channel banks are under water at the time of rating.



5 = Flooding. The flood plain is completely covered.
4 = High. Channel full to the normal high water line.
3 = Moderate. Bottom and ½ of lower banks wetted.
2 = Low. Bottom covered but very little of the lower banks wet.
1 = "Dry". Essentially no flow. Water may stand in bottom depressions.

* Use an asterisk behind all estimates that could be measured but weren't.

17

Fish barrier on Little Cherry Cr. 1/4 mile up from confluence with Libby Cr.:

Falls
- 3' drop on upper shelf
- 6' drop on middle shelf
- 8' bedrock chute

2530 Hydrologic Surveys, Prescriptions, and Plans April 22, 1981

Peak Flow Calculations Little Cherry Creek and Culvert Recommendations

Zone Engineer, Z-II

The Kootenai National Forest Hydraulic Guide was used to calculate peak flows for the listed recurrance intervals:

$$Q_{10} = 19 \text{ cfs}$$
$$Q_{20} = 23 \text{ cfs}$$
$$Q_{50} = 38 \text{ cfs}$$

Since a 48-inch culvert washed out in the December 26 and 27, 1980 flood, we recommend a 60-inch culvert for this crossing. This size culvert will be compatible with the active channel cross sectional area (12 sq. ft.). The cross sectional area of the 60-inch pipe is 19.6 sq. ft., but that capacity will be reduced by burying the bottom of the pipe. The U.S. Geologic Survey has indicated the 2-year recurrence interval peak flow would normally fill the active channel to capacity in western Montana streams.

Because of a falls barrier further downstream, it is not necessary to provide high flow fish passage at this site for migratory spawners. However, fish passage at normal to low flows should be accomodated in order to maintain viable populations of resident cutthroat and rainbow trout in Little Cherry Creek. To achieve this objective, the culvert should be placed at the existing streambed gradient and buried about 10 inches.

A round pipe would be preferable to a squash pipe for this particular application. Bedload should be allowed to accumulate in the bottom of the pipe. We recommend placing angular rock riprap (12-16 inches) at the culvert inlet and also as an apron at the outfall and for 20 feet downstream to dissipate energy. This should help prevent the outfall from becoming a vertical barrier to fish movement. We estimated the stream gradient at the site to be about 1½ percent. A 60-inch round culvert installed at this gradient according to the above recommendations should have water velocities acceptable for fish passage during most of the annual flow period.

LARRY MESHEW
Hydrologist

MICHAEL D. ENK
Fisheries Biologist Trainee

cc: ✓Enk
Meshew

LMESHEW/MDENK:dlw

LITTLE ~~CHERRY~~ CREEK
(lower section)
(from fork to falls below Fathen to mouth) 5.24

EST. FLOW 1.5 CFS

EST. TEMP 55° F

CHANNEL STABILITY excellent (bedrock)

BANK VEGETATION fair

BANK COVER fair

POOL DEV. fair

SUBSTRATE 20% Bedrock
10% Boulder
40% Rubble
20% Gravel
10% Sand

SPAWNING GRAVEL 10%

BARRIERS
*1 Rock SHELF (only barrier at lower flow)
2 OLD MINING AREA STREAM goes subsurface for ~ 10 yds. PASSABLE AT PEAK FLOW

Upper Little Cherry Creek (to fork) 9-21-77

EST. FLOW 1 CFS T29N R31W S. 23

TEMP. est. 55°F

CHANNEL STABILITY good

BANK VEGETATION good

BANK COVER good (root mass)

POOL DEVEL. fair to poor

SUBSTRATE 5% Boulder
40% Rubble
35% Gravel
20% Sand

SPAWNING GRAVEL 15%

BARRIERS
1 ¼ mi below culvert
2 100 yds below #1
3 ? Debris pile - probably can get thru
300 yds below #2

UPPER SECTION LOOKS good for spawning & marginal for rearing. The spawning gravel est. may be low due to high amount of sand & silt in gravel which could be flushed in Spring High Flows.

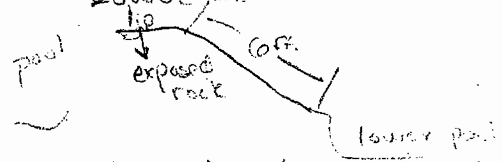
.3 4 falls at lower end [illegible] section

~ 3 ft drop (upper set)

~ 6 ft drop (middle set)

3 sets

Lower set is a [illegible]



Falls about 200 yds above [illegible]

* The rock shelf barrier has a side channel which would provide passage at peak flows ~40 cfs.

From Falls down there is no suitable spawning habit.

Creek goes subsurface for 30 yds [illegible]

Appendix D.
Fish survey field data sheets and associated information.

Date 7/22/04 **MULTIPLE DEPLETION ELECTROFISHING FORM** Page 1 Of ___

Water Name/Collection code Libby Creek **Shocking Section Name** Upper Cleveland

Section Boundaries: (GPS or Descriptive) Access Rd down

Section Length 520' **Estimated (E) or Measured (M)** ___ **Number of Depletion Runs** ___

Equipment used: Back Pack (one) **Settings:** I5 700V

Stream flow (cfs or % bankfull) ___ **Water Temperature:** ___ **Conductivity:** ___

Shocking Crew: ___

Other Fish Spp. Slimy sculpins **Herptiles observed:** Tailed frog

Comments: ___

	Species	Length	Weight	Run Number	Comments	Species	Length	Weight	Run Number	Comments
1	RBT	192		1		RBT	120		1	
2		168				RBT	70			
3		131					74			
4		160					120			
5		164					72			
6		123					140			
7		142					60			
8		160					63			
9		145					167			
10		155					105			
11		134					76			
12		154				RBT	60		1	
13		75								
14		82				RBT	145		2	
15		159					138			
16		60					172			
17		74					120			
18		100					143			
19		90					60			
20		87					104			
21		73					156			
22		77					125			
23		124					101			
24		88					80			
25		56				RBT	80		2	
26		150								
27		74				DV	212		1	
28		132								
29		145								
30	RBT	163								

Date 8/10/04 **MULTIPLE DEPLETION ELECTROFISHING FORM** Page 1 Of 4

Water Name/Collection code Libby Cr. **Shocking Section Name** Below Cleveland

Section Boundaries: (GPS or Descriptive)

Section Length 660 **Estimated (E) or Measured (M)** M **Number of Depletion Runs**

Equipment used: **Settings:**

Stream flow (cfs or % bankfull) **Water Temperature:** @ 1130 **Conductivity:**

Shocking Crew: [illegible]

Other Fish Spp. Slimy Sculpin **Herptiles observed:** Tailed Frog

Comments:

	Species	Length	Weight	Run Number	Comments	Species	Length	Weight	Run Number	Comments
1	RBT	102		1		RBT	74		1	
2		98					85			
3		84					184			
4		172					86			
5		83					93			
6		99					94			
7		137					87			
8		105					84			
9		143					105			
10		197					137			
11		145					96			
12		99					90			
13		76					174			
14		84					107			
15		87					97			
16		92					76			
17		97					96			
18		108					102			
19		133					81			
20		87					92			
21		69					104			
22		188					88			
23		87					154			
24		82					82			
25		76					95			
26		153					82			
27		142					85			
28		173					86			
29		108				RBT	91			
30	RBT	102		1		EBT	174	172	1	

Date 8/10/04 **MULTIPLE DEPLETION ELECTROFISHING FORM** Page 2 Of 4

Water Name/Collection code Libby Cr. **Shocking Section Name** Below Cleveland

Section Boundaries: (GPS or Descriptive)

Section Length 660 **Estimated (E) or Measured (M)** M **Number of Depletion Runs**

Equipment used: **Settings:**

Stream flow (cfs or % bankfull) **Water Temperature:** **Conductivity:**

Shocking Crew:

Other Fish Spp. **Herptiles observed:**

Comments:

	Species	Length	Weight	Run Number	Comments	Species	Length	Weight	Run Number	Comments
1	RBT	89		1		RBT	81		1	
2		146					101			
3		86					93			
4		102					76			
5		100					88			
6		132					100			
7		148					82			
8		95					97			
9		196					103			
10		102					79			
11		90					98			
12		95					92			
13		146					90			
14		76					88			
15		127					127			
16		115					86			
17		81					132			
18		139					192			
19		116					96			
20		97					165			
21		100					122			
22		175					129			
23		153					141			
24		106					171			
25		127					102			
26		74					102			
27		93					92			
28		84					95			
29	RBT	152					94			
30	RBT	91		1		RBT	110		1	

Date 8 /10 /04 **MULTIPLE DEPLETION ELECTROFISHING FORM** Page 3 Of 4

Water Name/Collection code Libby Cr Shocking Section Name Below Cleveland

Section Boundaries: (GPS or Descriptive)

Section Length Estimated (E) or Measured (M) Number of Depletion Runs

Equipment used: Settings:

Stream flow (cfs or % bankfull) Water Temperature: Conductivity:

Shocking Crew:

Other Fish Spp. Herptiles observed:

Comments:

	Species	Length	Weight	Run Number	Comments	Species	Length	Weight	Run Number	Comments
1	RBT	117		1		RBT	87		1	
2		99					75			
3		129					81			
4		101					89			
5		155					82			
6		94					199			
7		100					149			
8		138					140			
9		77					174			
10		137					182			
11		108					128			
12		96					156			
13		83					126			
14		80					88			
15		151					113			
16		126					81			
17		143					183			
18		87					106			
19		87					152			
20		82					130			
21		160					94			
22		106					124			
23		120					168			
24		83					157			
25		91					103			
26		95					95			
27		80					87			
28		103					82			
29		119					128			
30	RBT	101		1		DV	112		1	

Date 8/10/04 **MULTIPLE DEPLETION ELECTROFISHING FORM** Page 4 Of 7

Water Name/Collection code Libby Cr. Shocking Section Name Below Cleveland

Section Boundaries: (GPS or Descriptive)

Section Length Estimated (E) or Measured (M) Number of Depletion Runs

Equipment used: Settings:

Stream flow (cfs or % bankfull) Water Temperature: Conductivity:

Shocking Crew:

Other Fish Spp. Herptiles observed:

Comments:

	Species	Length	Weight	Run Number	Comments	Species	Length	Weight	Run Number	Comments
1	RBT	123		1		RBT	101		2	
2		120					87			
3		153					121			
4		75					100			
5		96					162			
6		97					136			
7		125					96			
8		128					119			
9		85					194			
10	EBT	64					133			
11	EBT	66					87			
12							96			
13	RBT	159		2			128			
14		96					120			
15		116					85			
16		81					104			
17		144					83			
18		82					83			
19		97					94			
20		100					109			
21		138				RBT	81		2	
22		92								
23		101								
24		137								
25		100								
26		91								
27		78				DV	193			
28		87				DV	116			
29		205								
30	RBT	99		2						

Date 8/11/04 **MULTIPLE DEPLETION ELECTROFISHING FORM** **Page** 1 **Of** ___

Water Name/Collection code Libby Creek **Shocking Section Name** Above Project (Bridge

Section Boundaries: (GPS or Descriptive) Above and Below Bridge

Section Length 470' **Estimated (E) or Measured (M)** ___ **Number of Depletion Runs** ___

Equipment used: 2 Back Packs **Settings:** I 5 700 volts 0.13 Amps

Stream flow (cfs or % bankfull) ___ **Water Temperature:** 54°F **Conductivity:** ___

Shocking Crew: ___

Other Fish Spp. ___ **Herptiles observed:** ___

Comments: ___

	Species	Length	Weight	Run Number	Comments	Species	Length	Weight	Run Number	Comments
1	RBT	116		1		RBT	142		1	
2		143					81			
3		124					138			
4		124					97			
5		92					181			
6		70					163			
7		105					166			
8		123					201			
9		83					88			
10		90					184			
11		199					109			
12		79					148			
13		202					105			
14		129					172			
15		115					134			
16		76					140			
17		72					106			
18		150					143			
19		206					122			
20		192					88			
21		152					73			
22		93								
23		92				DV	205			
24		77					242			
25		197					190			
26		191								
27		68								
28		89								
29		211								
30	RBT	140		1						

Date 8 / 11 / 04 **MULTIPLE DEPLETION ELECTROFISHING FORM** Page 2 Of 2

Water Name: Libby Creek Shocking Section Name Above Lower Cleveland Proj. Bhi

	Species	Length	Weight	Run Number	Comments	Species	Length	Weight	Run Number	Comments
1	RBT	107		1		RBT	81		1	
2		90				RBT	80		1	
3		75								
4		116								
5		96								
6		122								
7		112								
8		103								
9		95								
10		142								
11		106								
12		73								
13		72								
14		95								
15		138								
16		72								
17		87								
18		88								
19	RBT	71		1						
20										
21	RBT	190		2	2nd Pass					
22		175								
23		82								
24		121								
25		79								
26		94								
27		76								
28		116								
29		86								
30		67								
31		102								
32		135								
33		91								
34		77								
35	RBT	83								

15

Date 8/12/04 **MULTIPLE DEPLETION ELECTROFISHING FORM** Page 1 Of 2

Water Name/Collection code Libby Cr. Midas Shocking Section Name Midas

Section Boundaries: (GPS or Descriptive)

Section Length 565 Estimated (E) or Measured (M) Number of Depletion Runs

Equipment used: Settings: 25 500

Stream flow (cfs or % bankfull) 10 Water Temperature: 54°F Conductivity:

Shocking Crew: MS, CS, TO, JD, JD

Other Fish Spp. Herptiles observed: Tail Frogs + Tadpoles

Comments:

	Species	Length	Weight	Run Number	Comments	Species	Length	Weight	Run Number	Comments
1	RBT	149		1		RBT	176		1	
2		142					145			
3		92					129			
4		94					81			
5		75					93			
6		85					117			
7		77					118			
8		78					186			
9		82					113			
10		69					104			
11		84					162			
12		95					140			
13		77					117			
14		182					138			
15		163					161			
16		186					165			
17		226					92			
18		202					153			
19		167					93			
20		157					142			
21		180					85			
22		99					138			
23		99					130			
24		171					111			
25		78					92			
26		176				RBT	82			
27		82				EBT	190			
28		174				DV	246			
29		90				DV	224			
30	RBT	[illegible]		1		DV	222		1	

Date 8/12/04 **MULTIPLE DEPLETION ELECTROFISHING FORM** Page 2 Of 2

Water Name: Libby Cr. Shocking Section Name Midas

	Species	Length	Weight	Run Number	Comments	Species	Length	Weight	Run Number	Comments
1	RBT	92		1		RBT	100		1	
2		159					132			
3		98					106			
4	RBT	85				RBT	106		1	
5	~~—~~					~~—~~				
6	RBT	212								
7		103				RBT	180		2	
8		85					148			
9		67					139			
10		98					87			
11		90					93			
12		103					137			
13		125					147			
14		97					122			
15		85					165			
16		148					77			
17		78					90			
18		78					123			
19		90					66			
20		95					84			
21		96					87			
22		81					122			
23		75					152			
24		93					91			
25		137					88			
26		90					90			
27		125					80			
28		144					88			
29		155					100			
30		105					99			
31		85					133			
32		91				RBT	74			
33		80				DV	112		2	
34		78								
35	RBT	82		1						

Date 8 / 4 / 04 **MULTIPLE DEPLETION ELECTROFISHING FORM** Page 1 Of 1

Water Name: ... Cr 500' 58° @ 1030 Shocking Section Name Above Hwy 2

	Species	Length	Weight	Run Number	Comments	Species	Length	Weight	Run Number	Comments
1	Rbt	127	mort	1	Rbt Length 116 Run 1	EBT	65		1	
2		191			110		134			
3		97			167		161			
4		100			122		205			
5		80			115		142			
6		200			126		76			
7		133			117		83			
8		121			105		75			
9		190			128		78			
10		138			95		70			
11		125			104		82			
12		78			90		170			
13		117			RBT 129 1		158			
14		100					78			
15		134				EBT	73		1	
16		118				2nd Pass				
17		115				RBT	[illegible]		2	
18		93					72			
19		126					98			
20		110					105			
21		105					105			
22		137					120			
23		97					118			
24		110					109			
25		91					110			
26		102				RBT	101		2	
27		184								
28		177								
29		183								
30		156			EBT 65 2					
31		174			72					
32		115			76					
33		143			76					
34		105			70					
35	RBT	115		1	EBT 149 2					

MWF 68

RBT Fry 54

RAMSEY

RIES

SPECIES PRESENT	MIGRATION PERIOD	INCUBATION PERIOD	ABUNDANCE	SURVEY METHOD/SOURCE/DATE
RAINBOW	MAR 1 - MAY 15	APR 1 - JULY 15	LOW (inadequate survey)	SNORKEL/HANSEN/1982

HABITAT QUALITY

SPAWNING MODERATE/1978 , ______ , ______

REARING ______ , ______ , ______

RESIDENT HIGH/1978 , ______ , ______

HYDROLOGY

ACE	= PECA	- EXISTING CCE	DATE

STREAM TYPE ______ GRADIENT ______ DISCHARGE ______

TEMPERATURE READINGS 44°/6-14-78 , 51°/9-8-82 , ______

RIPARIAN STAND CONDITIONS

AGE & DESCRIPTION MUCH DECADENT OLD GROWTH

RECRUITMENT LEVEL & IMPORTANCE HIGH TO EXCESSIVE, MODERATELY IMPORTANT

ENTRIES ______ ALLOWABLE EXPOSURE ______ RETAIN OLD GROWTH ______

MANAGEMENT CONCERNS & DIRECTION

STREAM RAMSEY

REACH

DATE 9/8/82 TEMP. 51°

TROUT SURVEY

KEY

<3	3 - 7	>7	largest

COVER : P,F,G,E

		CLASS	W	× L	= A	DEPTH	COVER	RB <3	RB 3-7	RB >7	RB largest	CTT	BK	DV
LOW 'DGE	1)	2	10	25	250	2.5	F		1					
OVE 'DGE	2)	3	8	20	160	1.5	F	0						
	3)	4	10	15	150	1.5	P		3					
	4)	3	8	10	80	2	F		1	1	8			
	5)	3	12	10	120	2	F		1					
	6)													
	7)													
	8)													
	9)													
	10)													
	11)													
	[illegible])													
	13)													
	14)													
	15)													
	16)													
	17)													
	18)													
	19)													
	20)													
	21)													
	22)													
	23)													
	24)													
	TOTALS													

AGE DATA
Scales should be from "new" fish only

1st page only: Ramsey Creek (Water name from IBM listing)

Section 1 (Name or designation of shocking section)

Collection code _ _ _ _ _ _ (from Helena)

Species code W 0 0 1 (1 species per page)
(Prefix: W = wild; H = hatchery;
U = unknown or undesignated

Ordinarily only length (L) and age need be filled in. Weights required for dubbed-in ages (see Procedures).

Back Calculated Lengths

	Date	L	W	Age	Sex	1 1/	2	3				
1	8-26-76	4.4	.03	1+		2.7						
2		5.1	.05	2+		2.8	4.2					
3		6.3	.07	2+		2.9	5.0					
4		6.8	.11	2+		2.7	4.5					
5		6.9	.13	2+		2.3	4.6					
6	8-26-76	7.3	.16	3+		3.0	5.3	6.4				
7												
8												
9												
10												
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												
21												
22												
23												
24												
25												
26												
27												
28												

1/ Enter asterisk in this column if age (in age column) is dubbed in.

Page ______ of ______ ELECTROFISHING SHEET "Rite in the Rain"

1st page only: Date 08 25 76 (mo. da. yr.)

Water name Ramsy Cr

Name or designation of shocking section Section 1 (T27N R31W S.9) 500' below bridge

Collection code ______ (from Helena) Trip type 1 (1 = mark; 2 = recovery) Species code ______ (Prefix: W = wild; H = hatchery; U = unknown or undesignated)

	RB					DV								
	L	W1/	Mark code2/	Do Not	Punch	L	W1/	Mark code2/	Do Not	Punch	L	W1/	Mark code2/	Don't Punch
1	4.4	.03		Resid.		3.8	.02							
2	7.0	.14		"		8.4	.21	♂ M						
3	7.3	.16		"										
4	6.9	.13		"										
5	6.8	.11		"										
6	6.3	.07		"										
7	5.1	.05		"										
8														
9														
10														
11														
12														
13														
14														
15														
16														
17														
18														
19														
20														
21														
22														
23														
24														
25														
26														
27														
28														
29														
30														
31														
32														

Habitat notes
1. Many dead falls creating good pool habitat but barrier problem
2. banks stable
3. split channel
4. Flow about 20-30 CFS
5. stream width 24'
6. Bottom rubble-boulder, gravels sand in pool areas

1/ Weigh all "new" game fish or dub in weight. 2/ Mark code: 0 = unmarked; 1 = marked

Back Calculated Lengths
Ramsey Creek - Section I
RB - 1976

Year Class	Age	Length at Capture	Weight at Capture	Back Calculated Lengths 1	2	3
1975	1+	4.4	.03	2.7		
1974	2+	6.3	.09	2.7	4.6	
1973	3+	7.3	.16	3.0	5.3	6.4

Age 1+ Ave.s n=1 taken directly from Age Data Sheet

Age 2+ Ave.s
L at Capture = 25.1 ÷ 4 = 6.3
Wt. at Capture = .36 ÷ 4 = .09
Bk. Calc. L at 1 = 10.7 ÷ 4 = 2.7
Bk. Calc L at 2 = 18.3 ÷ 4 = 4.6

Age 3+ n=1 taken directly from Age Data Sheet

T27N R31W

11-5400 Code No. ~~11-534~~

Type water ~~10~~ 01

Name of STREAM Ramsey Cr. COUNTY Lincoln

Tributary of Libby Cr., Kootenai river Section of Stream

Source Barriers

Diversions NR Too Small Pollutions

Tributaries

Permanency and Flooding

Type of Shore Line: Sandy Gravelly Muddy Vegetated

Type of Bed: Sandy Boulders Gravelly Muddy

Pool Grade: Size Type Frequency

Character of Watershed: Mountains, rolling, flat, swampy, wooded, open

Fish native to this Stream

Length of Stream 4 mi

Transplanted species

Which species thrive best

Accessible by Distance from highway

POORMAN

RIES

SPECIES PRESENT	MIGRATION PERIOD	INCUBATION PERIOD	ABUNDANCE	SURVEY METHOD/SOURCE/DATE
RAINBOW			MODERATE	SNORKEL/HANSEN/8/20/8
DOLLY VARDEN			LOW	SNORKEL/HANSEN/8/20/82
			~~Mo~~	
RAINBOW			moDerate	Snorkel/Rezanka/8-94
Bull			Low	SNORKEL/REZANKA/8-94

HABITAT QUALITY

SPAWNING MODERATE/1978, ______, ______

REARING ______, ______, ______

RESIDENT MOD-HI / 1978, ______, ______

HYDROLOGY

ACE	= PECA	- EXISTING CCE	DATE

STREAM TYPE CASCADING GRADIENT ______ DISCHARGE ______

TEMPERATURE READINGS 42°/6-13-78, ______, ______

RIPARIAN STAND CONDITIONS

AGE & DESCRIPTION PREDOMINANTLY OLD GROWTH

RECRUITMENT LEVEL & IMPORTANCE HIGH- MODERATE IMPORTANCE

ENTRIES ______ ALLOWABLE EXPOSURE ______ RETAIN OLD GROWTH ______

MANAGEMENT CONCERNS & DIRECTION

STREAM *Poorman Creek*

REACH *Big Cherry Loop bridge to Little Cherry Loop culvert* TROUT SURVEY

DATE *8-10-94* TEMP. ______

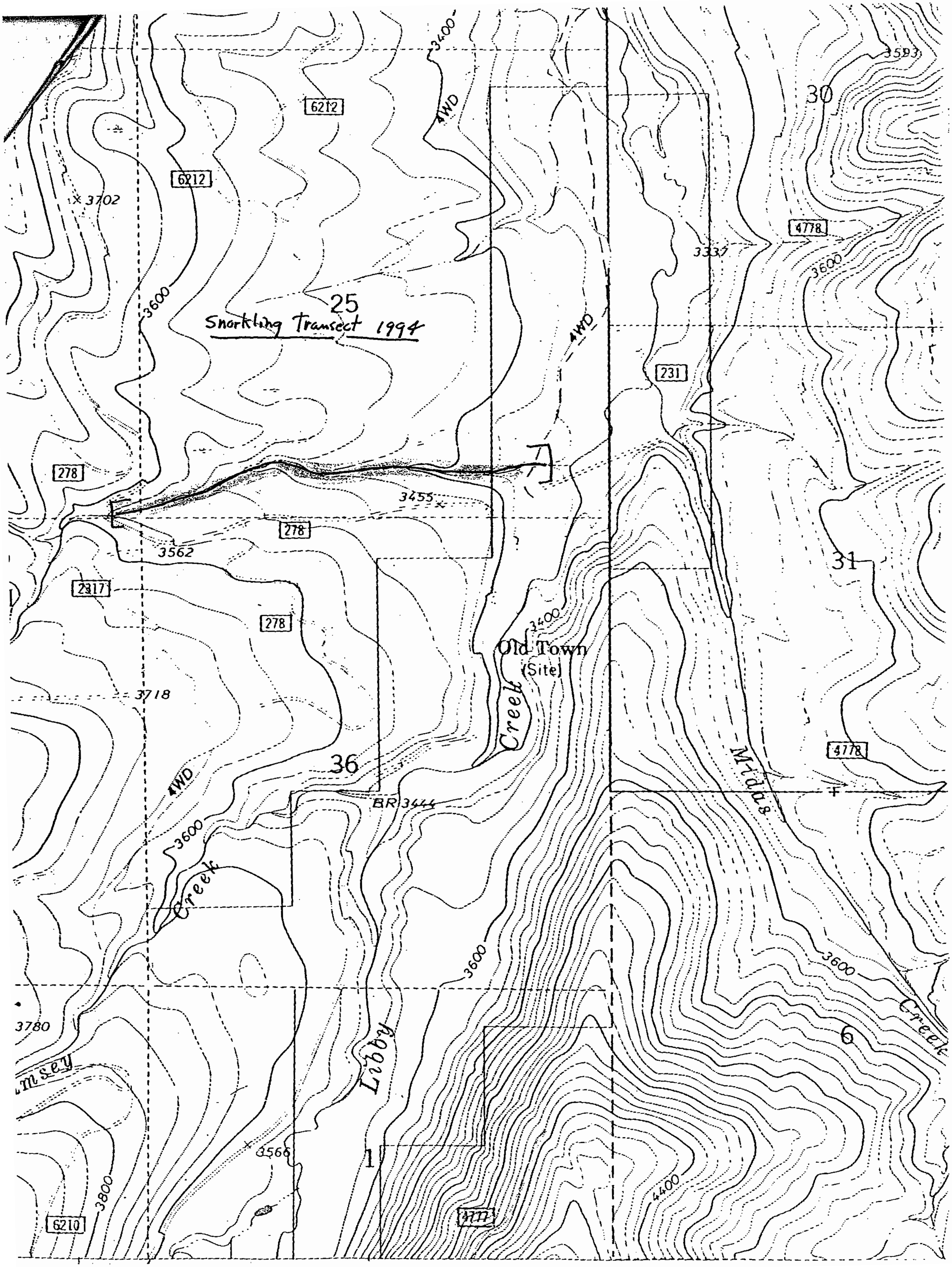
Surveyer : Resanka *Sec. 25, T 28N, R 31 W*

KEY

<3	3 - 7	>7	largest

COVER : P,F,G,E

	CLASS	W	L	A	DEPTH	COVER	RB <3	RB 3-7	RB >7	RB largest	CTT <3	CTT 3-7	CTT >7	CTT largest	BK <3	BK 3-7	BK >7	BK largest	DV <3	DV 3-7	DV >7	DV largest
1)		10'	20'		1.5'	Good	3	4	7	9												
2)		20'	10'		3'	mod.	-	5	3	10												
3)		20'	30'		5'	mod.	2	5	9	13											1	16
4)																						
5)																						
6)																						
7)																						
8)																						
9)																						
10)																						
11)																						
)																						
13)																						
14)																						
15)																						
16)																						
17)																						
18)																						
19)																						
20)																						
21)																						
22)																						
23)																						
24)																						
)																						
TOTALS																						



Snorkling Transect 1994
25
30
31
36
6
1
Old Town
(Site)
Libby Creek
Midas Creek
Creek
3400
3600
3800
4400
3702
3337
3455
3562
3718
3780
3566
3593
BR 3444
4WD
6212
4778
231
278
2317
6210
4777

STREAM POORMAN

REACH FROM MOUTH UP 200 yds.

DATE 8/20/82 TEMP. 54°

TROUT SURVEY

KEY

<3	3 - 7	>7	largest

COVER : P,F,G,E

	CLASS	W	L	A	DEPTH	COVER	RB	CTT	BK	DV
1)	2	8	8	64	2	G	2 9			
2)	2	6	4	24	1.5	E	0 3 1 7			
3)	3	4	12	48	1	E	0 1 0			
4)	4	4	12	48	1.5	G	0 3 0			
5)	2	8	20	160	2	G	0 3 1 7			
6)	3	6	12	72	1.5	G	0 4 0	SCULPIN 1		
7)	RN	6	12	72	1.2	P	0 1 0			
8)										
9)										
10)										
11)										
12)										
13)										
14)										
15)										
LOW VERT 16)	1	20	15	300	4	F	0 8 1 8			2 13
OVE 17)	3	5	10	50	2	G	0 1 1 7			
18)										
19)										
20)										
21)										
22)										
23)										
24)										
TOTALS				488			2 24 2			
							2 33 4			

39RBT
2DV

AGE DATA

Scales should be from "new" fish only

(M)

1st page only { Poorman Creek
(Water name from IBM listing)

Section 1
(Name or designation of shocking section)

Collection code ______
(from Helena)

Species code W001 (1 species per page)
(Prefix: W = wild; H = hatchery;
U = unknown or undesignated

Ordinarily only length (L) and age need be filled in. Weights required for dubbed-in ages (see Procedures).

Back Calculated Lengths

	Date	L	W	Age	Sex	1/	2					
1	8-26-76	3.8	.02	1+		2.9						
2		4.0	.02	1+		2.8						
3		4.4	.03	1+		3.6						
4		5.7	.06	1+		3.3						
5		5.9	.08	1+		3.5						
6		6.6	.10	2+		3.3	5.2					
7		6.9	.14	2+		3.0	6.2					
8												
9												
10												
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												
21												
22												
23												
24												
26												
27												
28												

1/ Enter asterisk in this column if age (in age column) is dubbed in.

Page ______ of ______ ELECTROFISHING SHEET "Rite in the Rain"

1st page only: Date 08 25 76 (mo. da. yr.) Water name Poorman Creek

Name or designation of shocking section Section 1 | T28N R31W S. 35
500' Section

Collection code ______ (from Helena) Trip type 1 (1 = mark; 2 = recovery) Species code ____ (Prefix: W = wild; H = hatchery) U = unknown or undesignate

	RB L	W1/	Mark code2/	Do Not	Punch	DV L	W1/	Mark code2/	Do Not	Punch	L	W1/	Mark code2/	Don't Punc
1	6.9	.14		Resid.		6.1	.07					Sculp.	8	
2	7.0	.16		"		3.7	.02							
3	6.6	.10		"										
4	7.0	.12		"										
5	5.9	.08		"										
6	5.5	.07		"										
7	5.8	.07		"										
8	4.1	.03		"										
9	4.4	.03		"										
0	4.0	.03		"										
1	3.8	.02		"										
2	5.7	.06		"										
3														
4														
5														
6														
7														
8														
9														
0														
1														
2														
3														
4														
5														
6														
7														
8														
9														
0														
1														
2														

Habitat Note
1. Rubble - Boulder bottom
2. good bank stability
3. Flow
4. Width Channel
5. mature timber on bank
* 6. Impassable culvert on road - note in text

1/ Weigh all "new" game fish or dub in weight. 2/ Mark code: 0 = unmarked; 1 = marked

Averages
Back Calculated Lengths
Poorman Creek – Section 1
RB – 1976

(M)

Year Class	Age	Length at Capture	Weight at Capture	Back Calculated Lengths 1	2	3
1975	1+	4.8	.04	3.2		
1974	2+	6.8	.12	3.2	5.7	

Age 1+ Aves
L at Capture = 23.8 ÷ 5 = 4.8
Wt. at Capture = .21 ÷ 5 = .04
Bk. Calc. L at 1 = 16.1 ÷ 5 = 3.2

Age 2+ Ave.s
L at Capture = 13.5 ÷ 2 = 6.8
Wt. at Capture = .24 ÷ 2 = .12
Bk. Calc. L at 1 = 6.3 ÷ 2 = 3.2
Bk. Calc. L. at 2 = 11.4 ÷ 2 = 5.7

T27N R31W

S 1

11-5240 Code No. 11-5240

Type water 10

Name of STREAM Poorman Cr. COUNTY Lincoln

Tributary of Libby Cr., Kootenai River Section of Stream

Source Barriers

Diversions NR Stump Ranch Pollutions

Tributaries

Permanency and Flooding

Type of Shore Line: Sandy Gravelly Muddy Vegetated

Type of Bed: Sandy Boulders Gravelly Muddy

Pool Grade: Size Type Frequency

Character of Watershed: Mountains, rolling, flat, swampy, wooded, open

Fish native to this Stream

Length of Stream 4 mi

Transplanted species

Which species thrive best

Accessible by Distance from highway

Appendix E.
Creel survey reports.

STATE OF MONTANA
FISH AND GAME DEPARTMENT
CREEL CENSUS

SOURCE CODE
9 - ALL WINTER
8 - WARDENS
7 - LOGS
3 - ALL SUMMER
2 - WARDENS
1 - LOGS

CATION: RAMSEY CREEK
YEAR: 62
DRAINAGE: 11 | AREA: 5400 | TYPE: 1
T27N R3W

SOURCE	SPECIES NAME	SPECIES CODE	NO. FISH	% OF TOTAL	AVG. LENGTH	NO. OF FISHERMEN	HOURS	CATCH/HR
3	RAINBOW TROUT	1	13	92.9	7.0			
	DOLLY VARDEN	5	1	7.1	8.0			
			14	100.0 *		4	3.5	4.0
1	RAINBOW TROUT	1	13	92.9	7.0			
	DOLLY VARDEN	5	1	7.1	8.0			
			14	100.0 *		4	3.5	4.0

MONTANA DEPARTMENT OF FISH WILDLIFE & PARKS
FISHERMAN LOG SUMMARY
PRINTED JANUARY 3, 1983

POORMAN CREEK WATER CODE 1-11-5240-1
COUNTY: LINCOLN

SEASON	SPECIES	NUMBER OF FISH	PERCENT OF TOTAL	AVERAGE LENGTH	MAN-DAYS	HOURS FISHED	GAME AND SPORT FISH CATCH/HOUR
MAY 81 THRU NOV 81	CUTTHROAT TROUT	6	100.00	8.0			
TOTALS		6	100 %		1	.5	12.0

****

MONTANA DEPARTMENT OF FISH AND GAME

FISHERMAN LOG SUMMARY   PREPARED   JANUARY 9, 1980

LITTLE CHERRY CREEK   WATER CODE 01-11-3900-10
COUNTY - LINCOLN

SEASON	SPECIES	NUMBER OF FISH	PERCENT OF TOTAL	AVERAGE LENGTH	MAN-DAYS	HOURS FISHED	GAME AND SPORT FISH CATCH PER HOUR
MAY 78 THRU NOV 78	CUTTHROAT TROUT	10	100.00	10.0			
TOTALS		10	100 %		1	1.5	6.7

****

Appendix F.
Fish genetics analysis correspondence and data.

January 22, 2004

Mike

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 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.

Robb

	Location	T	R	S	col	Number of Fish W	F_1	R
	East Fisher drainage							
✓	East Fisher	25	29	12	8/18/00	0	2	23
	Silver Butte drainage							
✓	Silver Butte	26	29	30	8/23/00	0	2	23
	Pleasant Valley drainage							
NO	Deer	28	27	19	8/30/93	1	1	11
	Wolf drainage							
NO	Richards	29	28	17	9/21/01	0	1	19
	Libby drainage							
✓	Bear	28	31	21	7/11/00	0	1	29
NO	Ramsey	27	31	10	8/22/00	0	1	24
	Big Cherry drainage							
	above Leigh	29	31	34	2000	18	1	6
	between Snow + Deep	29	31	27	8/16/00	0	2	23

W = westslope
F_1 = hybrid
R = rainbow

Location	T	R	S	col	Number of fish W	F$_1$	R
Yaak drainage							
East Fork	37	30	29	9/15/87	0	3	19
✓ East Fork	37	30	29	8/9/00	0	1	29
Blacktail	37	30	17	8/21/91	0	5	20
✓ Blacktail	37	30	20	8/9/00	0	3	22
Solo Joe	37	30	32	9/19/90	0	3	24
✓ Solo Joe	37	30	32	2000	0	0	25
✓ Caribou	37	30	22	7/19/86	0	1	23

Note the distributions in the East Fork, Blacktail, and Solo Joe samples statistically have been temporally stable indicating these should be considered redband populations with a small proportion of hybrid individuals.

Alleyne

2113-8503

Creek	ID	Percent RB	CR	WCT	YCT
Barnum Cr	BARN	X	(X)	2 X	
Pleasant Valley Fisher River	PF__	X			
Loon Lake	LLHI	X	X?		
McGinnis Creek	MCFR				
Miller Creek	SFM	X		X	
Fisher River Near McKillop Cr	FRMC	X	X		
Wolf Creek Fairview	WCFU				
Wolf Cr Below Calx (4 samples	WCBC				
Libby Cr Bt Ramsey Cr + Hazard Cr	LCAR	X			
Ramsey Creek	RAMS	X		one Hybrid	
Poorman Creek	POOR				
Field Station Spring Cr	LFSC	X	X		
Libby Cr bt Big Cherry Cr + Swamp Cr	LCBS				
Granite Cr Below Falls	GCBF	X		one	
Big Cherry Creek Above Leigh Cr	BCAL				
Big Cherry Cr Between Deep + Snowshoe	BCBS	X		X low	
Big Cherry Cr Below Deep Cr	BCBD	X			
Standard Cr W. Fisher	SCWF			X	
Trail Creek	TCWF	X		X	
Lake Cr.	LCWF	X		½ Fish	
West Fisher Cr below Trail	WFBT	X	—	X	
Silver Butte Fisher Above Iron Meadows	SBAI				
Silver Butte Fisher Below E. Fisher Cr	SBBE	X		2 RBxWCT	
East Fisher Cr. Below Miller Lake	EFBM	X		2 RBxWCT	
Grave Cr.	GC__			X	
Pipe Cr Below East Fk	PCBE	X	X	X	
Bear Creek	____?				

Creek	ID	RB	CR	WC	YC
YAAK R Below W. FK + Vinal Cr	YRAV	X			
Solo Joe Cr	SJYR	X			
Blacktail Cr	BTYR				
E. FK YAAK Below Blacktail	EFYR				
~~Caribou Cr~~	~~CCEY~~				

Barnum mostly RB
Marl mostly RB
Deer more Hybridized w/ WCT

Note: Most ^or all^ of the tributaries to Koocanusa (including Grave Creek and Lodge Creek) have some amount of Augmentation

Risks:

For WCT

- W. Fk. Yaak is at (1) due to Barrier Falls
- There are many small headwater streams that have "pure" WCT but I don't know of any that are above "permanent" barriers

For IRB

- EFK Yaak - Falls
- Callahan - Falls maybe not a barrier to DV
- Wolf Creek - Quite possible temp?
- Pleasant Valley Fisher - Temp?
- Silver Butte Fisher } temp?
- East Fisher

If anybody starts popping off about Fishing regulations, Slap 'em upside the head and tell them it was from Hensler

We need up to date Genetic maps that include all USFS surveys. Ours haven't Been updated since about '95.

2160
7440

IF I was to draw a map of the historic distribution of WCT & IRB I would have to say it looks like WCT distribution extends to the entire Kootenai drainage, top to bottom. IRB distribution implies, I think, that they came in to the population later and presumably **out** competed, etc the local WCT pops (if they even existed at time of invasion). The assumption is that something of a barrier may have existed near present Libby Dam (there is a fault there). For whatever reasons, the distribution of IRB did not "effective" pass beyond that area.

Currently we are seeing WCT in most Basins, generally at the head ends in high gradient or above high gradie

To say that Kootenai Falls is or was a barrier to IRB is a bit presumptious. The IRB in E.Fk. Yaak are considered Native and wild, they exist above Yaak Falls (elev 2440) which is Greater elevation than Kootenai Falls (2160). Therefore the probability exists that somewhere between 7000 years ago and today, some other Function served to separate the species and define their distributions.

WCT Comments

① Add Two Falls

Current Distn 1) E. Fk. Yaak NE 1/4 sec 25 T37 R31
Complete upstream Barrier ≈ 50 ft

2) Callahan Creek
- Partial
- Probably to RB maybe not DV
NE 1/4 sec 23 T31 R33

② Redband (IRB) range includes
- All Basins downstream of Libby dam → not Lake Creek (WCT)
- Libby Cr drainage appears to be IRB
- Fisher drainage is IRB
upper and smaller High gradient streams are WCT
- WCT/IRB Hybrids should be considered wild + native until proven otherwise
- West Fisher Creek
  - Upper WCT
  - Lower IRB

WCT range
- West Fk Yaak
- Lake Creek
- Above Libby Dam
- Upper West Fisher
- High Gradient Fisher Tribs.

February 13, 2004

Amee Rief
Kootenai National Forest
Troy Ranger Station
1437 North Highway 2
Troy, Montana 59935

Amee;

We have completed the protein electrophoretic analysis of the following trout collected from the Kootenai River drainage:

Sample	T	R	S	Col date	Sample size
Beetle Creek	36N	23W	2	6/30/03	25
Cedar Creek	31N	32W	33	7/30/03	25
Colonite Creek	53N	29W	2	7/31/03	25
Doe Creek	29N	29W	21	7/28/03	26
Houghton Creek	26N	29W	14	8/5/03	25
Parmenter Creek	30N	31W	10	7/24/03	25

Horizontal starch gel electrophoresis was used to determine each fish's genetic characteristics (genotype) at 45 loci (genes) coding for proteins present in muscle, liver, or eye tissue (Table 1). At some of these loci, westslope cutthroat trout, *Oncorhynchus clarki lewisi,* and rainbow trout, *O. mykiss*, rarely share alleles (form of a gene) in common (Table 2). This situation also pertains to a comparison of westslope and Yellowstone cutthroat trout, *O.c. bouvieri*, and rainbow and Yellowstone cutthroat trout (Table 2). Loci at which such fixed genetic differences exist between taxa are commonly termed diagnostic loci because the alleles detected at them can be used to help determine whether a sample came from a non-hybridized population of one of these fishes or a population in which hybridization between or all three of them has or is occurring.

Allele frequencies at *LDH-B2** and *sSOD-1** also differentiate Columbia River redband trout (redband), *O.m. gairdneri*, and coastal rainbow trout, *O.m. irideus*. Redband trout are native to the Columbian River drainage east of the Cascade Mountain crest presumably up to barrier falls on the Snake, Pend Oreille, Spokane, and Kootenai rivers (Behnke 1992). Populations of this fish usually possess the *LDH-B2*76* allele at a frequency greater than 0.250 and the *sSOD-1*152* allele at a frequency less than 0.100 (Knudsen et al. 2002). In contrast, coastal rainbow trout are native to waters west of the Sierra Nevada and Cascade Mountain crests in the continental United States (Behnke 1992). Populations of this fish usually possess *LDH-B2*76* at a frequency less than 0.100 and *sSOD -1*152* at a frequency greater than 0.150 (Knudsen et al. 2002). These alleles are generally absent from westslope cutthroat trout populations (e.g. Leary et al. 1997; Leary 2003 a,b). In conjunction with information from the diagnostic loci, therefore, allele frequencies at these loci can help determine whether redband, coastal rainbow trout, or both had a genetic contribution to a population.

Alleles characteristic of only westslope cutthroat trout were detected at all the loci analyzed in the samples from Beetle Creek, Colonite Creek, and Houghton Creek (Table 3). With a sample size of 25 fish and the number of diagnostic loci analyzed, we have better than a 99% chance of detecting as little as a two percent rainbow trout or a one percent Yellowstone cutthroat trout genetic contribution to a population. These samples, therefore, almost undoubtedly came from non-hybridized westslope cutthroat trout populations.

In the Parmenter Creek sample, alleles characteristic of only rainbow trout were detected in all the fish except two (Table 4). The latter two fish possessed alleles characteristic of both rainbow and Yellowstone cutthroat trout among the diagnostic loci between these fishes that were analyzed indicating they were definitely of hybrid origin (Table 4). The non-random distribution of rainbow and Yellowstone cutthroat trout alleles at diagnostic loci among the fish suggests that at the time of sampling this reach of Parmenter Creek contained a mixture of mainly rainbow trout and a small proportion of hybrids between rainbow and Yellowstone cutthroat trout. Considering just the rainbow trout, the allele frequencies at *LDH-B2** and *sSOD-1** are highly characteristic of redband trout (Table 4). Thus, we can further state that when sampled this reach of Parmenter Creek predominantly contained non-hybridized redband trout and a few hybrids between rainbow and Yellowstone cutthroat trout. The proportion of rainbow trout alleles among the hybrids (0.10) is too small to allow a reliable determination of whether they were produced from redband or coastal rainbow trout. Since redband trout were highly predominant in the sample, we suggest from a management perspective the stream reach be considered containing redband trout. Obviously, however, the presence of fish of hybrid origin threatens the future genetic integrity of the redband trout population.

The sample from Doe Creek contained alleles characteristic of both westslope cutthroat and rainbow trout at all the diagnostic loci analyzed between these fishes (Table 5). Like the Parmenter Creek sample, however, the rainbow and westslope cutthroat trout alleles at the diagnostic loci are not randomly distributed among the fish in the sample. In contrast, ten fish were definitely of hybrid origin and the remaining 16 appeared to be non-hybridized westslope cutthroat trout (Table 5). At the time of sampling, therefore, Doe Creek appeared to contain a mixture of westslope cutthroat trout and hybrids between this fish and rainbow trout. Since the sample contained an appreciable proportion of non-hybridized and hybridized fish, from a management perspective we suggest the stream reach sampled simply be considered containing hybridized fish.

In order to determine whether redband, coastal rainbow trout, or both fishes had a genetic contribution to the hybridized fish in Doe Creek, the allele frequencies at *LDH-B2** and *sSOD-1** have to be corrected for the westslope cutthroat trout genetic contribution. Since *LDH-B2*76* and *sSOD-1*152* are usually not present in westslope cutthroat trout populations, the frequency of these alleles in the rainbow trout genetic contribution to the hybridized fish is the observed frequency divided by the average rainbow trout genetic contribution (0.290). The corrected LDH-B2*76 frequency of 0.172 is intermediate to those characteristic of redband and coastal rainbow trout while the corrected sSOD-1*152 frequency of 0.000 is characteristic of redband trout. Taken together these results strongly indicate both redband and coastal rainbow trout have had a genetic contribution to the hybridized fish.

Alleles characteristic of only rainbow trout were detected at all the loci analyzed in the Cedar Creek sample (Table 6). With the 25 fish collected and number of diagnostic loci analyzed, we have better than a 99% chance of detecting as little as a two percent westslope or one percent Yellowstone cutthroat trout genetic contribution to the population. The Cedar Creek population, therefore, is almost undoubtedly non-hybridized rainbow. Furthermore, the LDH-B2*76 and sSOD-1*152 frequencies are highly characteristic of coastal rainbow trout indicating this population to be predominantly if not solely coastal rainbow trout.

Sincerely,

Robb Leary

Literature Cited

Behnke, R.J. 1992. Native trout of western North America. American Fisheries Society Monograph 6.

Knudsen, K.L., C.C. Muhlfeld, G.K. Sage, and R.F. Leary. 2002. Genetic structure of Columbia River redband trout populations in the Kootenai River drainage, Montana. Transactions of the American Fisheries Society 131: 1093-1105

Leary, R.F. 2003a. Letter to Mike Hensler, Montana Department of Fish, Wildlife, and Parks. May 1, 2003.

Leary, R.F. 2003b. Letter to Lee Brundin, Kootena National Forest. October 10, 2003.

Leary, R.F., F.W. Allendorf, and N. Kanda. 1997. Lack of genetic divergence between westslope cutthroat trout from the Columbia and Missouri river drainages. University of Montana Wild Trout and Salmon Genetics Laboratory Report 97/1.

Table 1
Enzymes and loci examined. Tissues: E=eye, L=liver, M=muscle

Enzyme	Loci	Tissue
Adenylate kinase	*AK-1*, AK-2**	M
Alcohol dehydrogenase	*ADH**	L
Aspartate aminotransferase	*sAAT-1*,sAAT-2**	L
	*sAAT-3,4**	M
Creatine kinase	*CK-A1*, CK-A2**	M
	CK-B, CK-C1*, CK-C2**	E
Dipeptidase	*PEPA-1*, PEPA-2**	E
Glucose-6-phosphate isomerase	*GPI-A**	E
	GPI-B1, GPI-B2**	M
Glyceraldehyde-3-phosphate dehydrogenase	*GAPDH-3*, GAPDH-4**	E
Glycerol-3-phosphate dehydrogenase	*G3PDH-1*, G3PDH-2**	L
N-aceytl-beta glucosaminidase	*bGLUA**	L
Iditol dehydrogenase	*IDDH**	L
Isocitrate dehydrogenase	*mIDHP-1*, mIDHP-2**	M
	sIDHP-1, sIDHP-2**	L
Lactate dehydrogenase	*LDH-A1*, LDH-A2**	M
	LDH-B1, LDH-B2*, LDH-C**	E
Malate dehydrogenase	*sMDH-A1,2**	L
	*sMDH-B1,2**	M
Malic enzyme	*sMEP-1**	M
	*sMEP-2**	L
Phosphoglucomutase	*PGM-1*, PGM-2**	M
	*PGM-1r**	L

Table 1- continued

Enzyme	Loci	Tissue
Phosphogluconate dehydrogenase	*PGDH**	M
Superoxide dismutase	*sSOD-1**	L
Tripeptide aminopeptidase	*PEPB**	E
Xanthine dehydrogenase-like	*XDH-l**	L

Table 2
Alleles at the diagnostic loci that differentiate westslope cutthroat trout and rainbow trout, westslope and Yellowstone cutthroat trout, and rainbow or Yellowstone cutthroat trout. When more than one allele exists at a locus within a taxon, the most common allele is listed first.

Locus	Taxa and characteristic alleles	
	Westslope	Rainbow
*sAAT-1**	*200, 250*	*100*
*CK-A2**	*84*	*100*
*GPI-A**	*92, 100*	*100*
*IDDH**	*40, 100*	*100, 200, 40*
*sIDHP-1**	*86, 71*	*100, 114, 71, 40*
	Westslope	Yellowstone
*sAAT-1**	*200, 250*	*165*
*CK-C1**	*100, 38*	*100*
*GPI-A**	*92, 100*	*100*
*IDDH**	*40, 100*	*100*
*mIDHP-1**	*100*	*-75*
*sIDHP-1**	*86, 71*	*71*
*sMEP-1**	*100, 70*	*90*
*sMEP-2**	*100*	*110*
*PEPA-1**	*100*	*101*
*PEPB**	*100*	*135*
*PGM-1**	*100, 110, null*	*Null*
	Rainbow	Yellowstone
*sAAT-1**	*100*	*165*
*CK-A2**	*100*	*84*
*CK-C1**	*100, 38, 150*	*38*
*mIDHP-1**	*100*	*-75*
*sIDHP-1**	*100, 114, 71, 40*	*71*
*sMEP-1**	*100*	*90*
*sMEP-2**	*100, 75*	*110*
*PEPA-1**	*100, 115*	*101*
*PEPB**	*100, 120*	*135*
*PGM-1**	*100, 110, null*	*null*

Table 3
Allele frequencies at the loci showing evidence of genetic variation in samples from what appear to be non-hybridized westslope cutthroat trout populations in Beetle Creek, Colonite Creek, and Houghton Creek.

		Sample and allele frequencies		
Locus	Alleles	Beetle	Colonite	Houghton
*sAAT-1**	*200*	1.000	1.000	0.717
	Null	-	-	0.283
*bGLUA**	*100*	0.180	1.000	1.000
	90	0.820	-	-
*IDDH**	*40*	1.000	0.920	1.000
	100	-	0.080	-
*sMDH-B1,2**	*100*	1.000	0.990	1.000
	83	-	0.010	-

Table 4
Allele frequencies at the loci showing evidence of genetic variation and at *sSOD-1** in what appear to be 23 non-hybridized redband trout collected from Parmenter Creek. Genotypes at the diagnostic loci between rainbow trout and Yellowstone cutthroat trout in two hybridized fish of these taxa in the sample. Y=only Yellowstone alleles detected at the locus, Y/R= both Yellowstone and rainbow alleles detected at the locus.

Locus	Alleles	Allele frequencies
*G3PDH-1**	*100*	0.978
	140	0.022
*bGLUA**	*100*	0.978
	90	0.022
*sIDHP-1,2**	*100*	0.500
	71	0.261
	40	0.239
*LDH-B2**	*100*	0.283
	76	0.717
*sSOD-1**	*100*	1.000
	152	-

Diagnostic locus and genotype

No.	*sAAT-1**	*CK-A2**	*CK-C1**	*mIDHP-1**	*sIDHP-1**
16	Y/R	Y	Y	Y	Y
19	Y	Y	Y	Y	Y

No.	*sMEP-1**	*sMEP-2**	*PEPA-1**	*PEPB**	*PGM-1**
16	Y	Y	Y	Y/R	Y
19	Y	Y	Y/R	Y	Y/R

Table 5

Allele frequencies at the loci showing evidence of genetic variation in what appear to be 16 non-hybridized westslope cutthroat trout collected from Doe Creek. Genotypes at the diagnostic loci between westslope cutthroat and rainbow trout in ten hybridized fish of these taxa in the sample. W=only westslope alleles detected, W/R=both westslope and rainbow alleles detected, R=only rainbow alleles detected.

Locus	Alleles	Allele frequencies
*ADH**	*100*	0.293
	null	0.707
*sIDHP-2**	*100*	0.969
	40	0.031
*LDH-B2**	*100*	0.438
	24	0.563
*sMDH-B1,2**	*100*	0.438
	125	0.563

Hybrid Individuals

	Diagnostic locus and genotype				
No.	*sAAT-1**	*CK-A2**	*GPI-A**	*IDDH**	*sIDHP-1**
1	W/R	W/R	W/R	W/R	W/R
4	W	W/R	W	W/R	W/R
6	W/R	W	W/R	W/R	W/R
8	W/R	W	W	W/R	W/R
9	W/R	W/R	W	W/R	W/R
13	W	W/R	W/R	W/R	W/R
16	R	W/R	W	W	W
18	W	W	W	W/R	W
19	W	W	W	W/R	W
21	W	W	W	W/R	W

Table 6
Allele frequencies at the loci showing evidence of genetic variation in what appears to be largely if not solely a coastal rainbow trout population in Cedar Creek.

Locus	Alleles	Allele frequencies
*sAAT-3,4**	*100*	0.970
	92	0.030
*G3PDH-1**	*100*	0.920
	140	0.080
*bGLUA**	*100*	0.940
	70	0.060
*sIDHP-1,2,**	*100*	0.630
	71	0.190
	40	0.180
*LDH-B2**	*100*	0.920
	76	0.080
*LDH-C**	*100*	0.900
	95	0.100
*sMDH-A1,2**	*100*	0.960
	40	0.040
*sMDH-B1,2**	*100*	0.860
	83	0.140
*sMEP-1**	*100*	0.760
	90	0.240
*sSOD-1**	*100*	0.260
	152	0.740

The University of Montana

Division of Biological Sciences
The University of Montana
Missoula, Montana 59812-4824
Phone: (406) 243-5122
FAX: (406) 243-4184

May 1, 2003

Mike Hensler
Montana Department of Fish, Wildlife, and Parks
475 Fish Hatchery Road
Libby, MT 59923

Mike;

We have completed the protein electrophoretic analysis of the trout collected from the following waters in the Kootenai River drainage (collection locations within the drainage and within subdrainages are generally listed from upstream to downstream):

Subdrainage and collection location	Collection date	Sample size
Graves Creek		
at Lewis confluence	2000	8
above Blue Sky	2000	13
at Clarence confluence	2000	12
Fisher River		
Pleasant Valley Fisher River		
above Loon Lake	7/10/00	30
Barnum Creek	8/23/00	19
Loon Lake at Happys Inn	5/31/00	21
McGinnis Creek	8/18/00	25
Silver Butte Fisher River		
East Fisher Creek	8/18/00	25
above Iron Meadow	8/18/00	24
below East Fisher Creek	8/23/00	25
West Fisher Creek		
Standard Creek	8/11/00	14
Lake Creek at campground	8/11/00	25
Trail Creek	8/11/00	24
West Fisher Creek	8/11/00	25
Miller Creek		
South Fork Miller Creek	7/31/00	10
Miller Creek below mile 1 marker	7/31/00	10
Miller Creek sideroad by highway	7/31/00	10

Subdrainage and collection location	Collection date	Sample size
Fisher River near McKilbo Creek	11/28/00	25
Wolf Creek below Calyx Creek	8/1/00	4
Libby Creek		
Ramsey Creek	8/22/00	25
Libby Creek above Ramsey below Howard	2000	30
Poorman Creek	8/22/00	25
Libby Creek between Big Cherry & Swamp	8/18/00	25
Libby Field Station Spring Creek	10/19/00	25
Bear Creek		
upper bridge	7/11/00	9
¼ mile below bridge	7/11/00	21
Big Cherry Creek		
above Leigh	2000	25
between Smearl and Deep	8/10/00	25
Granite Creek below Falls	8/22/00	26
below Deep	8/10/00	25
Pipe Creek below East Fork	8/21/00	25
Yaak River		
Solo Joe Creek	2000	25
East Fork Yaak River below Blacktail	8/9/00	30
Blacktail Creek	8/9/00	25
Yaak River West Fork to Vinal	11/8/00	25

Horizontal starch gel electrophoresis was used to determine each fish's genetic characteristics at 43 loci (genes) coding for proteins present in muscle, liver, or eye tissue (Table 1). At some of these loci, westslope cutthroat trout, *Oncorhynchus clarki lewisi* and rainbow trout, *O. mykiss*, rarely share alleles (form of a gene) in common (Table 2). This situation also pertains to a comparison of westslope and Yellowstone cutthroat trout, *O. c. bouvieri,* and Yellowstone cutthroat and rainbow trout (Table 2). Loci at which such fixed genetic differences exist between taxa are commonly termed diagnostic loci because the alleles detected at them can be used to help determine whether a sample came from a non-hybridized population of one of these fishes or a population in which hybridization between two or all three of them has or is occurring.

Allele frequencies at *LDH-B2** and *sSOD-1** also differentiate Columbia River redband trout (redband), *O. m. gairdneri*, and coastal rainbow trout, *O. m. irideus*. Redband trout, or those native to the Fraser and Columbia River drainages east of the Cascade Mountain crest up to the barrier falls on the Pend Oreille, Spokane, Snake, and Kootenai Rivers (Behnke 1992) usually possess the *LDH-B2*76* allele at a frequency greater than 0.250

and the *sSOD-1*152* allele at a frequency less than 0.100 (Knudsen et al. 2002). In contrast, coastal rainbow trout, or those native to waters west of the Sierra Nevada and Cascade Range crest in the continental United States (Behnke 1992) usually possess *LDH-B2*76* at a frequency less than 0.100 and *sSOD-1*152* at a frequency greater than 0.150 (Knudsen et al. 2002). Allele frequencies at these loci, therefore, can help determine whether redband, coastal rainbow trout, or both had a genetic contribution to a population.

Graves Creek drainage

Evidence of genetic variation was detected at three loci among the samples collected from Graves Creek (Table 3). Contingency table chi-square analysis indicated the allele frequencies were statistically homogenous among the samples at all the genetically variable (polymorphic) loci (Table 3). Thus, there is no indication the samples came from genetically divergent populations so they were combined into one for further analysis.

Alleles characteristic of only westslope cutthroat trout were detected in the Graves Creek sample (Table 3). With the sample size of 33, we have better than a 96 percent chance of detecting as little as a one percent rainbow trout genetic contribution to the population and better than a 99 percent chance of detecting as little as a one percent Yellowstone cutthroat trout genetic contribution to the population. Graves Creek, therefore, almost undoubtedly contains a non-hybridized westslope cutthroat trout population.

Fisher River drainage

Alleles characteristic of only rainbow trout were detected in the Pleasant Valley Fisher River sample collected above Loon Lake and the McGinnis Creek sample (Table 4). The allele frequencies at *LDH-B2** and *sSOD-1** in both samples are characteristic of redband trout. With the sample size of 30 for the Pleasant Valley Fisher River, we have better than a 95 percent chance of detecting as little as a one percent westslope or Yellowstone cutthroat trout genetic contribution to the population. This population, therefore, is almost undoubtedly non-hybridized redband trout. With the 25 fish collected from McGinnis Creek, we have better than a 95 percent chance of detecting as little as a one percent Yellowstone cutthroat genetic contribution to the population, but only a 92 percent chance of detecting as little as a one percent westslope cutthroat trout genetic contribution to the population. Thus, we cannot reasonably exclude the possibility that the McGinnis Creek population may be slightly hybridized with westslope cutthroat trout. Although the status of this population is somewhat uncertain, the conservative approach would be to consider it non-hybridized redband trout unless future data indicate otherwise.

The Barnum Creek sample contained alleles characteristic of both rainbow and westslope cutthroat trout at the all the diagnostic loci between these fishes from which we were able to obtain data (Table 5). The rainbow and westslope cutthroat trout alleles do not appear to be randomly distributed among the fish in the sample. In contrast, significantly (x^2_1 = 1,011.320; P<0.001) more fish appeared to be non-hybridized rainbow (N=4) or westslope cutthroat trout (N=2) than expected by chance. Thus, at the time of sampling the Barnum Creek population contained mainly individuals of hybrid origin, but also some non-hybridized rainbow and westslope cutthroat trout. From a practical perspective, however, this population should simply be treated as a hybridized one.

In order to determine whether redband, coastal rainbow, or both taxa had a genetic contribution to the Barnum Creek population, we have to correct the allele frequencies at *LDH-B2** and *sSOD-1** for the presence of a westslope cutthroat trout genetic contribution. Since *LDH-B2*76* and *sSOD-1*152* are usually not present in westslope cutthroat trout populations, the frequency of these alleles in the rainbow trout contributing genes to the population is the observed frequency divided by the average rainbow trout genetic contribution. These corrected allele frequencies are characteristic of redband trout at *LDH-B2** (Table 5). At *sSOD-1**, however, the corrected allele frequencies are characteristic of coastal rainbow trout (Table 5). Thus, both redband and coastal rainbow trout have had a genetic contribution to the Barnum Creek population.

Alleles characteristic of only rainbow trout were detected in the Loon Lake sample. With the sample size of 21, we can reasonably exclude the possibility the population is slightly hybridized with Yellowstone cutthroat trout, but we have only an 88 percent chance of detecting as little as a one percent westslope cutthroat trout genetic contribution to the population. We cannot, therefore, reasonably exclude the possibility that the population may be slightly hybridized with westslope cutthroat trout. Unless future data indicate otherwise, however, the conservative approach would be to treat Loon lake as non-hybridized rainbow trout.

At *LDH-B2**, the observed genotypic distribution significantly differed (x^2_1=5.965; $P<0.025$) from that expected based on random mating. This was due to observing significantly more homozygous (individuals possessing two copies of the same allele at a locus) and less heterozygous (individuals possessing two different alleles at a locus) genotypes than expected. The simplest explanation for this deviation from expected random mating proportions is that the sample contained fish from two or more genetically divergent populations. Thus, we cannot obtain meaningful allele frequency estimates from the sample and determine whether or not the fish represent redband, coastal rainbow trout, or both. *LDH-B2*76*, however, was fairly common among the fish collected indicating that redband trout at least had a partial genetic contribution to the sample.

Alleles characteristic of both rainbow and westslope cutthroat trout were detected at the diagnostic loci analyzed between these fishes in the samples from East Fisher River, Silver Butte Fisher River above Iron Meadow, and Silver Butte Fisher River below East Fisher (Table 6). The westslope cutthroat trout alleles, however, were not randomly distributed among the fish in any of the samples. In the East Fisher River sample, the westslope cutthroat trout alleles were detected in only two fish. One fish was heterozygous at all diagnostic loci suggesting it to be a first generation hybrid and the other was heterozygous at one diagnostic locus and homozygous for rainbow trout alleles at the others indicating it was a post first generation hybrid (Table 6). In the Silver Butte Fisher River sample above Iron Meadow, two fish appeared to be westslope cutthroat trout, one a first generation hybrid, and five to be post first generation hybrids (Table 6). Only two fish possessed westslope cutthroat trout alleles in the Silver Butte Fisher River sample below East Fisher River and both were post first generation hybrids (Table 6). The remaining fish in all three samples possessed alleles characteristic of only rainbow trout indicating they probably were non-hybridized rainbow trout. Thus, at the time of sampling the East Fisher River and Silver Butte Fisher below East Fisher appear to have contained a mixture of rainbow trout and fish of hybrid origin. Silver Butte Fisher River above Iron Meadow appears to have contained a mixture of rainbow trout, westslope cutthroat trout, and fish of hybrid origin when it was sampled.

Only those fish that appeared to be rainbow trout in the East Fisher River and the two Silver Butte Fisher River samples were used to determine whether they were redband, coastal rainbow trout, or both. In all three samples, the allele frequencies at *LDH-B2** and *sSOD-1** were highly characteristic of redband trout indicating the fish were probably redband (Table 7).

In the West Fisher River drainage, all the loci analyzed in the Standard Creek sample were invariant for alleles characteristic of westslope cutthroat trout. Because of the small sample size, we cannot reasonably exclude the possibility that the Standard Creek population may be slightly hybridized with rainbow trout, Yellowstone cutthroat trout, or both but evidence of hybridization was not detected because of sampling error. Although the status of this population is uncertain, the conservative approach would be to consider it non-hybridized westslope cutthroat trout unless future data indicate otherwise.

Alleles characteristic of both rainbow and westslope cutthroat trout were detected at the diagnostic loci analyzed between these fishes in the Lake Creek and Trail Creek samples. The westslope cutthroat trout alleles, however, do not appear to be randomly distributed among the fish in either of these samples. In contrast, the Lake Creek sample appeared to contain six rainbow trout, six westslope cutthroat trout, and 13 post first generation hybrids (table 6). Likewise, the Trail Creek sample appeared to contain 11 rainbow trout, four westslope cutthroat trout, and nine post first generation hybrids (Table 6). Thus, at the time of sampling both populations appeared to be a mixture of rainbow trout, westslope cutthroat trout, and fish of hybrid origin.

The allele frequencies at *LDH-B2** and *sSOD-1** in the rainbow trout collected from Trail Creek are both characteristic of redband trout (Table 8). These fish, therefore, appear to be at least mainly redband trout. We cannot conclude they are not hybridized with coastal rainbow trout with much conviction, however, because with the small sample size we cannot reasonably exclude the possibility of a slight coastal rainbow trout genetic influence.

The rainbow trout collected form Lake Creek appear to be both coastal rainbow and redband trout. The *LDH-B2** allele frequencies are characteristic of coastal rainbow, but the *sSOD-1** allele frequencies are characteristic of redband trout (Table 8). Thus, we conclude these fish are probably hybridized coastal rainbow and redband trout.

At all the diagnostic loci analyzed between westslope cutthroat and rainbow trout in the West Fisher Creek sample collected below Trail Creek, alleles characteristic of both taxa were detected (Table 9). The alleles at these loci appear to be randomly distributed among the fish indicating the population to be a hybrid swarm between rainbow and westslope cutthroat trout in which essentially all fish are of hybrid origin.

After corrected for hybridization with westslope cutthroat trout, the allele frequencies at *LDH-B2** in the West Fisher Creek sample are characteristic of redband trout (Table 9). The allele frequencies at *sSOD-1**, however, fall between those characteristic of redband and coastal rainbow trout indicating hybridization between these fishes most likely has occurred within the population. Overall, therefore, this population appears to be a hybrid swarm among westslope cutthroat, coastal rainbow, and redband trout.

In the Miller Creek drainage, alleles characteristic of only westslope cutthroat trout were detected in the South Fork Miller Creek sample (Table 10). Because of the small sample size, we cannot reasonably exclude the possibility that the population may be slightly hybridized with rainbow trout, Yellowstone cutthroat trout, or both fishes but this was not detected because of sampling error. Although the status of this population is uncertain, the conservative approach would be to consider it non-hybridized westslope cutthroat trout unless future data indicate otherwise.

Contingency table chi-square analysis indicates the allele frequencies were statistically homogeneous at all the genetically variable loci between the two Miller Creek samples. These samples, therefore, were combined into one for further analysis.

Alleles characteristic of both rainbow and westslope cutthroat trout were detected at all the diagnostic loci analyzed between these fishes in the Miller Creek sample (Table 11). The westslope cutthroat trout alleles, however, do not appear to be randomly distributed among the fish in the sample. In contrast the sample appears to have contained six non-hybridized rainbow trout and 14 post first generation hybrids. Thus, at the time of sampling the Miller Creek population appears to have been a mixture of rainbow trout and fish of hybrid origin between rainbow and westslope cutthroat trout. From a practical perspective, however, the population should simply be considered hybridized since the majority of fish appear to be of hybrid origin.

Allele frequencies corrected for hybridization with westslope cutthroat trout in the Miller Creek sample at *sSOD-1** are characteristic of redband trout (Table 11). The corrected allele frequencies at *LDH-B2**, however, fall between those characteristic of redband and coastal rainbow trout (Table 11). Hybridization between these two fishes, therefore, also appears to have occurred in the Miller Creek drainage.

In the Fisher River sample collected near McKilbo Creek, alleles characteristic of only rainbow trout were detected (Table 12). With the sample size of 25, we have better than a 95 percent chance of detecting as little as a one percent Yellowstone cutthroat trout genetic contribution to the population. Thus, we can be reasonably sure hybridization with Yellowstone cutthroat trout has not occurred within the population. On the other hand, we have only a 92 percent chance of detecting as little as a one percent westslope cutthroat trout contribution to the population. We cannot, therefore, reasonably exclude the possibility that the population may be slightly hybridized with westslope cutthroat trout, but unless future data indicate otherwise the conservative approach would be to consider the population non-hybridized with cutthroat trout.

Allele frequencies at *LDH-B2** in the Fisher River sample are marginally characteristic of redband trout, but the *sSOD-1** allele frequencies are highly characteristic of coastal rainbow trout (Table 12). This almost undoubtedly, therefore, is a hybridized population of redband and coastal rainbow trout with a substantial coastal rainbow trout genetic contribution.

The sample from Wolf Creek appeared to contain three non-hybridized redband trout and one first generation hybrid between redband and westslope cutthroat trout (Tables 6 and 13). Because of the extremely small sample size, no further statements regarding the status of this population can be made.

Libby Creek drainage

The sample from Ramsey Creek appeared to contain 24 redband trout and a single post first generation hybrid between redband and westslope cutthroat trout (Tables 6 and 14). Since hybridization between redband and westslope cutthroat trout appears to be infrequent in Ramsey Creek and the vast majority of the fish appear to be redband trout, from a management perspective we do not consider it inappropriate to consider the population to be redband trout.

Alleles characteristic of only rainbow trout were detected in the samples collected from Libby Creek above Ramsey and Poorman Creek (Table 14). With the sample size of 30 from Libby Creek, we can reasonably exclude the possibility that this population may be slightly hybridized with westslope or Yellowstone cutthroat trout. This population, therefore, is almost undoubtedly non-hybridized rainbow trout. With the sample size of 25 from Poorman Creek, we can reasonably exclude the possibility the population may be slightly hybridized with Yellowstone cutthroat trout, but we cannot reasonably exclude the possibility it may be slightly hybridized with westslope cutthroat trout. Although the status of the Poorman Creek population is somewhat uncertain, conservatively it should be considered non-hybridized rainbow trout unless future data indicate otherwise.

The *LDH-B2** and *sSOD-1** allele frequencies in the samples collected from Libby Creek above Ramsey and Poorman Creek are characteristic of redband trout (Table 14). These populations therefore appear to be redband trout.

Only alleles characteristic of rainbow trout were detected in the samples collected from Libby Creek between Big Cherry and Swamp and Libby Field Station Spring Creek (Table 15). In both samples, the *LDH-B2** allele frequencies are characteristic of redband trout. The *sSOD-1** allele frequencies in the Libby Creek sample are intermediate between those characteristic of redband and coastal rainbow trout while they are characteristic of coastal rainbow trout in the Spring Creek sample. Thus, we conclude both Libby Creek between Big Cherry and Swamp and Libby Field Station Spring Creek contain hybridized populations of redband and coastal rainbow trout.

Contingency table chi-square analysis indicated the allele frequencies were statistically homogeneous at all the genetically variable loci between the Bear Creek samples collected at the upper bridge and one-quarter mile below it. Thus, the samples were combined into a single Bear Creek sample for further analysis.

The Bear Creek sample appeared to contain 29 redband trout and a first generation hybrid between redband and westslope cutthroat trout (Tables 6 and 16). Since hybridization between redband and westslope cutthroat trout appears to be infrequent in the Bear Creek population and the majority of the fish appear to be non-hybridized redband trout, from a management perspective it would not be inappropriate to consider Bear Creek a redband trout population.

The sample from Big Cherry Creek above Leigh Creek contained what appeared to be 18 westslope cutthroat trout which were genetically invariant at all loci examined, six redband trout (Table 16), and one post first generation hybrid between these fishes (Table 6). Thus, at the time of sampling this section of the creek appeared to be mainly a mixture of redband and westslope cutthroat trout with a small proportion of fish of hybrid origin.

The sample from Big Cherry Creek collected between Smearl and Deep appeared to contain 23 redband trout (Table 16) and two post first generation hybrids between redband and westslope cutthroat trout (Table 6). Thus, like the other situations in which only a few fish of hybrid origin were found in a predominantly non-hybridized redband trout population, from a management perspective it would not be inappropriate to consider this portion of Big Cherry Creek to be occupied by redband trout.

Alleles characteristic of only rainbow trout were detected in the Big Cherry Creek sample collected below Deep Creek (Table 16). With the sample size of 25, we can reasonably exclude the possibility that the population may be slightly hybridized with Yellowstone cutthroat trout but not westslope cutthroat trout. Like other situations in which the status of a population is somewhat uncertain we suggest a conservative interpretation be adopted. That is, consider the population to be non-hybridized.

The allele frequencies in the Big Cherry Creek below Deep Creek sample at *LDH-B2** and *sSOD-1** are both highly characteristic of redband trout (Table 16). Thus, at the time of sampling this portion of Big Cherry Creek also appears to have been mainly, if not solely, occupied by redband trout.

The Granite Creek sample appears to have contained 24 redband trout and one westslope cutthroat trout (Table 16). This population, therefore, appears to be predominantly redband trout with a small proportion of westslope cutthroat trout. It is of course also possible it may contain a small proportion of fish of hybrid origin, but they were not detected because of sampling error.

Pipe Creek drainage

Alleles characteristic of both rainbow and westslope cutthroat trout were detected at all the diagnostic loci analyzed between these fishes in the sample collected from Pipe Creek below the East Fork (Table 17). Although the westslope cutthroat trout alleles are not randomly distributed among the fish in the sample, the allele frequencies at *LDH-B2** and *sSOD-1** corrected for westslope cutthroat trout hybridization strongly suggest the population is also hybridized between redband and coastal rainbow trout. The *LDH-B2** allele frequencies are characteristic of redband trout, but the *sSOD-1** allele frequencies are intermediate between those characteristic of redband and coastal rainbow trout (Table 17). Thus, this population should simply be considered hybridized, containing a genetic contribution from westslope cutthroat, redband, and coastal rainbow trout.

Yaak River drainage

The sample from the East Fork Yaak River collected below Blacktail contained 29 redband trout and one post first generation hybrid between redband and westslope cutthroat trout (Tables 6 and 18). Similarly, the Blacktail Creek sample contained 22 redband trout, one first generation hybrid between redband and westslope cutthroat trout, and two post first generation hybrids between these fishes (Tables6 and 18). Again, since redband trout are by far the predominant fish in these populations, it would not be inappropriate from a management perspective to consider them redband trout.

Alleles characteristic of only rainbow trout were detected in the Solo Joe Creek and Yaak River samples (Table 18). With the 25 fish in each sample, we can reasonably exclude the possibility that these populations may be slightly hybridized with Yellowstone cutthroat trout, but not westslope cutthroat trout. As in similar situations where the status of populations was somewhat uncertain, we suggest the conservative approach of considering them non-hybridized be adopted.

The *LDH-B2** and *sSOD-1** allele frequencies in both the Solo Joe and Yaak River samples are highly characteristic of redband trout (Table 18). These populations, therefore, apparently are non-hybridized redband trout.

Genetic divergence among redband trout populations in the Kootenai River drainage.

Using protein electrophoretic data from redband trout populations in North Fork Callahan Creek and South Fork Callahan Creek and three Yaak River populations (East Fork, Basin Creek, and Porcupine Creek), Knudsen et al. (2002) reported substantially more genetic divergence between populations from the two drainages than among populations within the drainages. Of the total genetic variation detected, 15.5% was due to differences between populations from the drainages and only 3.5% to differences among populations within the drainages. Based on these results they suggested that if supplementation of redband trout populations was to be considered that drainage specific broodstocks would be required to avoid substantially altering the genetic characteristics of many populations.

Since we now have protein electrophoretic data from many more redband trout populations in the Kootenai River drainage we felt it would be worthwhile to reinvestigate how much genetic divergence exists among them. Thus, we used the procedure of Chakraborty (1980) to partition the total amount of genetic variation detected among the samples into the proportion due to genetic differences among populations from different drainages, differences among populations within drainages, and genetic variation within populations. The analysis used data from the 28 loci analyzed in common between the investigation of Knudsen et al (2002) and our study, with the exception of *PGM-1**. This locus was eliminated from the analysis since the null allele can conclusively be detected only in homozygous individuals. Because of this, it will be detected only in populations in which it exists at appreciable frequency. The allele frequencies at the locus, therefore, are bimodal with many populations lacking the null allele and the remainder possessing it a frequency greater than 0.250. Thus, inclusion of this locus in the analysis would result in an inflated estimate of the amount of genetic divergence among populations.

The analysis included the five samples previously analyzed by Knudsen et al. (2002), a sample of Gerrard redband trout also analyzed by Knudsen et al. (2002), and all samples we analyzed that contained 20 or more redband trout with the exception of Poorman Creek and Big Cherry Creek above Leigh in the Libby Creek drainage and Blacktail Creek in the Yaak River drainage. These samples were excluded from the analysis because data from *sIDHP-1,2** was not obtainable from them.

The results indicate that 7.8% of the total genetic variation detected is due to genetic differences among populations in the Fisher River, Libby Creek, Callahan Creek, and Yaak River drainages and Gerrard redband derived from Kootenay Lake fish. An additional 6.7% of the total genetic variation detected is attributable to genetic differences among populations within individual drainages. Thus, unlike the previous results which indicated there was substantial genetic divergence between populations from different drainages but very little divergence among populations within drainages our results suggest appreciable divergence exists at both levels. Based on these results we suggest that a more conservative supplementation program is warranted than previously recommended. That is, instead of developing broodstocks at the drainage level it would be more advisable to consider developing them at the individual population level.

Sincerely,

Robb Leary

Robb Leary

Literature cited

Behnke, R.J. 1992. Native trout of western North America. American Fisheries Society Monograph 6.

Chakraborty, R. 1980. Gene-diversity analysis in nested subdivided populations. Genetics 96: 721-726.

Knudsen, K.L., C.C. Muhlfeld, G.K. Sage, and R.F. Leary. 2002. Genetic structure of Columbia River redband trout populations in the Kootenai River drainage, Montana, revealed by microsatellite and allozyme loci. Transactions of the American Fisheries Society 131: 1093-1105.

TABLE 1

Enzymes and loci examined. Tissues: E = eye, L = liver, M = muscle.

Enzyme	Loci	Tissue
Adenylate kinase	*AK-1*, AK-2**	M
Alcohol dehydrogenase	*ADH**	L
Aspartate aminotransferase	*sAAT-1*, sAAT-2**	L
	*sAAT-3,4**	M
Creatine kinase	*CK-A1*, CK-A2**	M
Dipeptidase	*PEPA-1*, PEPA-2**	E
Glucose-6-phosphate isomerase	*GPI-A*, GPI-B1*, GPI-B2**	M
Glyceraldehyde-3-phosphate dehydrogenase	*GAPDH-3*, GAPDH-4**	E
Glycerol-3-phosphate dehydrogenase	*G3PDH-1*, G3PDH-2**	L
N-acetyl-beta-glucosaminidase	*bGLUA**	L
Iditol dehydrogenase	*IDDH**	L
Isocitrate dehydrogenase	*mIDHP-1*, mIDHP-2**	M
	*sIDHP-1,2**	L

TABLE 1 — *continued*

Enzyme	Loci	Tissue
Lactate dehydrogenase	*LDH-A1*, LDH-A2**	M
	LDH-B1, LDH-B2*, LDH-C**	E
Malate dehydrogenase	*sMDH-A1,2**	L
	*sMDH-B1,2**	M
Malic enzyme	*mMEP-2**	M
	*sMEP-1,2**	L
Phosphoglucomutase	*PGM-1*, PGM-2**	M
	*PGM-1r**	L
Phosphogluconate dehydrogenase	*PGDH**	M
Superoxide dismutase	*sSOD-1**	L
Tripeptide aminopeptidase	*PEPB**	E
Xanthine dehydrogenase	*XDH**	L

TABLE 2

Alleles at the diagnostic loci that differentiate westslope cutthroat trout and rainbow trout, westslope cutthroat and Yellowstone cutthroat trout, or rainbow and Yellowstone cutthroat trout. When more than one allele exists at a locus within a taxon, the most common allele is listed first.

Locus	Taxa and characteristic alleles	
	Westslope	Rainbow
*sAAT-1**	*200, 250*	*100*
*CK-A2**	*84*	*100, 75*
*GPI-A**	*92, 100*	*100*
*IDDH**	*40, 100*	*100, 200, 40*
*sIDHP-1**	*86, 71*	*100, 114, 71, 40*
	Westslope	Yellowstone
*sAAT-1**	*200, 250*	*165*
*GPI-A**	*92, 100*	*100*
*IDDH**	*40, 100*	*100*
*mIDHP-1**	*100*	*-75*
*sIDHP-1**	*86, 71*	*71*
*sMEP-1**	*100, 70*	*90*
*sMEP-2**	*100*	*110*
*PEPA-1**	*100*	*101*
*PEPB**	*100*	*135*
*PGM-1**	*100, 110, null*	*null*
	Rainbow	Yellowstone
*sAAT-1**	*100*	*165*
*CK-A2**	*100, 75*	*84*
*mIDHP-1**	*100*	*-75*
*sIDHP-1**	*100, 114, 71, 40*	*71*
*sMEP-1**	*100*	*90*
*sMEP-2**	*100, 75*	*110*
*PEPA-1**	*100, 115*	*101*
*PEPB**	*100, 120*	*135*
*PGM-1**	*100, 110, null*	*null*

TABLE 3

Allele frequencies at the loci showing evidence of genetic variation in three samples from a non-hybridized westslope cutthroat trout population in Graves Creek. X^2 is contingency table chi-square statistic with two degrees of freedom for heterogeneity of allele frequencies among the samples. Combined are allele frequencies when the samples are combined into one.

Locus	Alleles	Lewis	Blue Sky	Clarence	X^2	Combined
		Sample and allele frequencies				
*bGLUA**	*100*	0.625	0.885	0.727	3.990	0.766
	90	0.375	0.115	0.273		0.234
*LDH-B2**	*100*	0.938	0.923	0.792	2.704	0.879
	76	0.062	0.077	0.208		0.121
*PGM-2**	*100*	0.938	1.000	1.000	3.205	0.985
	85	0.062	-	-		0.015

TABLE 4

Allele frequencies at the loci showing evidence of genetic variation in samples from two redband trout populations in the Pleasant Valley Fisher River drainage.

		Sample and allele frequencies	
Locus	Alleles	McGinnis	Pleasant Valley above Loon Lake
*sAAT-1**	*100*	1.000	0.475
	null	-	0.525
*GPI-A**	*100*	1.000	0.983
	92	-	0.017
*bGLUA**	*100*	0.980	0.833
	90	0.020	-
	80	-	0.167
*sIDHP-1,2**	*100*	0.513	0.573
	71	0.263	0.073
	40	0.225	0.354
*LDH-B2**	*100*	0.580	0.633
	76	0.420	0.367
*sMDH-B1,2**	*100*	0.990	0.983
	83	0.010	0.017
*PGM-2**	*100*	1.000	0.900
	90	-	0.100
*sSOD-1**	*100*	1.000	0.933
	152	-	0.067

TABLE 5

Allele frequencies at the diagnostic loci between westslope cutthroat and rainbow trout analyzed from a hybridized population of these fishes in Barnum Creek. At each locus, the allele characteristic of rainbow trout is listed first. Allele frequencies at *LDH-B2** and *sSOD-1** in the rainbow trout contributing to the population corrected for the westslope cutthroat trout genetic contribution are also given.

Locus	Alleles	Allele frequencies
*sAAT-1**	*100*	0.553
	200	0.447
*CK-A2**	*100*	0.763
	84	0.267
*GPI-A**	*100*	0.553
	92	0.447
*IDDH**	*100*	0.806
	40	0.194
Average rainbow		0.669
Average westslope		0.331
Allele frequencies corrected for westslope cutthroat trout hybridization		
*LDH-B2**	*100*	0.646
	76	0.354
*sSOD-1**	*100*	0.803
	152	0.197

TABLE 6

Genotypes of individuals of hybrid origin at the diagnostic loci between redband and westslope cutthroat trout analyzed in samples from redband trout populations containing some hybridized fish. R=homozygous for redband trout alleles. H=heterozygous for redband and westslope cutthroat trout alleles. W=homozygous for westslope cutthroat trout alleles. NS=locus not scoreable.

	Locus and genotype				
Individual	*sAAT-1**	*CK-A2**	*GPI-A**	*IDDH**	*sIDHP-1**
East Fisher River					
1	R	R	H	R	R
2	H	H	H	H	H
Silver Butte Fisher River above Iron Meadow					
1	R	R	H	R	R
2	H	H	H	R	H
3	H	H	H	H	H
4	R	H	W	W	R
5	W	W	W	W	H
6	H	H	W	H	H
Silver Butte Fisher River below East Fisher					
1	R	R	R	H	R
2	H	R	R	H	H
Lake Creek					
1	H	R	H	R	H
2	R	H	R	R	R
3	R	R	R	H	H
4	R	R	H	H	R
5	H	R	H	R	R
6	R	W	H	W	R
7	H	R	R	R	R
8	H	R	H	H	R
9	R	R	R	R	H
10	R	R	H	H	H
11	R	H	R	R	R
12	H	W	H	H	H
13	H	W	W	R	H

TABLE 6 – continued

Individual	Locus and genotype				
	*sAAT-1**	*CK-A2**	*GPI-A**	*IDDH**	*sIDHP-1**
Trail Creek					
1	H	H	R	R	R
2	H	R	H	W	H
3	R	H	H	H	R
4	H	H	W	W	H
5	R	R	R	H	R
6	W	W	H	W	H
7	R	R	H	R	R
8	R	H	H	R	R
9	W	W	H	H	R
Wolf Creek					
1	H	H	H	H	H
Ramsey Creek					
1	H	R	R	R	H
Bear Creek					
1	H	H	H	H	NS
Big Cherry Creek above Leigh					
1	H	H	R	H	NS
Big Cherry between Smearl and Deep					
1	R	R	H	R	H
2	H	R	R	R	H
East Fork Yaak River below Blacktail					
1	H	R	H	R	NS
Blacktail Creek					
1	H	R	R	H	NS
2	H	R	H	H	NS
3	H	H	H	H	NS

TABLE 7

Allele frequencies at the loci showing evidence of genetic variation in samples from redband trout populations in the Silver Butte Fisher River drainage. All samples also contained hybridized individuals between redband and westslope cutthroat trout and the sample collected above Iron Meadow also contained westslope cutthroat trout. See text for further details.

		Samples and allele frequencies		
		East Fork	Silver Butte Fisher River	
Locus	Alleles	Fisher River	below East Fisher	above Iron Meadow
*sIDHP-1,2**	*100*	0.716	0.690	0.672
	71	0.193	0.131	0.125
	40	0.091	0.179	0.203
*LDH-B2**	*100*	0.348	0.413	0.500
	76	0.652	0.587	0.500
*sMDH-B1,2**	*100*	0.989	1.000	1.000
	83	0.011	-	-
*PEPA-1**	*100*	1.000	1.000	0.969
	115	-	-	0.031
*PGM-1**	*100*	1.000	1.000	0.750
	Null	-	-	0.250
*PGM-2**	*100*	0.978	1.000	1.000
	90	0.022	-	-
*sSOD-1**	*100*	0.978	0.978	1.000
	152	0.022	0.022	-

TABLE 8

.Allele frequencies at the genetically variable loci in what appears to be mainly redband trout collected from Trail Creek and probably a hybridized group of coastal rainbow and redband trout collected from Lake Creek.

		Sample and allele frequencies	
Locus	Alleles	Lake	Trail
*bGLUA**	*100*	1.000	0.955
	80	-	0.045
*sIDHP-1,2**	*100*	0.708	0.705
	71	0.083	0.159
	40	0.208	0.136
*LDH-B2**	*100*	0.917	0.455
	76	0.083	0.545
*PGM-1**	*100*	0.592	1.000
	Null	0.408	-
*PGM-2**	*100*	1.000	0.955
	90	-	0.045
*sSOD-1**	*100*	1.000	0.955
	152	-	0.045

TABLE 9

Allele frequencies at the diagnostic loci analyzed between rainbow trout and westslope cutthroat trout in a sample collected from a hybridized population of these fishes in West Fisher Creek. At each locus, the allele characteristic of westslope cutthroat trout is listed last. The allele frequencies at *LDH-B2** and *sSOD-1** corrected for hybridization with westslope cutthroat trout further indicate hybridization between coastal rainbow and redband trout has occurred in the population.

Locus	Alleles	Allele frequencies
*sAAT-1**	*100*	0.940
	200	0.060
*CK-A2**	*100*	0.940
	84	0.060
*GPI-A**	*100*	0.979
	92	0.021
*IDDH**	*100*	0.980
	40	0.020
*sIDHP-1**	*100*	0.140
	71	0.300
	40	0.540
	86	0.020
Average rainbow		0.964
Average westslope		0.036
Allele frequencies corrected for hybridization with westslope cutthroat trout.		
*LDH-B2**	*100*	0.668
	76	0.332
*sSOD-1**	*100*	0.896
	152	0.104

TABLE 10

Allele frequencies at the loci showing evidence of genetic variation in a sample from what appears to be a non-hybridized westslope cutthroat trout population in South Fork Miller Creek.

Locus	Alleles	Allele frequencies
*sAAT-1**	*200*	0.684
	null	0.316
*LDH-B2**	*100*	0.850
	24	0.150

TABLE 11

Allele frequencies at the diagnostic loci analyzed between rainbow and westslope cutthroat trout in a sample from the population in Miller Creek in which hybridization between these fishes has occurred. At each locus, the allele characteristic of westslope cutthroat trout is listed last. The allele frequencies at *LDH-B2** and *sSOD-1** corrected for hybridization with westslope cutthroat trout further indicate hybridization between coastal rainbow and redband trout has occurred within the population.

Locus	Alleles	Allele frequencies
*sAAT-1**	*100*	0.763
	200	0.237
*CK-A2**	*100*	0.800
	84	0.200
*GPI-A**	*100*	0.775
	92	0.225
*IDDH**	*100*	0.711
	40	0.289
*sIDHP-1**	*100*	0.429
	71	0.107
	40	0.179
	86	0.286
Average rainbow		0.753
Average westslope		0.247
Allele frequencies corrected for westslope cutthroat trout hybridization.		
*LDH-B2**	*100*	0.867
	76	0.133
*sSOD-1**	*100*	0.967
	152	0.033

TABLE 12

Allele frequencies at the genetically variable loci in a sample from a hybridized population of redband and coastal rainbow trout collected from the Fisher River near McKilbo Creek.

Locus	Alleles	Allele frequencies
*bGLUA**	*100*	0.840
	80	0.120
	70	0.020
*IDDH**	*100*	0.980
	150	0.020
*sIDHP-1,2**	*100*	0.667
	71	0.156
	40	0.177
*LDH-B2**	*100*	0.820
	76	0.180
*sMDH-A1,2**	*100*	0.990
	40	0.010
*sMDH-B1,2**	*100*	0.900
	83	0.050
	74	0.050
*sMEP-2**	*100*	0.980
	75	0.020
*PGM-1**	*100*	0.717
	Null	0.283
*PGM-2**	*100*	0.940
	90	0.060
*sSOD-1**	*100*	0.780
	152	0.220

TABLE 13

Allele frequencies at the genetically variable loci in what appear to be three redband trout collected from Wolf Creek. The sample also contained a single first generation hybrid between redband and westslope cutthroat trout.

Locus	Alleles	Allele frequencies
*sIDHP-1,2**	*100*	0.750
	71	0.125
	40	0.125
*LDH-B2**	*100*	0.500
	76	0.500

TABLE 14

Allele frequencies at the genetically variable loci in samples from what appear to be three redband trout populations in the Libby Creek drainage. The Ramsey Creek sample also contained one post first generation hybrid between redband and westslope cutthroat trout which was not included for the calculation of allele frequencies. N.S. = locus not scoreable.

		Sample and allele frequencies		
Locus	Alleles	Ramsey	Libby above Ramsey	Poorman
*IDDH**	*100*	1.000	1.000	0.980
	150	-	-	0.020
*sIDHP-1,2**	*100*	0.675	0.560	N.S.
	71	0.125	0.095	
	40	0.200	0.345	
*LDH-A1**	*100*	0.958	1.000	1.000
	Null	0.042	-	-
*LDH-B2**	*100*	0.708	0.433	0.280
	76	0.292	0.533	0.720
	24	-	0.033	-
*sMDH-B1,2**	*100*	1.000	0.992	0.970
	83	-	0.008	0.030
*PEPA-1**	*100*	1.000	0.867	1.000
	115	-	0.133	-
*PGM-1**	*100*	1.000	0.592	1.000
	Null	-	0.408	-
*sSOD-1**	*100*	1.000	0.983	0.980
	152	-	0.017	0.020

TABLE 15

Allele frequencies at the loci showing evidence of genetic variation in samples from hybridized populations of redband and coastal rainbow trout collected from Libby Creek between Big Cherry and Swamp (Libby) and Libby Field Station Spring Creek (Spring) in the Libby Creek drainage.

Locus	Alleles	Sample and allele frequencies Libby	Spring
*G3PDH-1**	*100*	0.980	1.000
	140	0.020	-
*bGLUA**	*100*	0.780	0.800
	80	0.220	0.180
	70	-	0.020
*IDDH**	*100*	0.920	0.940
	150	0.080	0.060
*sIDHP-1,2**	*100*	0.615	0.680
	71	0.167	0.070
	40	0.219	0.250
*LDH-B2**	*100*	0.760	0.640
	76	0.240	0.360
*sMDH-B1,2**	*100*	0.970	0.920
	125	-	0.010
	95	-	0.010
	83	0.030	0.060
*sMEP-2**	*100*	1.000	0.980
	75	-	0.020
*PGM-1**	*100*	0.510	0.717
	Null	0.490	0.283
*PGM-2**	*100*	0.900	0.820
	90	0.100	0.180
*sSOD-1**	*100*	0.880	0.840
	152	0.120	0.160

TABLE 16

Allele frequencies at the genetically variable loci in samples of 29 redband trout collected from Bear Creek, six collected from Big Cherry Creek above Leigh (Leigh), 23 from Big Cherry between Smearl and Deep (Smearl), 25 from Big Cherry below Deep (Deep), and 25 from Granite Creek. The Bear Creek sample also contained one first generation hybrid between redband and westslope cutthroat trout. The Big Cherry Creek sample above Leigh contained one post first generation hybrid between redband and westslope cutthroat trout and the sample collected between Smearl and Deep two such fish. The Big Cherry Creek sample above Leigh also contained 18 westslope cutthroat trout and one such fish was present in the Granite Creek sample. NS=locus not scoreable in sample.

		Sample and allele frequencies				
Locus	Alleles	Bear	Leigh	Smearl	Deep	Granite
*CK-A1**	*100*	1.000	1.000	0.978	1.000	1.000
	75	-	-	0.022	-	-
*bGLUA**	*100*	1.000	1.000	0.804	0.940	0.980
	80	-	-	0.196	0.060	0.020
*IDDH**	*100*	1.000	1.000	0.935	0.960	0.940
	150	-	-	0.065	0.040	0.060
*sIDHP-1,2**	*100*	0.618	NS	0.798	0.610	0.730
	71	0.211		0.131	0.250	0.220
	40	0.171		0.071	0.140	0.050
*LDH-B2**	*100*	0.362	0.417	0.674	0.540	0.260
	76	0.638	0.583	0.326	0.460	0.740
*sMDH-B1,2**	*100*	1.000	1.000	0.989	1.000	0.990
	125	-	-	0.011	-	-
	83	-	-	-	-	0.010
*PEPA-1**	*100*	0.931	1.000	1.000	1.000	1.000
	115	0.069	-	-	-	-
*PGM-1**	*100*	0.413	1.000	1.000	1.000	0.471
	Null	0.587	-	-	-	0.529
*PGM-2**	*100*	0.983	1.000	0.783	0.980	1.000
	110	0.017	-	-	-	-
	90	-	-	0.217	0.020	-
*sSOD-1**	*100*	0.983	0.917	0.957	1.000	1.000
	152	0.017	0.083	0.043	-	-

TABLE 17

Allele frequencies at the diagnostic loci between rainbow and westslope cutthroat trout analyzed in a sample collected from a hybridized population of these fishes in Pipe Creek below the East Fork. At each locus, the allele characteristic of westslope cutthroat trout is listed last. The allele frequencies at *LDH-B2** and *sSOD-1** corrected for hybridization with westslope cutthroat trout further indicate hybridization between redband and coastal rainbow trout has occurred in the population.

Locus	Alleles	Allele frequencies
*sAAT-1**	*100*	0.860
	200	0.140
*CK-A2**	*100*	0.900
	84	0.100
*GPI-A**	*100*	0.860
	92	0.140
*IDDH**	*100*	0.880
	40	0.120
*sIDHP-1**	*100*	0.360
	71	0.300
	40	0.180
	86	0.160
Average rainbow		0.868
Average westslope		0.132
Allele frequencies corrected for westslope cutthroat trout hybridization.		
*LDH-B2**	*100*	0.470
	76	0.530
*sSOD-1**	*100*	0.862
	151	0.138

TABLE 18

Allele frequencies at the loci showing evidence of genetic variation in 29 redband trout collected from the East Fork Yaak River, 25 from Solo Joe Creek, 22 from Blacktail Creek, and 25 from the Yaak River. The East Fork Yaak River sample also contained a post first generation hybrid between redband and westslope cutthroat trout and the Blacktail Creek sample two such fish and a first generation hybrid.

		Sample and allele frequencies			
Locus	Alleles	Solo Joe	E.F.Yaak	Blacktail	Yaak
*bGLUA**	*100*	1.000	1.000	0.955	0.960
	80	-	-	0.045	0.040
*LDH-B2**	*100*	0.220	0.086	0.045	0.080
	76	0.780	0.914	0.955	0.920
*sMDH-B1,2**	*100*	1.000	1.000	1.000	0.980
	74	-	-	-	0.020
*PGM-2**	*100*	1.000	1.000	0.977	1.000
	90	-	-	0.023	-
*sSOD-1**	*100*	1.000	1.000	1.000	0.960
	152	-	-	-	0.040

October 10, 2003

Lee Brundin
Kootenai National Forest
Libby Ranger District
12577 Highway 37
Libby, MT 59923

Lee:

We have completed the protein electrophoretic analysis of the following trout samples collected from streams in the Kootenai River drainage (Note samples are generally listed from upstream to downstream):

Drainage and Stream	T (N)	R (W)	S	Collected	N
Fisher River					
Syrup Creek	30	27	29 NE ¼	9/21/01	18 redband
Richards Creek	29	28	17 SW ¼	9/21/01	20
Libby Creek					
Bear Creek	28	31	19 SE ¼	10/2/01	10
Big Cherry Drainage					
Horse Creek	29	31	6 SE ¼	9/4/01	15
Shaughnessy Creek	29	31	5 NW ¼	9/4/01	15
Prospect Creek	30	31	32 NW ¼	9/4/01	16
Flower Creek					
Flower Creek		?		?	17
South Fork Flower Creek	30	31	30 NE ¼	9/24/01	16
Pipe Creek					
East Fork Drainage					
Deception Creek	34	31	27 NW ¼	9/12/01	9
East Fork Pipe Creek	34	31	26 SW ¼	10/1/01	14
Beulah Creek	33	31	3 SW ¼	9/12/01	16
Pipe Creek (upper)	33	31	16 SW ¼	9/25/01	14
Pipe Creek ~~(lower)~~ unnamed trib to Pipe Sec 5	32	31	5 NE ¼	9/4/01	13

Drainage and Stream	T (N)	R (W)	S	Collected	N
Quartz Creek					
Hemlock Creek	33	32	10 SW ¼	9/13/01	15
Flattail Creek tributary	33	32	14 NE ¼	9/25/01	17
Flattail Creek	33	32	15 NE ¼	9/13/01	11
Lost Fork (upper)	33	32	29 NE ¼	9/13/01	19
Lost Fork (lower)	33	32	23 SW ¼	9/13/01	8
Big Foot Creek	33	32	35 NW ¼	9/13/01	19
Seventeen Mile Creek	33	32	35	?	4
Quartz Creek	32	32	14 NW ¼	9/25/01	18
Unlabeled Sample		?		?	19

Horizontal starch gel electrophoresis was used to determine each fish's genetic characteristics at 43 loci (genes) coding for proteins in muscle, liver, or eye tissue (Table 1). At some of these loci, westslope cutthroat trout, *Oncorhynchus clarki lewisi*, and rainbow trout, *O. mykiss*, rarely share alleles (form of a gene) in common (Table 2). Loci at which such fixed genetic differences exist between taxa are commonly termed diagnostic loci because the alleles detected at them can help to determine whether a sample came from a non-hybridized population of one of these fishes or a population in which hybridization between two or all three of them has or is occurring.

Allele frequencies at *LDH-B2** and *sSOD-1** also differentiate Columbia River redband trout (redband), *O.m. gairdneri*, and coastal rainbow trout, *O.m. irideus*. Redband trout, or those native to the Fraser and Columbia River drainages east of the Cascade Mountain crest up to barrier falls on the Pend Oreille, Spokane, Snake, and Kootenai Rivers (Behnke 1992) usually possess the *LDH-B2*76* allele at a frequency greater than 0.250 and the *sSOD-1*152* allele at a frequency less than 0.100 (Knudsen et al. 2002). In contrast, coastal rainbow trout or those native to waters west of the Sierra Nevada and Cascade Range crest in the continental United States (Behnke 1992), usually possess *LDH-B2*76* at a frequency less than 0.100 and *sSOD-1*152* at a frequency greater than 0.150 (Knudsen et al. 2002). Allele frequencies at these loci, therefore, can help determine whether redband, coastal rainbow trout, or both had a genetic contribution to a population.

Fisher River drainage

The fish in the sample from Syrup Creek had genetic characteristics highly typical of redband trout (Table 3). This population, therefore, appears to be non-hybridized redband trout. With the sample size of 18, however, we can only reasonably exclude the possibility the population may be slightly hybridized with Yellowstone cutthroat trout. Although this population may be slightly hybridized with westslope cutthroat or coastal rainbow trout, conservatively it should be considered redband unless future data indicate otherwise.

The Richards Creek sample had allele frequencies at *LDH-B2** and *sSOD-1** intermediate to those characteristics of redband and coastal rainbow trout. (Table 4). Thus, this appears to be a hybridized population of redband and coastal rainbow trout.

The Richards Creek sample also contained one fish that was heterozygous for alleles characteristic of westslope cutthroat and rainbow trout at three of the five diagnostic loci analyzed between these fishes (note this individual was not included in the above analysis). This population, therefore, also contains some fish of recent hybrid origin with westslope cutthroat trout.

Libby Creek drainage

Allele frequencies at *LDH-B2** were intermediate to those characteristics of redband and coastal rainbow trout in the Bear Creek sample (Table 3). In contrast, allele frequencies at *sSOD-1** in the sample were highly characteristic of redband trout (Table 3). The status of this population, therefore, is somewhat uncertain. It could be redband trout with unusual genetic characteristics or it could be a hybridized population of redband and coastal rainbow trout. In this situation, we strongly favor the former interpretation because previous analysis of fish collected further down the Bear Creek drainage indicated them to be redband trout (Leary 2003), and no lakes that potentially may contain non-native trout exist in the drainage above the present sample.

The Shaughnessy Creek sample contained alleles characteristic of both westslope cutthroat and rainbow trout at three of the five diagnostic loci analyzed between these fishes (Table 5). The rainbow trout alleles appear to be randomly distributed among the fish in the sample indicating it came from a hybrid swarm between westslope cutthroat and rainbow trout in which essentially all fish are of hybrid origin. The proportion of rainbow trout alleles in the population is too small to allow for a reasonable assessment of whether they originated from redband, coastal rainbow trout, or both fishes.

Alleles characteristic of both westslope cutthroat and rainbow trout were detected at all the diagnostic loci analyzed between these fishes in the Horse Creek sample (Table 5). In contrast to the Shaughnessy Creek sample, the rainbow trout alleles do not appear to be randomly distributed among the fish in this sample. Rather, four fish appeared to be non-hybridized westslope cutthroat trout, one non-hybridized rainbow trout, and the remaining ten were definitely of hybrid origin. Although the population does contain some non-hybridized individuals, from a management perspective it probably should be considered hybridized since the majority of individuals are of hybrid origin.

The non-hybridized rainbow trout in the sample was a *LDH-B2* 100/76* heterozygote and a *sSOD-1* 100 homozygote*. This multiple locus genotype is much more characteristic of redband than coastal rainbow trout. Thus, we conclude this fish most likely was a redband trout.

In order to determine whether redband, coastal rainbow trout, or both fishes had a genetic contribution to the hybridized fish in Horse Creek, the allele frequencies at *LDH-B2** and *sSOD-1** have to be corrected for the westslope cutthroat trout genetic contribution. Since *LDH-B2*76* and *sSOD-1* 152* are usually not present in westslope cutthroat trout populations, the frequency of these alleles in the rainbow trout genetic contribution to the hybridized fish is the observed frequency divided by the average rainbow trout genetic contribution. The corrected *LDH-B2*76* allele frequency of 0.202 is intermediate to those characteristic of redband and coastal rainbow trout. The absence of *sSOD-1* 152* from the hybridized fish is characteristic of redband trout. Thus, overall the results suggest that both redband and coastal rainbow trout have hybridized with westslope cutthroat trout and each other in Horse Creek.

All loci analyzed in the Prospect Creek sample were invariant for alleles characteristic of westslope cutthroat trout. Although we cannot reasonably exclude the possibility this population may be slightly hybridized with redband, coastal rainbow trout, or both because only 16 fish were collected, since it appears to be non-hybridized westslope cutthroat trout the conservative approach would be to consider it as such unless future data indicate otherwise.

Flower Creek drainage

Alleles characteristic of both westslope cutthroat and rainbow trout were detected at three of the four diagnostic loci analyzed between these fishes in the sample from South Fork Flower Creek (Table 5). The alleles appear to be randomly distributed among the fish in the sample indicating the population to be a hybrid swarm between westslope cutthroat and rainbow trout in which essentially all fish are of hybrid origin. Like the Shaughnessy Creek population, the proportion of rainbow trout alleles in this hybrid swarm is too small to allow for a reasonable assessment of whether redband, coastal rainbow trout, or both had hybridized with the westslope cutthroat trout.

In the Flower Creek sample, one fish was heterozygous for alleles characteristic of both westslope cutthroat and rainbow trout at all diagnostic loci analyzed between these fishes indicating it was a first generation hybrid. Another fish was heterozygous at three diagnostic loci and homozygous for rainbow trout alleles at the other two suggesting it was a backcross between a first generation hybrid and rainbow trout. Both these hybrid individuals were *LDH-B2* 100/76* heterozygotes, suggesting they were produced from redband trout. The remaining 15 fish in the sample possessed alleles characteristic of only westslope cutthroat trout at all the loci analyzed (Table 6). At the time of sampling, therefore, the portion of Flower Creek sampled appears to mainly have been inhabited by non-hybridized westslope cutthroat trout and a relatively small proportion of recent hybrids between westslope cutthroat and redband trout.

Pipe Creek drainage

The Deception Creek and East Fork Pipe Creek samples possessed alleles characteristic of both westslope and Yellowstone cutthroat trout at all the diagnostic loci between these fishes that were analyzed (Table7). The Yellowstone cutthroat trout alleles were randomly distributed among the fish in both samples. Deception Creek and East Fork Pipe Creek, therefore, almost undoubtedly contain a hybrid swarm between westslope and Yellowstone cutthroat trout in which essentially all fish are of hybrid origin.

Alleles characteristic of only westslope cutthroat trout were detected at all the loci analyzed in the Beulah Creek sample (Table 6). This population, therefore, appears to be non-hybridized westslope cutthroat trout.

All loci analyzed in the upper Pipe Creek sample were invariant for alleles characteristic of only westslope cutthroat. Thus, this portion of Pipe Creek also appears to be inhabited by westslope cutthroat trout.

In contrast to the above results, alleles characteristic of both westslope cutthroat and rainbow trout were detected at all the diagnostic loci analyzed between these fishes in the lower Pipe Creek sample (Table 5). The sample contained 12 fish definitely of hybrid origin between westslope cutthroat and rainbow trout and one fish that possessed alleles characteristic of only rainbow trout at all loci analyzed. The latter fish was an _LDH-B2*76_ homozygote and an _sSOD-1* 152/100_ heterozygote. The former genotype is highly characteristic of redband trout while the latter genotype is much more characteristic of coastal rainbow trout. This fish, therefore, is likely of redband and coastal rainbow trout hybrid origin. This portion of Pipe Creek, therefore, appears to contain a hybrid swarm between westslope cutthroat, redband, and coastal rainbow trout.

Quartz Creek drainage

Alleles characteristic of only westslope cutthroat trout were detected at all the loci analyzed in the Hemlock Creek, Flattail Creek tributary, Flattail Creek, upper and lower Lost Fork Creek, Big Foot Creek, Seventeen Mile Creek and Quartz Creek samples (Table 6). All these creeks, therefore, appear to contain non-hybridized westslope cutthroat trout populations.

Unlabeled sample

The sample of unknown origin contained alleles characteristic of both westslope cutthroat and rainbow trout at all the diagnostic loci analyzed between these fishes (Table 5). The rainbow trout alleles appear to be randomly distributed among the fish in the sample. Furthermore, the _LDH-B2*76_ frequency of 0.117 corrected for hybridization is intermediate to those characteristic of redband and coastal rainbow trout. This sample, therefore, almost undoubtedly came from a hybrid swarm between westslope cutthroat, redband, and coastal rainbow trout.

Sincerely,

Robb Leary

Robb Leary

Literature Cited

Behnke, R.J. 1992. Native trout of western North America. American Fisheries Society Monograph 6.

Knudsen, K.L., C.C. Muhlfeld, G. K. Sage, and R. F. Leary. 2002. Genetic structure of Columbia River redband trout populations in the Kootenai River drainage, Montana. Transactions of the American Fisheries Society 131:1093-1105

Leary, R.F. 2003. Letter to Mike Hensler, Montana Department of Fish, Wildlife and Parks. May 1, 2003.

TABLE 1

Enzymes and loci examined. Tissues: E = eye, L = liver, M = muscle.

Enzyme	Loci	Tissue
Adenylate kinase	*AK-1*, AK-2**	M
Alcohol dehydrogenase	*ADH**	L
Aspartate aminotransferase	*sAAT-1*, sAAT-2**	L
	*sAAT-3,4**	M
Creatine kinase	*CK-A1*, CK-A2**	M
Dipeptidase	*PEPA-1*, PEPA-2**	E
Glucose-6-phosphate isomerase	*GPI-A*, GPI-B1*, GPI-B2**	M
Glyceraldehyde-3-phosphate dehydrogenase	*GAPDH-3*, GAPDH-4**	E
Glycerol-3-phosphate dehydrogenase	*G3PDH-1*, G3PDH-2**	L
N-acetyl-beta-glucosaminidase	*bGLUA**	L
Iditol dehydrogenase	*IDDH**	L
Isocitrate dehydrogenase	*mIDHP-1*, mIDHP-2**	M
	*sIDHP-1,2**	L

TABLE 1 — *continued*

Enzyme	Loci	Tissue
Lactate dehydrogenase	*LDH-A1**, *LDH-A2**	M
	*LDH-B1**, *LDH-B2**, *LDH-C**	E
Malate dehydrogenase	*sMDH-A1,2**	L
	*sMDH-B1,2**	M
Malic enzyme	*mMEP-2**	M
	*sMEP-1,2**	L
Phosphoglucomutase	*PGM-1**, *PGM-2**	M
	*PGM-1r**	L
Phosphogluconate dehydrogenase	*PGDH**	M
Superoxide dismutase	*sSOD-1**	L
Tripeptide aminopeptidase	*PEPB**	E
Xanthine dehydrogenase	*XDH**	L

TABLE 2

Alleles at the diagnostic loci that differentiate westslope cutthroat trout and rainbow trout, westslope cutthroat and Yellowstone cutthroat trout, or rainbow and Yellowstone cutthroat trout. When more than one allele exists at a locus within a taxon, the most common allele is listed first.

Locus	Taxa and characteristic alleles	
	Westslope	Rainbow
*sAAT-1**	*200, 250*	*100*
*CK-A2**	*84*	*100, 75*
*GPI-A**	*92, 100*	*100*
*IDDH**	*40, 100*	*100, 200, 40*
*sIDHP-1**	*86, 71*	*100, 114, 71, 40*
	Westslope	Yellowstone
*sAAT-1**	*200, 250*	*165*
*GPI-A**	*92, 100*	*100*
*IDDH**	*40, 100*	*100*
*mIDHP-1**	*100*	*-75*
*sIDHP-1**	*86, 71*	*71*
*sMEP-1**	*100, 70*	*90*
*sMEP-2**	*100*	*110*
*PEPA-1**	*100*	*101*
*PEPB**	*100*	*135*
*PGM-1**	*100, 110, null*	*null*
	Rainbow	Yellowstone
*sAAT-1**	*100*	*165*
*CK-A2**	*100, 75*	*84*
*mIDHP-1**	*100*	*-75*
*sIDHP-1**	*100, 114, 71, 40*	*71*
*sMEP-1**	*100*	*90*
*sMEP-2**	*100, 75*	*110*
*PEPA-1**	*100, 115*	*101*
*PEPB**	*100, 120*	*135*
*PGM-1**	*100, 110, null*	*null*

Table 3

Allele frequencies at the loci showing evidence of genetic variation in samples from what appear to be redband trout populations. NA= locus not analyzed in sample.

		Sample and allele frequencies	
Locus	Alleles	Syrup	Bear
*bGLUA**	*100*	0.778	1.000
	70	0.222	-
*IDDH**	*100*	1.000	0.950
	200	-	0.050
*sIDHP-1,2**	*100*	0.500	NA
	71	0.347	
	40	0.153	
*LDH-B2**	*100*	0.361	0.850
	76	0.639	0.150
*sMDH-B1,2**	*100*	0.958	1.000
	83	0.042	-
*sMEP-2**	*100*	0.917	1.000
	75	0.083	-
*PGM-1**	*100*	0.591	0.368
	null	0.409	0.632

Table 4

Allele frequencies at the loci showing evidence of genetic variation in a sample from a hybridized population of redband and coastal rainbow trout in Richards Creek.

Locus	Alleles	Allele Frequencies
*bGLUA**	*100*	0.816
	70	0.184
*LDH-B2**	*100*	0.882
	76	0.118
*sMDH-A1,2**	*100*	0.961
	40	0.039
*sMDH-B1,2**	*100*	0.868
	83	0.132
*sMEP-2**	*100*	0.895
	75	0.105
*PEPB**	*100*	0.895
	120	0.105
*PGM-1**	*100*	0.603
	null	0.397
*PGM-2**	*100*	0.868
	90	0.132
*sSOD-1**	*100*	0.895
	152	0.105

Table 5

Allele frequencies at the diagnostic loci between westslope cutthroat and rainbow trout analyzed in samples from hybridization populations of these fishes. At each locus, the allele characteristic of westslope cutthroat trout is listed first. NA as in Table 3.

		Sample and Allele Frequencies				
Locus	Alleles	Shaugnessy	Horse	S.F. Flower	Lower Pipe	Unknown
*sAAT-1**	*200*	0.933	0.767	0.969	0.500	0.947
	100	0.067	0.233	0.031	0.500	0.053
*CK-A2**	*100*	1.000	0.800	0.969	0.577	0.921
	84	-	0.200	0.031	0.423	0.079
*GPI-A**	*92*	0.933	0.643	0.969	0.462	0.842
	100	0.067	0.357	0.031	0.538	0.158
*IDDH**	*40*	1.000	0.821	1.000	0.577	0.889
	100	-	0.179	-	0.423	0.111
*sIDHP-1**	*86*	0.967	0.728	NA	NA	NA
	100	0.033	0.272			
Average westslope		0.967	0.752	0.977	0.529	0.900
Average rainbow		0.033	0.248	0.023	0.471	0.100

Table 6

Allele frequencies at the loci showing evidence of genetic variation in samples from what appear to be non-hybridized westslope cutthroat trout populations

		Sample and allele frequencies				
Locus	Allele	Flower	Beulah	Hemlock	Flattail trib.	Flattail
*bGLUA**	*100*	0.900	1.000	0.833	1.000	0.773
	90	0.100	-	0.167	-	0.227
sMDH-B1,2	*100*	1.000	1.000	0.967	1.000	1.000
	125	-	-	0.033	-	-
*LDH-B1**	*100*	1.000	1.000	1.000	0.353	0.864
	60	-	-	-	0.647	0.136
*LDH-B2**	*100*	1.000	1.000	1.000	1.000	1.000
	112	-	-	-	-	-
*PEPA-1**	*100*	1.000	1.000	1.000	1.000	1.000
	115	-	-	-	-	-
*PGM-2**	*100*	1.000	0.969	0.900	1.000	1.000
	85	-	0.031	0.100	-	-

Table 6 – continued

Locus	Alleles	Sample and allele frequencies				
		Lost Fork		Big Foot	Seventeen Mile	Quartz
		Upper	Lower			
*bGLUA**	*100*	1.000	0.875	1.000	0.750	0.861
	90	-	0.125	-	0.250	0.139
*sMDH-B1,2**	*100*	0.882	0.875	1.000	1.000	1.000
	125	0.118	0.125	-	-	-
*LDH-B1**	*100*	1.000	1.000	1.000	1.000	1.000
	60	-	-	-	-	-
*LDH-B2**	*100*	1.000	0.813	1.000	1.000	1.000
	112	-	0.188	-	-	-
*PEPA-1**	*100*	1.000	1.000	0.974	1.000	1.000
	85	-	-	0.026	-	-
*PGM-2**	*100*	1.000	1.000	1.000	0.875	1.000
	85	-	-	-	0.125	-

Table 7

Allele frequencies at the diagnostic loci analyzed between westslope and Yellowstone cutthroat in samples from hybridized populations of these fishes. At each locus, the allele characteristic of westslope cutthroat trout is listed first.

		Sample and allele frequencies	
Locus	Alleles	Deception	East Fork Pipe
*sAAT-1**	*200*	0.611	0.786
	165	0.389	0.214
*GPI-A**	*92*	0.722	0.750
	100	0.278	0.250
*IDDH**	*40*	0.500	0.571
	100	0.500	0.429
*mIDHP-1**	*100*	0.778	0.464
	-75	0.222	0.536
*sMEP-1**	*100*	0.667	0.571
	90	0.333	0.429
*sMEP-2**	*100*	0.750	0.679
	110	0.250	0.321
*PEPA-1**	*100*	0.500	0.536
	101	0.500	0.464
*PEPB**	*100*	0.833	0.607
	135	0.167	0.393
Average westslope		0.670	0.621
Average Yellowstone		0.330	0.380

Westslope Cutthroat Trout Genetics

Sample #	Date	Collector	# Fish	River Mile		%	Count
17010103		**Yaak**					
Arbo Creek			*Trib to Yaak River*				
231	9/15/1987	HUSTON, JOE	30	4.02			
					Columbia Basin Redband Trout	47	
					Westslope Cutthroat Trout	53	
Beaver Creek			*Trib to South Fork Yaak River*				
541	9/5/1991	PERKINSON, DOUG	25	5.17			
					Westslope Cutthroat Trout	100	
Blacktail Creek			*Trib to Out-of-state*				
517	8/21/1991	HUSTON, JOE	25	1.75			
					Columbia Basin Redband Trout	96	
					Westslope Cutthroat Trout	4	
Burnt Creek			*Trib to Yaak River*				
228	9/1/1987	HUSTON, JOE	26	0.25			
					Rainbow Trout	97.4	
					Westslope Cutthroat Trout	2.6	
633	7/21/1992	PERKINSON, DOUG	25	0.6			
					Columbia Basin Redband Trout	77.4	
					Rainbow Trout	20.9	
634	7/21/1992	PERKINSON, DOUG	25	4.26			
					Westslope Cutthroat Trout	100	
Caribou Creek			*Trib to East Fork Yaak River*				
171	7/19/1986	HUSTON, JOE	24	0.92			
					Columbia Basin Redband Trout	98.7	
					Westslope Cutthroat Trout	1.3	
Cyclone Creek			*Trib to Yaak River*				
562	9/18/1991	PERKINSON, DOUG	25	1.59			
					Columbia Basin Redband Trout	19.6	
					Westslope Cutthroat Trout	80.4	
East Fork Yaak River			*Trib to Yaak River*				
229	9/15/1987	HUSTON, JOE	22	5.1			
					Columbia Basin Redband Trout	98.1	
					Westslope Cutthroat Trout	1.8	

Sample #	Date	Collector	# Fish	River Mile	Species	%	Count
230	9/15/1987	HUSTON, JOE	22	5.37			
					Columbia Basin Redband Trout	98.1	
					Westslope Cutthroat Trout	1.9	
521	8/22/1991	HUSTON, JOE	6	0.82			
					Columbia Basin Redband Trout	98.1	
					Westslope Cutthroat Trout	1.1	
Fourth of July Creek			*Trib to Yaak River*				
564	9/18/1991	PERKINSON, DOUG	25	2.48			
					Westslope Cutthroat Trout	100	
French Creek			*Trib to West Fork Yaak River*				
522	8/22/1991	PERKINSON, DOUG	26	0.32			
					Westslope Cutthroat Trout	100	
Garver Creek			*Trib to West Fork Yaak River*				
524	8/23/1991	PERKINSON, DOUG	19	1.22			
					Westslope Cutthroat Trout	100	
Hellroaring Creek			*Trib to Yaak River*				
551	9/11/1991	PERKINSON, DOUG	27	4.13			
					Westslope Cutthroat Trout	48.6	
					Yellowstone Cutthroat Trout	51.4	
553	9/13/1991	PERKINSON, DOUG	24	0.95			
					Columbia Basin Redband Trout	95.5	
					Westslope Cutthroat Trout	4.5	
Independence Creek			*Trib to Yaak River*				
558	9/16/1991	PERKINSON, DOUG	25	0.37			
					Columbia Basin Redband Trout	20.4	
					Westslope Cutthroat Trout	79.6	
Kilbrennan Creek			*Trib to No Downlink*				
1048	10/20/1994	PERKINSON, DOUG	10	3.16			
					Rainbow Trout	100	
1071	7/10/1995	PERKINSON, DOUG	28	3.08			
					Rainbow Trout	100	
Kilbrennan Lake			*Trib to Feeder Creek*				
1638	5/24/1995	PERKINSON, DOUG	37	0			
					Rainbow Trout	72	
					Westslope Cutthroat Trout	28	
Koo Koo Creek			*Trib to Yaak River*				

Sample #	Date	Collector	# Fish	River Mile	Species	%	Count
523	8/22/1991	PERKINSON, DOUG	7	0.89			
					Westslope Cutthroat Trout	100	

Meadow Creek — *Trib to Yaak River*

Sample #	Date	Collector	# Fish	River Mile	Species	%	Count
554	9/13/1991	PERKINSON, DOUG	25	0.5			
					Columbia Basin Redband Trout	77.3	
					Rainbow Trout	6.3	
					Westslope Cutthroat Trout	16	

Middle Fish Lake — *Trib to NO DOWNLINK*

Sample #	Date	Collector	# Fish	River Mile	Species	%	Count
1669	7/28/1992	HUSTON, JOE	10	0			
					Westslope Cutthroat Trout	100	

Mt Henry Lake — *Trib to NO DOWNLINK*

Sample #	Date	Collector	# Fish	River Mile	Species	%	Count
1715	7/7/1992	LEARY, ROBB	12	0			
					Westslope Cutthroat Trout	100	12

North Fish Lake — *Trib to NO DOWNLINK*

Sample #	Date	Collector	# Fish	River Mile	Species	%	Count
1659	7/28/1992	PERKINSON, DOUG	19	0			
					Westslope Cutthroat Trout	100	

North Fork Meadow Creek — *Trib to Meadow Creek*

Sample #	Date	Collector	# Fish	River Mile	Species	%	Count
556	9/16/1991	PERKINSON, DOUG	25	0.89			
					Westslope Cutthroat Trout	100	

Pete Creek — *Trib to Yaak River*

Sample #	Date	Collector	# Fish	River Mile	Species	%	Count
235	9/9/1987	HUSTON, JOE	6	1.89			
					Westslope Cutthroat Trout	100	
538	9/5/1991	PERKINSON, DOUG	10	3.28			
					Columbia Basin Redband Trout	10.4	
					Rainbow Trout	9.6	
					Westslope Cutthroat Trout	80	
539	9/5/1991	PERKINSON, DOUG	7	8.11			
					Westslope Cutthroat Trout	100	

Pheasant Creek — *Trib to Yaak River*

Sample #	Date	Collector	# Fish	River Mile	Species	%	Count
540	9/5/1991	HUSTON, JOE	26	1.44			
					Westslope Cutthroat Trout	100	

Red Top Creek — *Trib to Yaak River*

Sample #	Date	Collector	# Fish	River Mile	Species	%	Count
560	9/17/1991	PERKINSON, DOUG	25	0.92			
					Columbia Basin Redband Trout	10.4	
					Rainbow Trout	2	
					Westslope Cutthroat Trout	87.6	

Sample #	Date	Collector	# Fish	River Mile	%	Count
561	9/17/1991	PERKINSON, DOUG	25	3.65		
			Westslope Cutthroat Trout		100	
Seventeenmile Creek			*Trib to Yaak River*			
225	9/1/1987	HUSTON, JOE	26	0.24		
			Columbia Basin Redband Trout		74.9	
			Rainbow Trout		22.9	
			Westslope Cutthroat Trout		2.2	
226	9/1/1987	HUSTON, JOE	19	6.77		
			Westslope Cutthroat Trout		100	
Solo Joe Creek			*Trib to East Fork Yaak River*			
449	9/19/1990	HUSTON, JOE	27	0.96		
			Columbia Basin Redband Trout		90.7	
			Rainbow Trout		6.8	
			Westslope Cutthroat Trout		2.5	
South Fork Meadow Creek			*Trib to Meadow Creek*			
557	9/16/1991	PERKINSON, DOUG	25	2.3		
			Westslope Cutthroat Trout		100	
Spread Creek			*Trib to Yaak River*			
134	9/26/1984	HUSTON, JOE	10	0.2		
			Rainbow Trout		6	
			Westslope Cutthroat Trout		94	
549	9/9/1991	PERKINSON, DOUG	26	5.23		
			Rainbow Trout		10.8	
			Westslope Cutthroat Trout		89.2	
550	9/11/1991	PERKINSON, DOUG	25	0.57		
			Columbia Basin Redband Trout		10.3	
			Rainbow Trout		12.5	
			Westslope Cutthroat Trout		77.2	
Turner Creek			*Trib to Vinal Creek*			
452	9/20/1990	PERKINSON, DOUG	27	1.3		
			Rainbow Trout		4.3	
			Westslope Cutthroat Trout		95.7	
598	9/9/1991	HUSTON, JOE	25	1.11		
			Rainbow Trout		4.3	
			Westslope Cutthroat Trout		95.7	
Wampoo Creek			*Trib to Yaak River*			
563	9/18/1991	HUSTON, JOE	12	0.46		

Sample #	Date	Collector	# Fish	River Mile	%	Count
			Westslope Cutthroat Trout		100	
Wee Lake			*Trib to NO DOWNLINK*			
1636	7/6/1995	PERKINSON, DOUG	6	0		
			Rainbow Trout		100	
1697	9/18/1994	PERKINSON, DOUG	9	0		
			Rainbow Trout		100	
West Fork Yaak River			*Trib to Yaak River*			
227	9/1/1987	HUSTON, JOE	3	4.36		
			Westslope Cutthroat Trout		100	
546	9/6/1991	PERKINSON, DOUG	25	0.33		
			Westslope Cutthroat Trout		100	
555	9/16/1991	HUSTON, JOE	25	4.68		
			Westslope Cutthroat Trout		100	
Yaak River			*Trib to Kootenai River*			
968	8/1/1994	HUSTON, JOE	28	29.78		
			Columbia Basin Redband Trout		96.7	
			Westslope Cutthroat Trout		3.3	
1074	8/4/1995	PERKINSON, DOUG	28	30.44		
			Rainbow Trout		96.7	
			Westslope Cutthroat Trout		3.3	

MESSAGE SCAN

To Biologists

From: Douglas Perkinson:R01F14A
Postmark: Dec 02,91 1:49 PM Delivered: Dec 02,91 1:52 PM

Subject: Sensitive Fish Sampling, 1991

Comments:
attached documents the samples taken in 1991. I will send a signed hardcopy to the Rangers for your files.

--------========X========--------

United States Department of Agriculture | Forest Service | Kootenai NF | 506 US Highway 2 West
Libby, MT 59923

Reply To: 2670 TES Mgmt

Date: 2 December 1991

Subject: Sensitive Fish Sampling, 1991

To: District Rangers

The following list of streams were sampled during the 1991 field season by myself and assistants, or by the Montana Natural Heritage Program under a challenge cost-share agreement with the Kootenai National Forest. In all cases the objective was to determine the distribution and relative abundance of sensitive fish populations in our Forest waters. In all cases the challenge cost-share funds were used to pay for non-USFS work (sampling, genetics, literature searches, etc.) - the S.O. and District's involvement in these surveys used contributed P&M funds from general fish program management, or other program funds when a non-Biologist wanted some OJT.

When the sampling revealed the presence of trout that appeared to be either Redband, Westslope cutthroat, or Bull trout we kept a 25 fish sample for genetic testing by the University of Montana (challenge cost-share agreement). When the sampling found sculpins in a stream, we generally kept a sample of 5 fish for confirmation of our field classification to species (either Torrent or Shorthead). Prior to April 15 of 1992 we will receive a formal report from the University of Montana, and the Montana Natural Heritage Program, on the final results of this year's sampling. I will forward a copy of each report to you at that time. Please extend my thanks to your employees that assisted our effort this past year.

Cabinet District

WhitePine Creek * - T23N R32W S28 cutthroat
South Fork, Marten Creek - T24N R33W S11 cutthroat
South Fork, Bull River - T28N R33W S14 bull

Sculpin samples (incomplete list)
Beaver Creek
WhitePine Creek
Marten Creek
Elk Creek
Blue Creek
Bull River
Rock Creek
Vermillion River

Fisher River District

Silver Butte - Fisher River * - T26N R30W S36 cutthroat/rainbow

Sculpin samples (incomplete list)
Silver Butte - Fisher River
Pleasant Valley - Fisher River
Cripple Horse Creek
FiveMile Creek
Bristow Creek

Rexford District

Sculpin samples (incomplete list)
TenMile Creek
Sutton Creek
Pinkham Creek
Tobacco River
Boulder Creek
Big Creek

Fortine District

Wigwam River drainage (in Canada) ** bull

Sculpin samples (incomplete list)
Tobacco River
Graves Creek
Fortine Creek
Sunday Creek - Stillwater River

Libby District

Bear Creek - T28N R31W S15 cutthroat/rainbow [redacted]
Little Cherry Creek - T28N R31W S24 cutthroat/rainbow
Poorman Creek - T28N R31W S25 cutthroat/rainbow — has had bull trout Mike Melin pers. comm.
Ramsey Creek - T28N R31W S36 cutthroat/rainbow
Upper Libby Creek - T27N R31W S01 cutthroat/rainbow & [redacted]
Midas Creek - T28N S30W S31 cutthroat/rainbow
Lower Libby Creek - T28N S30W S09 cutthroat/rainbow

note: trout sample was a composite of 45 fish from all seven streams for the MONTANORE project

Quartz Creek - T32N R32W S35 bull

~~Sculpin samples (incomplete list)~~
Libby Creek ***
Cedar Creek
Quartz Creek ***
Pipe Creek
Big Cherry Creek
Granite Creek
Swamp Creek

Three Rivers District

East Fork Yaak River - T37N R29W S32 redband
Caribou Creek - T37N R30W S14 no fish present
Hudson Creek - T36N R30W S05 no fish present
Blacktail Creek - T37N R30W S17 redband
North Fork Yaak ** - in Canada redband
Boyd Creek - T37N R32W S01 cutthroat
KooKoo Creek - T37N R31W S17 cutthroat
West Fork Yaak - T37N R32W S35 cutthroat (not enough fish to sample)
T37N R32W S06 cutthroat
T37N R33W S22/27 cutthroat
Garver Creek - T37N R32W S18 cutthroat
French Creek - T37N R32W S35 cutthroat
Vinal Creek - T36N R31W S23 cutthroat/rainbow
Yodkin Creek - T36N R31W S23 cutthroat
Cool Creek - T35N R32W S08/09 no fish present
Pheasant Creek - T35N R33W S11/12 cutthroat
Pete Creek - T37N R33W S36 cutthroat
T36N R33/32W S13/18 cutthroat
Spread Creek - T36N R34W S03 no fish present
T36N R33W S19 cutthroat
T35N R33W S03 cutthroat/rainbow
Hellroaring Creek - T36N R34W S35 cutthroat
T35N R33W S19/18 cutthroat/rainbow
Meadow Creek - T35N R34W S13 cutthroat
T35N R34W S22 cutthroat
T35N R33W S19 cutthroat/rainbow
RedTop Creek - T35N R33W S31 cutthroat/rainbow
T35N R34W S11 cutthroat
Cyclone Creek - T35/34N R33W S32/06 cutthroat/rainbow
4th of July Creek - T34N R33W S20/30 cutthroat
Independence Creek - T34N R33W S15/22 cutthroat
Wampoo Creek - T33N R33W S04/05 cutthroat/rainbow
South Fork Yaak - T35N R32W S01/02 cutthroat/rainbow (not enough fish to sample)
T35N R31/32W S18/13 (only Brook trout present)
T34N R31W S08 (only Brook trout present)
Fowler Creek - T35N R31W S18 (only Brook trout present)
Clay Creek - T35N R32W S36 (only Brook trout present)

Sculpin samples (incomplete list)

East Fork Yaak
Basin Creek
North Fork Yaak
West Fork Yaak
Vinal Creek
Yaak River (upper ford)
Beaver Creek
~~South Fork Yaak~~
Pete Creek
Pheasant Creek
Meadow Creek
Yaak River (sylvanite)
17-mile Creek
Yaak River *** (Hwy 2)
O'Brien Creek
Callahan Creek
Lake Creek
Stanley Creek

Of the samples taken in 1991, I expect something on the order of three new Sensitive redband trout populations (Blacktail, Boyd and KooKoo); five new Sensitive Westslope cutthroat populations (French, Upper Spread, Hellroaring, Meadow, and Whitepine); and two new Sensitive Bull trout populations (Wigwam and South Fork Bull). The problem of course is that we cannot identify truly sensitive fish populations (less than 2 percent hybridization) without a destructive genetic test - a field exam is not definitive.

The sculpin work in 1991 should reveal that nearly every tributary to the Kootenai River is a Sensitive torrent sculpin watershed except for a few rare, barriered watersheds like the Yaak and upper Libby Creek (these have Slimy sculpins, non-sensitive). At the time of sampling it appeared as though nearly all Clark Fork River tributaries were occupied by Slimy sculpins, but the physical characteristics of the fish may prove them to be intermediate between slimy, mottled and shorthead sculpins with no clear idea whether they are hybrids, common or sensitive sculpins. This unfortunate confusion would be the consequence of precious little sculpin research work in the U.S. that we could use to resolve the issue.

In 1992, assuming funding of challenge cost-share is approximately as in FY91, I plan to sample around ten additional watersheds on D4 for redband, cutthroat and bull trout, ten additional watersheds on D7 for cutthroat and bull trout, and around ten watersheds on the remainder of the Forest for cutthroat. The priorities in the trout sampling will be to document the fish status for the Big Creek FEIS, the Checkerboard Exchange FEIS, the ASARCO Rock Creek DEIS, high-profile timber sale EA's, and then general fish recon surveys. Unless funding is a bit better than expected, no sculpin work except a hybridization (genetics) study is planned, other than an occasional recon exam as I sample for trout.

/s/

R. Douglas Perkinson
Forest Fisheries Biologist

---

*   collected by Montana Department of Fish, Wildlife and Parks
**   collected by Canadian Ministry of the Environment personnel
*** 25-sculpin sample for hybridization study

Protocol for collecting genetic samples

FIN CLIPS (PINE or Micro-satellite)

1: Use fin rays
2: Preserve a piece of fin about ½ the size of a paper hole punch
3: Collect 30 samples per stream (less than 30 and statistics suffer) up to 50 samples
  Collect 6 samples from 5 different sites in the stream (2-5 habitat units apart)
  Collect fish at least 1+ older if possible and a range of ages
4: Preserve the fins in leak-proof vials
5: Label the vial with a 4-letter ID and a sequential number
  Example: Libby Creek above Libby Falls might be LCAF-01...LCAD-30
6: Write the ID number on a slip of rite-n-rain (pencil) also.
7: Use ID number as a guide, fill out the sample form with legal description, ID number, species, length, weight, date.
8: These are sent to Paul Spruell (bull trout) or Kathy Knudsen (rainbow/cutthroat)

WHOLE FISH (Allozyme)

1: Take a cooler filled with ice and saran wrap for each individual fish and 1 gallon zip-locs for entire sample.
2: Collect 25 samples per stream (less than 25 and statistics suffer) up to 50 samples
  Collect 5 samples from 5 different sites in the stream (2-5 habitat units apart)
  Collect fish at least 1+ older if possible and a range of ages
3: Write the ID number on a slip of rite-n-rain (pencil).
4: Wrap fish individually in saran wrap with ID number put all sample in larger zip locs
5: Use ID number as a guide, fill out the sample form with legal description, ID number, species, length, weight, date.
6: Make sure to freeze as soon as possible and sent to Lab at UM as quickly as possible
7: These are sent to Robb Leary

MEMORANDOM
February 5, 2001

TO: MFWP Regional Genetic Contacts (Mike Hensler, Mark Deleray, Region 1; Ladd Knotek, Region 2; Lee Nelson, Region 3; Anne Tews, Region 4; Ken Frazer, Region 5)

FROM: John K. Wenburg, Wild Trout and Salmon Genetics Laboratory

SUBJECT: Genetic Analysis at the University of Montana: This memorandum is to serve as a follow up to the discussions at the recent AFS meeting in Butte based on the letter I sent out to the regional contacts in January. I have incorporated some changes here, based on those discussions.

The following applies to all genetic samples submitted to our lab for DNA analysis:

Fin clip (PINEs and microsatellites) submission:

We will only be accepting samples that are prioritized for the current contract year (July 1st, 2000 – June 30th, 2001). Samples must all be submitted with the standardized sample form that has been developed for this purpose. This form will soon be distributed to each region. The form must be filled out completely. Samples submitted without this form, with partially completed forms, or those that are not listed on the prioritization list for a region that year **will be returned.** Regions should retain any samples collected that will be archived or submitted for analysis in future years. The samples should be kept in alcohol and efforts should be taken to assure it does not evaporate, as dry tissue is recalcitrant to DNA extraction. To these ends, it is advisable to store individual tubes in an upright position and not left randomly distributed in a baggie. Samples should also be checked occasionally (e.g., every few months) to ensure they are continually immersed in alcohol, which should be added if necessary. Samples should be protected from direct sunlight.

Individuals within samples should be given unique sequential numbers (i.e., 1, 2, 3...). This number along with the creek name is all that needs to be provided to us (along with the completed sample form). We do not need copies of the data sheets, maps, etc. The collecting biologists should keep all additional information and we will contact them directly to request further information when necessary.

We have all the samples for the current contract year. No additional samples will be accepted until we have coordinated the submission of next year's samples.

I have returned the large backlog of samples to the designated contact for each region to redistribute to the collecting biologist. These samples can be resubmitted and prioritized in future years with completed sample forms as each region sees fit. This will allow the biologists that collected and know the most about the samples to properly complete the sample forms, cull the samples as necessary, and submit them in future years with the appropriate prioritization scheme.

Starting next year, each regional contact should submit to me a list of all samples to be analyzed on that year's budget, prior to submission of any samples. Each sample should be numbered sequentially in order of importance within each region to help us to complete the analyses in the most efficient order.

Some of the returned samples may have been designated for analysis from additional funding sources or budgets, although I attempted to keep those for which I had sufficient information. **Arrangement for resubmission of these and all other samples that are not from the base FWP budget should be made with me prior to submission.** Ken McDonald will coordinate which samples will be analyzed for each funding source. This will not delay analysis, but instead will ensure proper coordination of projects and samples. I will coordinate sample priorities with Ken for the samples for each additional funding source.

Whole fish submission (allozymes):

In general, the details given above pertain to whole fish samples as well as fin clips. In addition, due to space constraints and freezing requirements, before submitting allozyme samples, you must confirm through Robb Leary (406-243-5503) or myself that 1) there will be somebody in the lab to receive the samples on the day they are sent, 2) we have the required freezer space available, and 3) the samples being submitted have been prioritized on a current budget.

Sample sizes:

As noted above, whenever possible, sample sizes of at least 25 individuals should be submitted. With smaller sample sizes we have low statistical power to detect hybridization or to determine if samples can be pooled as one population. Using the six diagnostic PINE markers we have identified between westslope cutthroat trout and rainbow trout, 25 individuals are required in order to have a 95% chance of detecting 1% hybridization. With sample sizes below 25, the power of detection drops of rapidly, being only 70% with sample sizes of 10. With samples containing less than 25 fish, our estimates are very rough; reporting them in MRIS may be misleading.

For example, if 5 groups of 5 fish are collected at short intervals in a creek and submitted as 5 samples, they will be reported in MRIS as 5 separate entities. The power to detect 1% hybridization for each will only be 45%. However, if these fish are submitted as one sample of 25, the results will appear for one sample of 25 in MRIS with a 95% chance to detect 1% hybridization. Furthermore, with sample sizes of 5 we cannot perform statistically significant tests for homogeneity between these small samples to test if they belong to the same population. Collections should be split up into separate sample submissions only if there are reasons to suspect they are different populations (e.g., barriers present) and every effort should be made to increase the samples sizes to 25 for each putative population. There is a large dose of professional judgment that must be made on the part of the collecting biologists to determine what samples likely come from different populations; we cannot always determine this genetically.

If there is a need to distinguish between smaller sections within a larger sample, this information can be given in the comment section of the sample form by reference to the numbers designated for fish in each section (i.e., 1-15 section 1; 15-30 section 2, etc.). If we find genetically that there is then an obvious area where hybridization starts or stops, we will report the hybridization status of each group of individuals based on their unique numbers and/or sections in our report to the collecting biologist. Furthermore, if the samples appear to come from two separate populations and not a hybrid swarm, the sample will be split into two separate samples after analysis for reporting in MRIS. This may provide a rough spatial determination of hybrid zones to identify where future samples should be collected in order to increase the power of detection in specific regions and is preferable to submission of multiple small samples from spot collections.

It is critical to note that in hybrid swarms all individuals are of hybrid origin, even those that have apparently "pure" genotypes at our diagnostic loci. Due to the random reshuffling of alleles during sexual reproduction, many individuals will appear pure for one or the other parental species due to the limited number of marker loci used, even when they are actually hybrids. It is not possible to detect or "rescue" pure individuals from these populations, as they cannot be reliably identified and likely do not exist.

It should also be noted that testing for hybridization and population differentiation requires two different types of analysis; both should be requested only when necessary. We will perform both analyses when requested, if sample sizes are appropriate, but please note that doing so requires substantially more time and will delay the results.

Summary:

-Submit samples for the current contract year only, each with a completed sample form. **No additional samples should be submitted this year until we have coordinated the submission of next year's samples.**

-In future years, each regional contact should submit a list of all samples to be analyzed on that year's budget, prior to submission of any samples. These samples should be numbered sequentially in order of importance.

-Number individuals in each sample with unique numbers (i.e., 1, 2, 3….) and give sample location only. Note in comment area of sample form when information on sections within samples may be important and give the numbers designated for fish in each (i.e., 1-15 section 1; 15-30 section 2). The collecting biologist should retain all additional sample information.

-Arrange for analysis of all other samples from additional contracts and monies with me personally, before submission. These samples will be prioritized for each budget and not as part of the base FWP budget.

-Submit samples of at least 25 individuals whenever possible (it is always a good idea to submit a few extra samples (~10%) to compensate for samples that do not amplify well).

-Request both hybridization and population differentiation analysis only when necessary.

Please feel free to contact me with any questions or suggestions. I can be contacted by email (preferred): jkw@selway.umt.edu, or by phone: (406) 243-5503.

Sincerely,

John K. Wenburg

Cc: Ken McDonald
Janet Hess-Herbert
Steve Carson
Jennifer Corbin

Agency: ____________________ FWP Region: ________

Collector: ____________________ Phone: ____________

Collection Date: ___/___/______ Target Date: ___/___/______

Hydrounit/Basin: ______________________________

Stream/Lake Name: ______________________________

Purpose for Analysis: (circle one) — Hybridization / Other (specify below or call lab)

Type of Analysis Requested: — Allozymes (whole fish) / DNA (fin clips)

Comments: ______________________________

Suspected Species: ______________

Number of Fish: ______________

Regional Contact:

Longitudinal Sample? ☐ Specify Units

Sample Location:
Begin AND End measures required for longitudinal samples only. For all other samples enter location in Begin measure.

TRS ¼ ¼ : *Begin* ______________ *End* ______________
and/or
Lat/Long: *Begin* ______________ *End* ______________
and/or
River Mile: *Begin* ______________ *End* ______________
and/or
UTM: Zone: *Begin* **x** ______________ *End* **x** ______________
y ______________ **y** ______________

Funding Source(s): See table on back of sheet

Agency: ____________________ FWP Region: ________

Collector: ____________________ Phone: ____________

Collection Date: ___/___/______ Target Date: ___/___/______

Hydrounit/Basin: ______________________________

Stream/Lake Name: ______________________________

Purpose for Analysis: (circle one) — Hybridization / Other (specify below or call lab)

Type of Analysis Requested: (circle one) — Allozymes (whole fish) / DNA (fin clips)

Comments: ______________________________

____

Suspected Species: ______________

Number of Fish: ______________

Regional Contact:

Longitudinal Sample? ☐ Specify Units

Sample Location:
Begin AND End measures required for longitudinal samples only. For all other samples enter location in Begin measure.

TRS ¼ ¼ : *Begin* ______________ *End* ______________
and/or
Lat/Long: *Begin* ______________ *End* ______________
and/or
River Mile: *Begin* ______________ *End* ______________
and/or
UTM: Zone: *Begin* **x** ______________ *End* **x** ______________
y ______________ **y** ______________

Funding Source(s): See table on back of sheet

Agency: ____________________ FWP Region: ________

Collector: ____________________ Phone: ____________

Collection Date: ___/___/______ Target Date: ___/___/______

Hydrounit/Basin: ______________________________

Stream/Lake Name: ______________________________

Purpose for Analysis: (circle one) — Hybridization / Other (specify below or call lab)

Type of Analysis Requested: (circle one) — Allozymes (whole fish) / DNA (fin clips)

Comments: ______________________________

____

Suspected Species: ______________

Number of Fish: ______________

Regional Contact:

Longitudinal Sample? ☐ Specify Units

Sample Location:
Begin AND End measures required for longitudinal samples only. For all other samples enter location in Begin measure.

TRS ¼ ¼ : *Begin* ______________ *End* ______________
and/or
Lat/Long: *Begin* ______________ *End* ______________
and/or
River Mile: *Begin* ______________ *End* ______________
and/or
UTM: Zone: *Begin* **x** ______________ *End* **x** ______________
y ______________ **y** ______________

Funding Source(s): See table on back of sheet

ID #	Funding Source
AVISTA	AVISTA
BLM	Bureau of Land Management
BPAF	Bonneville Power Administration - Flathead
BPAL	Bonneville Power Administration - Libby
FWP1	Montana Fish, Wildlife & Parks - Region 1
FWP2	Montana Fish, Wildlife & Parks - Region 2
FWP3	Montana Fish, Wildlife & Parks - Region 3
FWP4	Montana Fish, Wildlife & Parks - Region 4
FWP5	Montana Fish, Wildlife & Parks - Region 5
FWPH	Montana Fish, Wildlife & Parks - Hatcheries
PPL	Pacific Power & Light
USFS	USDA Forest Service
USFS013	USDA Forest Service - FWP Yellowstone Cutthroat Trout
USFWS	US Fish & Wildlife Service

ID #	Funding Source
AVISTA	AVISTA
BLM	Bureau of Land Management
BPAF	Bonneville Power Administration - Flathead
BPAL	Bonneville Power Administration - Libby
FWP1	Montana Fish, Wildlife & Parks - Region 1
FWP2	Montana Fish, Wildlife & Parks - Region 2
FWP3	Montana Fish, Wildlife & Parks - Region 3
FWP4	Montana Fish, Wildlife & Parks - Region 4
FWP5	Montana Fish, Wildlife & Parks - Region 5
FWPH	Montana Fish, Wildlife & Parks - Hatcheries
PPL	Pacific Power & Light
USFS	USDA Forest Service
USFS013	USDA Forest Service - FWP Yellowstone Cutthroat Trout
USFWS	US Fish & Wildlife Service

ID #	Funding Source
AVISTA	AVISTA
BLM	Bureau of Land Management
BPAF	Bonneville Power Administration - Flathead
BPAL	Bonneville Power Administration - Libby
FWP1	Montana Fish, Wildlife & Parks - Region 1
FWP2	Montana Fish, Wildlife & Parks - Region 2
FWP3	Montana Fish, Wildlife & Parks - Region 3
FWP4	Montana Fish, Wildlife & Parks - Region 4
FWP5	Montana Fish, Wildlife & Parks - Region 5
FWPH	Montana Fish, Wildlife & Parks - Hatcheries
PPL	Pacific Power & Light
USFS	USDA Forest Service
USFS013	USDA Forest Service - FWP Yellowstone Cutthroat Trout
USFWS	US Fish & Wildlife Service

Appendix G.
Fish spawning and redd survey field data sheets and associated information.

BULL TROUT REDD SURVEY

CREEK NAME: Libby Creek EXAMINER: Paul Bradt DATE: 10-24-95

AREA COVERED: - STARTING POINT DESCRIPTION: Spur Road off Libby Cr. going to Henry Skranak's mining claim

- FINISHING POINT DESCRIPTION: Miranda Mining Co.

- STARTING TIME: 2:45 AM
- FINISHING TIME: 4:00 PM

SUMMARY OF REDDS: No Redds found.

NUMBER: ______
Time: ______ Width and Lenght: ______
Approximate Location: ______
Comments: ______

NUMBER: ______
Time: ______ Width and Lenght: ______
Approximate Location: ______
Comments: ______

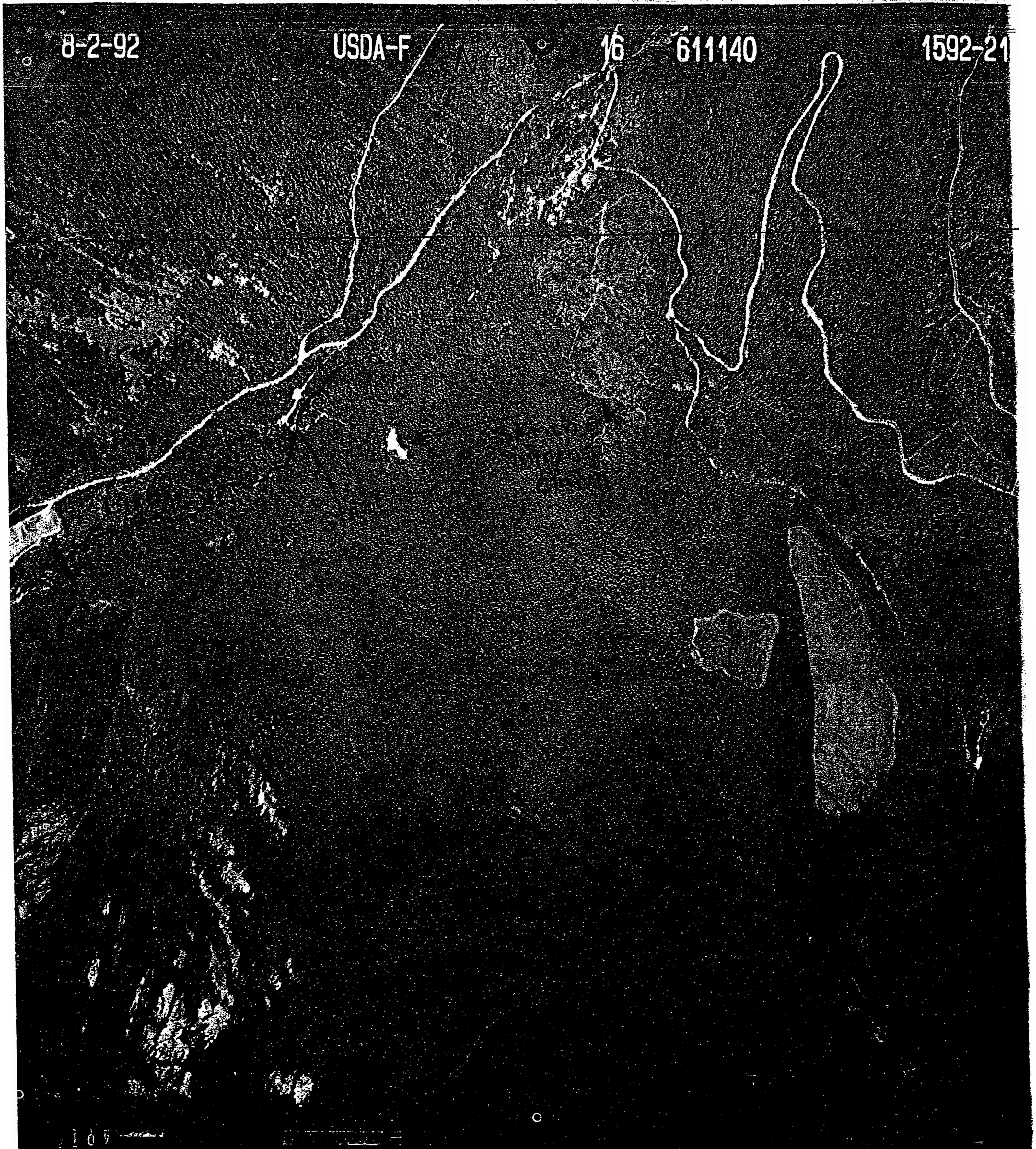
NUMBER: ______
Time: ______ Width and Lenght: ______
Approximate Location: ______
Comments: ______

NUMBER: ______
Time: ______ Width and Lenght: ______
Approximate Location: ______
Comments: ______

NUMBER: ______
Time: ______ Width and Lenght: ______
Approximate Location: ______
Comments: ______

OTHER NOTES (number and location of pools, log-jams, rapids, falls, etc.):

Stream averages about 25 feet wide and runs moderately fast. A fair amount of down trees and debris can be found in and across the stream. These jams account for some of the (9) pools 3 feet in depth or deeper that are found on this stretch. Small and medium gravels are commonly found that could provide spawning beds.


8-2-92
USDA-F
16
611140
1592-21

BULL TROUT REDD SURVEY

CREEK NAME: Upper Libby cr. EXAMINER: T. DICKSON DATE: 10/24

AREA COVERED: - STARTING POINT DESCRIPTION: where private land owner crosses libby creek.

- FINISHING POINT DESCRIPTION: where I met D. Snell (see atached photo)
- STARTING TIME: 1430
- FINISHING TIME: 1630

SUMMARY OF REDDS: no Redds

NUMBER: ______
Time: ______ Width and Lenght: ______
Approximate Location: ______
Comments: ______

NUMBER: ______
Time: ______ Width and Lenght: ______
Approximate Location: ______
Comments: ______

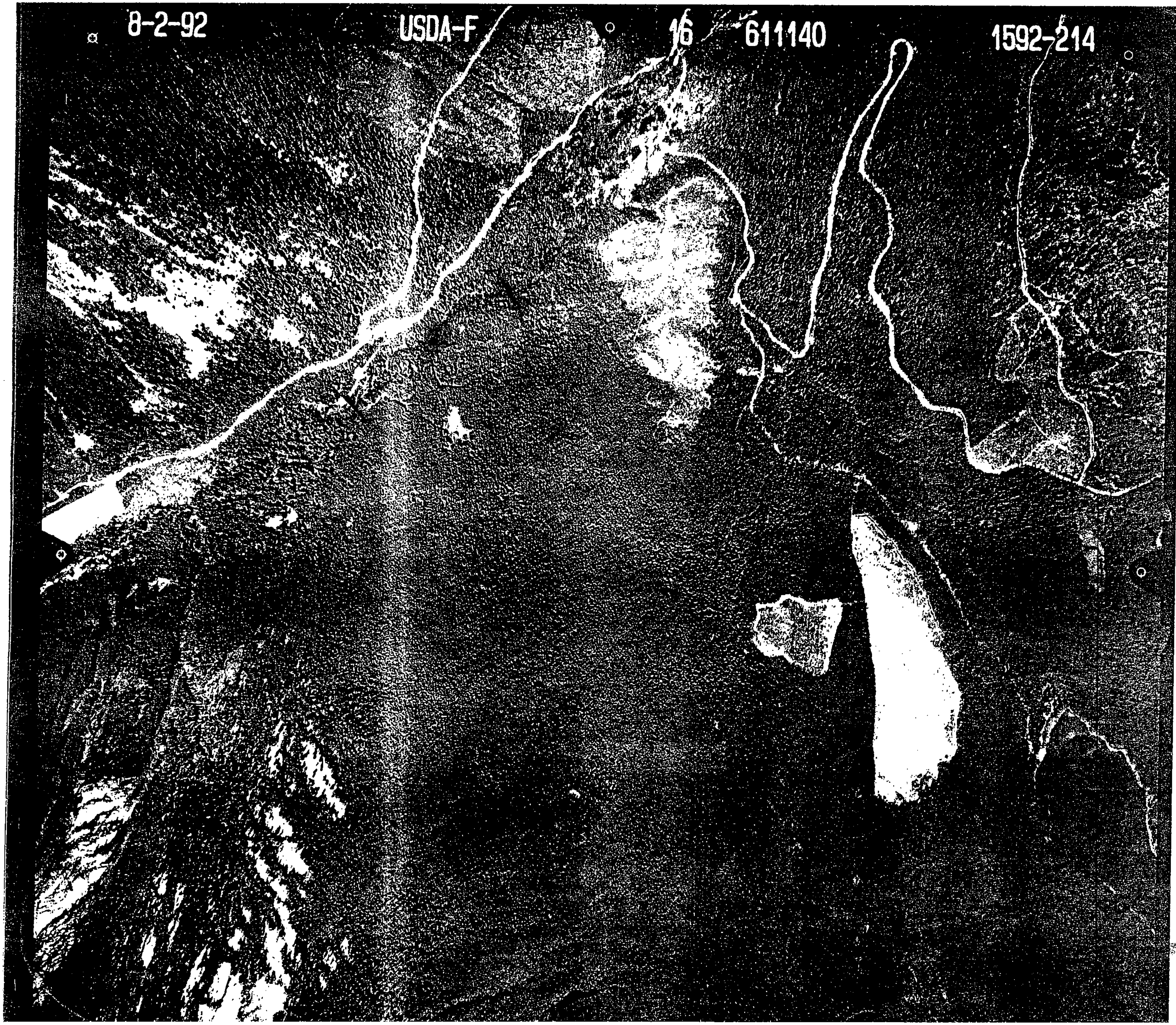
NUMBER: ______
Time: ______ Width and Lenght: ______
Approximate Location: ______
Comments: ______

NUMBER: ______
Time: ______ Width and Lenght: ______
Approximate Location: ______
Comments: ______

NUMBER: ______
Time: ______ Width and Lenght: ______
Approximate Location: ______
Comments: ______

OTHER NOTES (number and location of pools, log-jams, rapids, falls, etc.):

- this area is large pool + boulders below a 50 foot water fall and large boulders + some rapids above. The waterfall's approx. location is marked on the attached photo copy. This wf is a fish barrier. I would suggest approaching it from the down stream side, or bring your harness + rock climbing gear.



Falls o' death

END Points approximate

PVT land / mine

BULL TROUT REDD SURVEY

CREEK NAME: Upper Libby Creek EXAMINER: DAN Snell DATE: 10-24-95

AREA COVERED: - STARTING POINT DESCRIPTION: Begin At Upper Libby Creek Bridge And junction of Road #2316. Walk up Stream!

- FINISHING POINT DESCRIPTION: Approximately 1 mile And 1 Hour walk up Stream from Starting point.
- STARTING TIME: 1435
- FINISHING TIME: 1535

SUMMARY OF REDDS: No Redds observed.

NUMBER: ______
Time: ______ Width and Lenght: ______
Approximate Location: ______
Comments: ______

NUMBER: ______
Time: ______ Width and Lenght: ______
Approximate Location: ______
Comments: ______

NUMBER: ______
Time: ______ Width and Lenght: ______
Approximate Location: ______
Comments: ______

NUMBER: ______
Time: ______ Width and Lenght: ______
Approximate Location: ______
Comments: ______

NUMBER: ______
Time: ______ Width and Lenght: ______
Approximate Location: ______
Comments: ______

OTHER NOTES (number and location of pools, log-jams, rapids, falls, etc.):

14:35 - Weather is cloudy and overcast - Temp. 45° F.

14:38 - Libby Creek is joined on left by large braid in channel. Continue up main stream course but volume of water is now noticable less.

15:00 - I crossed freshly blazed and flagged property line. Freshly cut S.A.F. across creek below log jam.

15:05 I encountered another freshly blazed + ribboned property line. Stream becomes somewhat braided. Size and volume of stream appear to have increased again.

15:30 Stream channel becomes well entrenched. Large boulders are frequent. Lots of runs + riffles. Occassional pocket (over)

UPPER Libby CReek Bull TRout Redd Survey: 10-24-95
R.D.S.

NOT IN MINE SITE AREA

BULL TROUT REDD SURVEY

CREEK NAME: Libby Ck EXAMINER: S. Ghormley / A. Purdy DATE: 10-24-95

AREA COVERED: - STARTING POINT DESCRIPTION: SE Corner of the NW Section of Section # 9 on Horse Mountain Quad.

- FINISHING POINT DESCRIPTION: SE Corner of the N.E. Section of Section # 17 on Horse Mtn Quad # 3

- STARTING TIME: 1030

- FINISHING TIME: 1330

SUMMARY OF REDDS: None Found

NUMBER:

Time: Width and Lenght:

Approximate Location:

Comments:

NUMBER:

Time: Width and Lenght:

Approximate Location:

Comments:

NUMBER:

Time: Width and Lenght:

Approximate Location:

Comments:

NUMBER:

Time: Width and Lenght:

Approximate Location:

Comments:

NUMBER:

Time: Width and Lenght:

Approximate Location:

Comments:

OTHER NOTES (number and location of pools, log-jams, rapids, falls, etc.): Numerous gravel beds along this section provide potential Redd sites. None were found however.

NOT IN MINE SITE AREA

BULL TROUT REDD SURVEY

CREEK NAME: Upper Libby Creek EXAMINER: DAN Snell DATE: 10-24-95

AREA COVERED: - STARTING POINT DESCRIPTION: Begin AT Upper Libby Creek Bridge + JUNCTION OF ROAD #2316. WALK downstre

- FINISHING POINT DESCRIPTION: WAlked dowstream from the Above poin End reach near Rd #231 And came out AT mile post # 9.
- STARTING TIME: 10:45
- FINISHING TIME: 14:07

SUMMARY OF REDDS: No Redds Seen

NUMBER: ______

Time: ______ Width and Lenght: ______

Approximate Location: ______

Comments: ______

NUMBER: ______

Time: ______ Width and Lenght: ______

Approximate Location: ______

Comments: ______

NUMBER: ______

Time: ______ Width and Lenght: ______

Approximate Location: ______

Comments: ______

NUMBER: ______

Time: ______ Width and Lenght: ______

Approximate Location: ______

Comments: ______

NUMBER: ______

Time: ______ Width and Lenght: ______

Approximate Location: ______

Comments: ______

OTHER NOTES (number and location of pools, log-jams, rapids, falls, etc.):

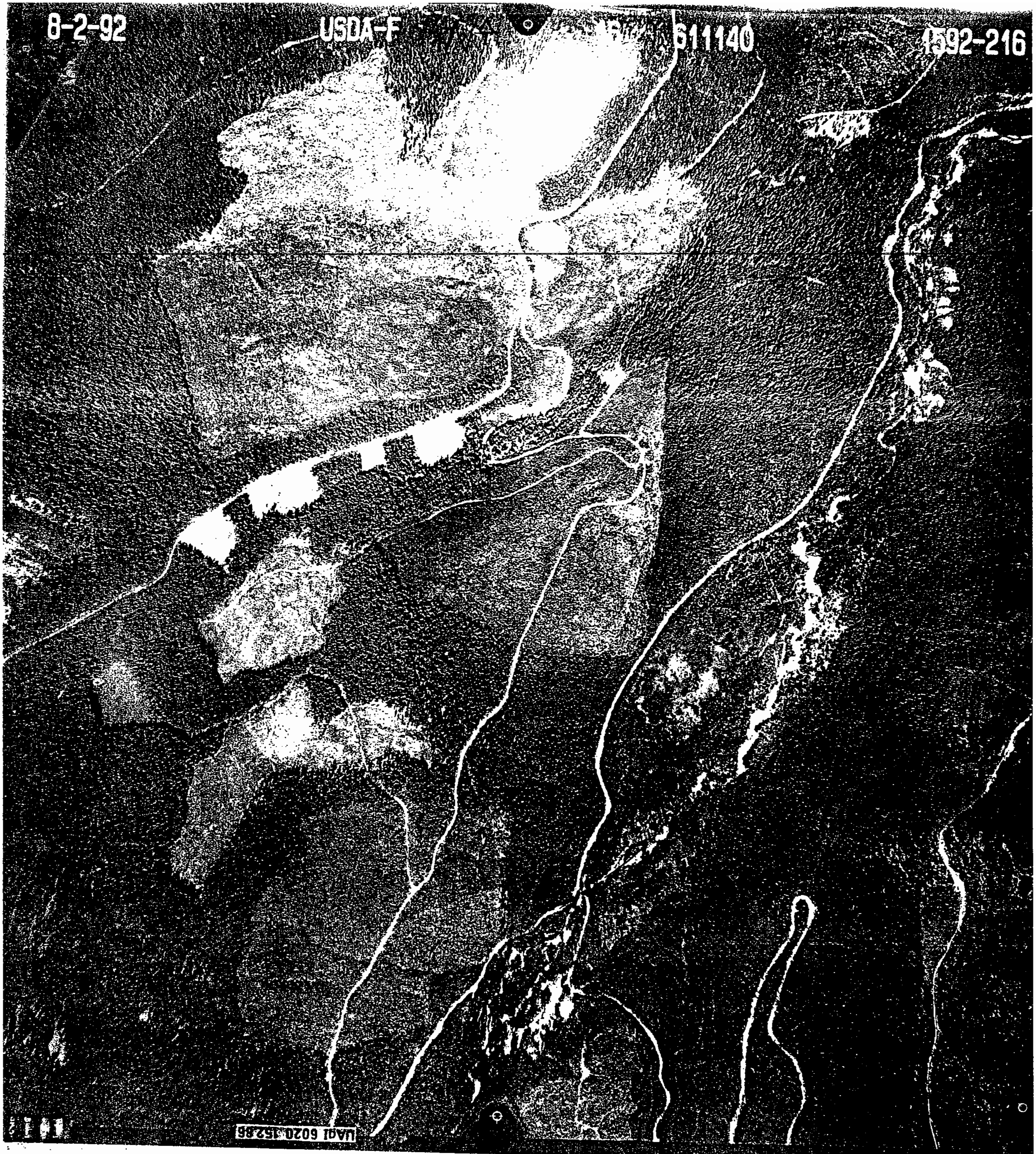
10:45 - Overcast + cloudy with occassional light drizzle. temp. 45° F. Occlassional fresh beaver chewed sticks in stream.

11:00 - Lots of boulders + cobble. Small log jams. Lots of big stumps and old bank disturbances

11:15 - Lots of small debri jams - OLD logging/mining signs in + Along stream channel.

11:30 - Occassional woody debri jams, small falls + pools. None are fish barriers. Stream is 15' wide and 6" → 24" deep - Stream bed is mostly cobble with small runs between pools + log jams.

(over)



UPPER Libby Creek Bull Trout Redd Survey

10-24-95
R.D.S.

BULL TROUT REDD SURVEY

CREEK NAME: Libby creek EXAMINER: T. Dickson DATE: 10/24/95

AREA COVERED: - STARTING POINT DESCRIPTION: Ramsey creek meets Libby creek

- FINISHING POINT DESCRIPTION: Small Island w/brush (met P. Bradt)
- STARTING TIME: ____________
- FINISHING TIME: ____________

SUMMARY OF REDDS: no Redds found.

NUMBER: ______
Time: ____________ Width and Lenght: ______________
Approximate Location: ______________
Comments: ______________

NUMBER: ______
Time: ____________ Width and Lenght: ______________
Approximate Location: ______________
Comments: ______________

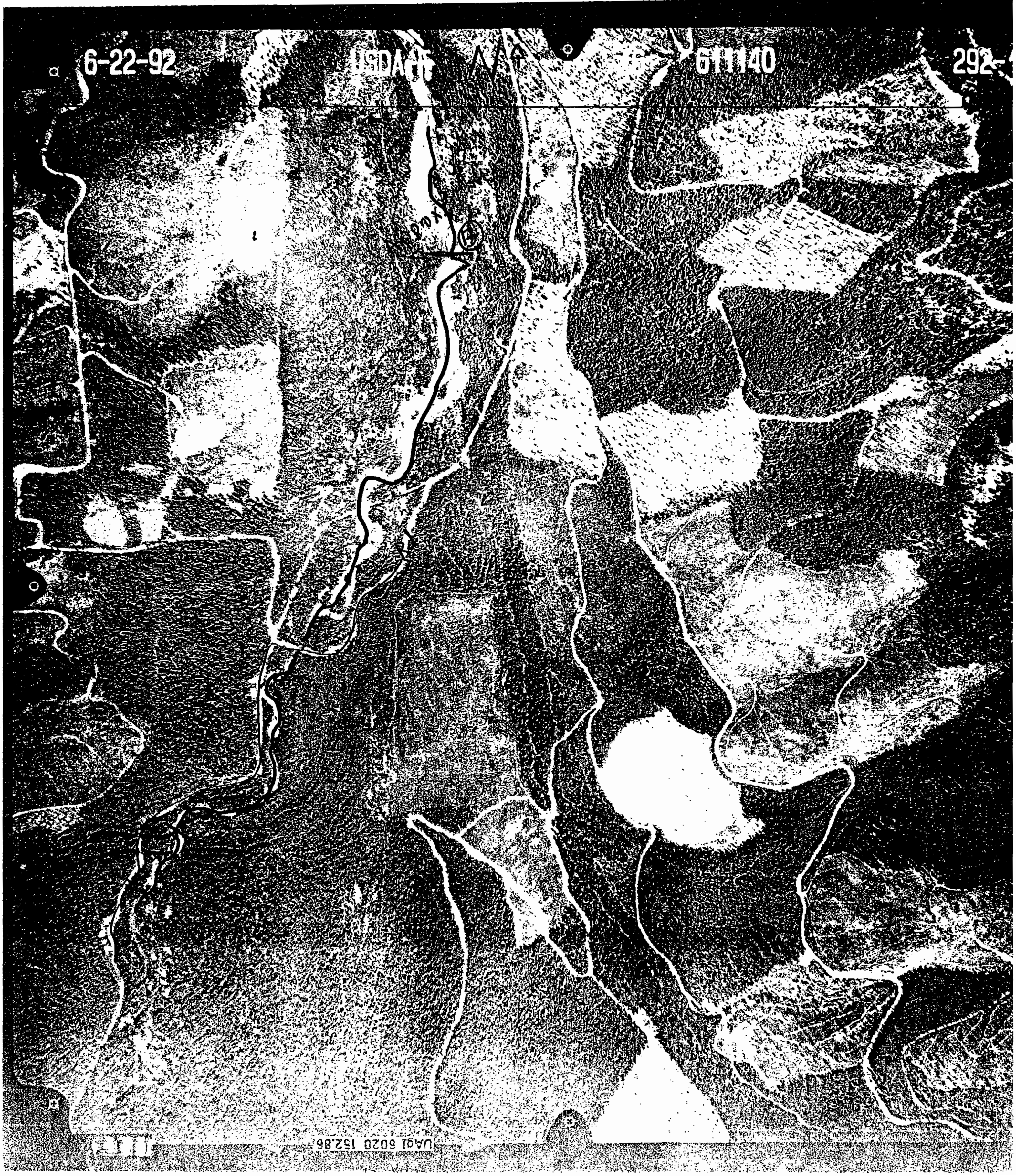
NUMBER: ______
Time: ____________ Width and Lenght: ______________
Approximate Location: ______________
Comments: ______________

NUMBER: ______
Time: ____________ Width and Lenght: ______________
Approximate Location: ______________
Comments: ______________

NUMBER: ______
Time: ____________ Width and Lenght: ______________
Approximate Location: ______________
Comments: ______________

OTHER NOTES (number and location of pools, log-jams, rapids, falls, etc.):
- braiding + small rapids throughout. Easy walking

T. DICKSEN
From Ramsey creek junction
to point B on map (where I
met P. Bradt)



BULL TROUT REDD SURVEY

CREEK NAME: Libby CR. EXAMINER: Paul Bradt DATE: 10-25-95

AREA COVERED: - STARTING POINT DESCRIPTION: Little Cherry confluence on Libby CR.

- FINISHING POINT DESCRIPTION: Approx. 1.2 miles upstream (see photo)
- STARTING TIME: 10:45 AM
- FINISHING TIME: 1:45 PM

SUMMARY OF REDDS: No REDDS FOUND

NUMBER: ______
Time: ____________ Width and Lenght: ____________
Approximate Location: ____________
Comments: ____________

NUMBER: ______
Time: ____________ Width and Lenght: ____________
Approximate Location: ____________
Comments: ____________

NUMBER: ______
Time: ____________ Width and Lenght: ____________
Approximate Location: ____________
Comments: ____________

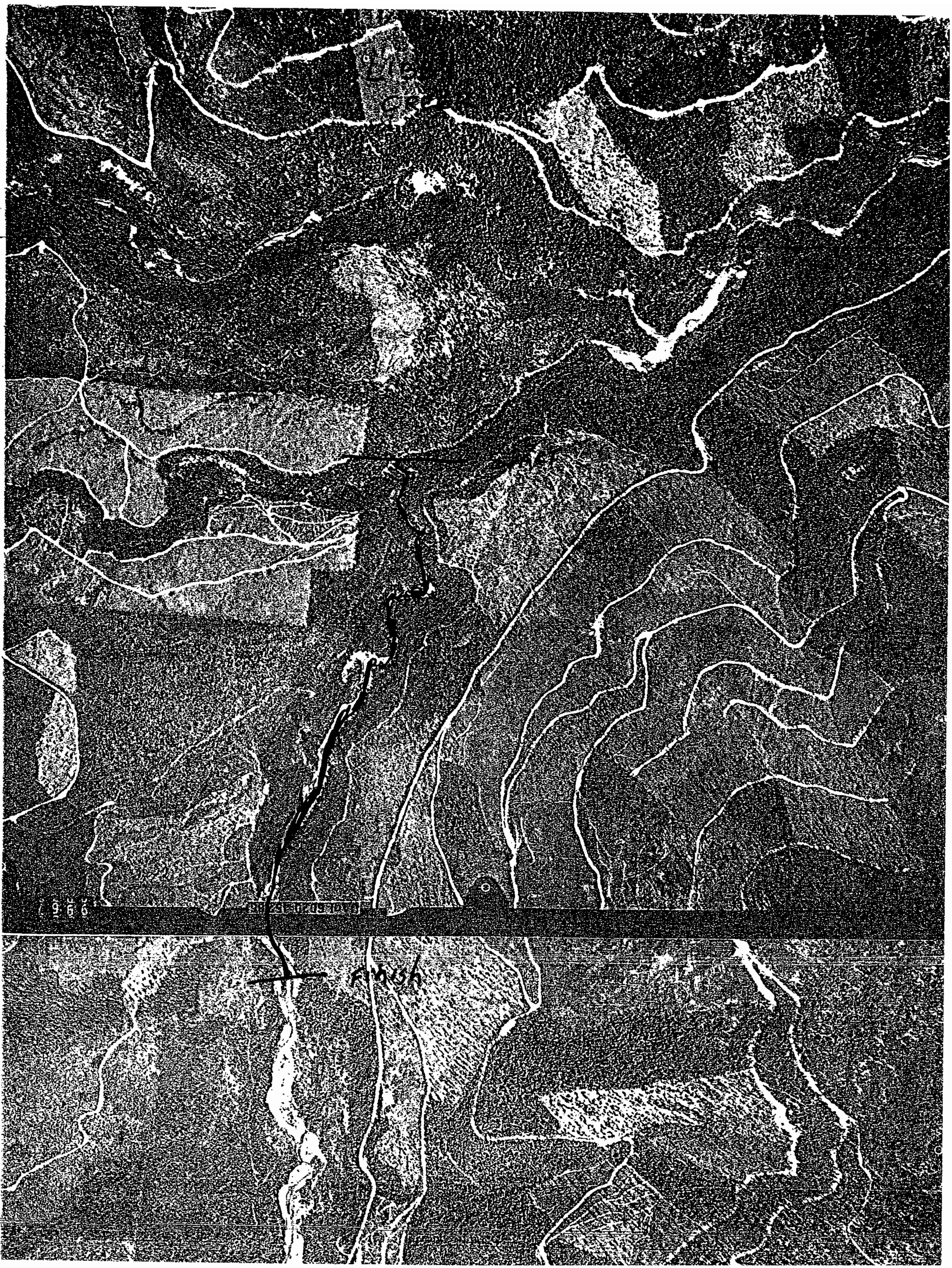
NUMBER: ______
Time: ____________ Width and Lenght: ____________
Approximate Location: ____________
Comments: ____________

NUMBER: ______
Time: ____________ Width and Lenght: ____________
Approximate Location: ____________
Comments: ____________

OTHER NOTES (number and location of pools, log-jams, rapids, falls, etc.):

The creek at the start of this survey was running moderately fast, was quite narrow due to the rock cliffs on both sides and meandered a lot. The stream is braided in many places which slows the stream and deposits some gravels in a few places. Some sections of the stream had lots of log debris and other stretches had little or none. At least (8) pools was counted that was 3 ft. deep or deeper.

This section has some potential for spawning and should be surveyed again.


Finish

BULL TROUT REDD SURVEY

CREEK NAME: Libby Creek EXAMINER: Art Purdey DATE: 10/25/95

AREA COVERED: - STARTING POINT DESCRIPTION: see map

- FINISHING POINT DESCRIPTION: met S. Ghormley at end
- STARTING TIME:
- FINISHING TIME:

SUMMARY OF REDDS: none seen

NUMBER:
Time: Width and Lenght:
Approximate Location:
Comments:

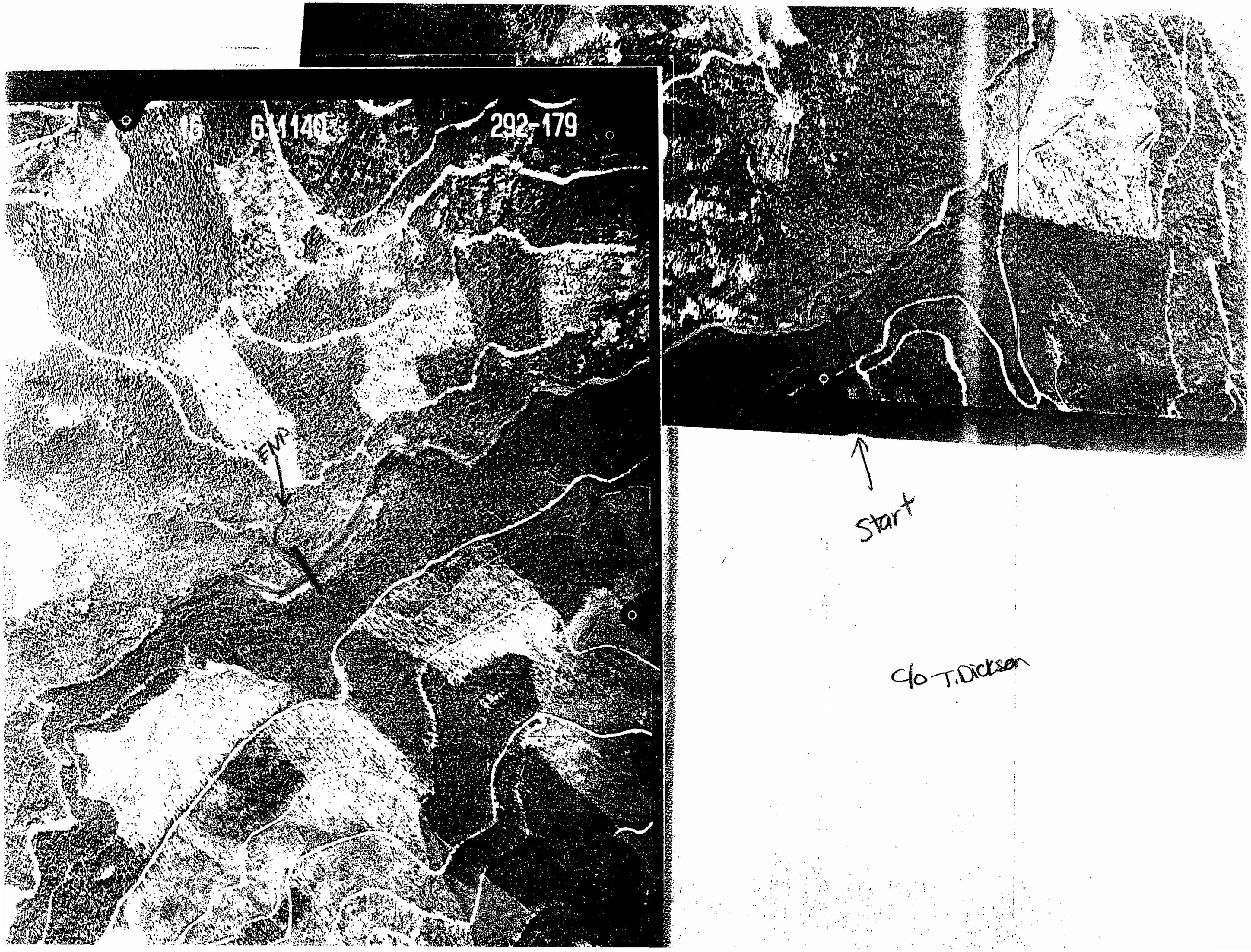
NUMBER:
Time: Width and Lenght:
Approximate Location:
Comments:

NUMBER:
Time: Width and Lenght:
Approximate Location:
Comments:

NUMBER:
Time: Width and Lenght:
Approximate Location:
Comments:

NUMBER:
Time: Width and Lenght:
Approximate Location:
Comments:

OTHER NOTES (number and location of pools, log-jams, rapids, falls, etc.):



c/o T. Dickson

BULL TROUT REDD SURVEY

CREEK NAME: Libby Creek EXAMINER: Art Pordey DATE: 10/25/95

AREA COVERED: - STARTING POINT DESCRIPTION: see map

- FINISHING POINT DESCRIPTION: meet S. Channel at end

- STARTING TIME: 0

- FINISHING TIME:

SUMMARY OF REDDS: none seen

NUMBER:

Time: Width and Lenght:

Approximate Location:

Comments:

NUMBER:

Time: Width and Lenght:

Approximate Location:

Comments:

NUMBER:

Time: Width and Lenght:

Approximate Location:

Comments:

NUMBER:

Time: Width and Lenght:

Approximate Location:

Comments:

NUMBER:

Time: Width and Lenght:

Approximate Location:

Comments:

OTHER NOTES (number and location of pools, log-jams, rapids, falls, etc.):

BULL TROUT REDD SURVEY

CREEK NAME: Libby Creek EXAMINER: T. Dickson DATE: 10/23/95

AREA COVERED: - STARTING POINT DESCRIPTION: (See map) Aprox 1 mile up stream

- FINISHING POINT DESCRIPTION: First bridge up Libby creek

- STARTING TIME: —

- FINISHING TIME: —

SUMMARY OF REDDS: No Redds

NUMBER:

Time: Width and Lenght:

Approximate Location:

Comments:

NUMBER:

Time: Width and Lenght:

Approximate Location:

Comments:

NUMBER:

Time: Width and Lenght:

Approximate Location:

Comments:

NUMBER:

Time: Width and Lenght:

Approximate Location:

Comments:

NUMBER:

Time: Width and Lenght:

Approximate Location:

Comments:

OTHER NOTES (number and location of pools, log-jams, rapids, falls, etc.):

area near bridge is a mess of large pools, rapids, falls, canyons + one major log jam. Some fish have been seen in the deep pools.

Very swift current, no major braids

T. DICKSON From Point A to first bridge that crosses Libby creek.

Reach # 1

BULL TROUT REDD SURVEY

CREEK NAME: Lower Libby Creek EXAMINER: DAN Snell DATE: 10-22-95

AREA COVERED: - STARTING POINT DESCRIPTION: Bridge over Libby Creek AT U.S. Hwy # 2

- FINISHING POINT DESCRIPTION: 1st Bridge over Libby Creek on Rd #231. About 1.3 miles From Hwy 2.
- STARTING TIME: 11:25
- FINISHING TIME: 13:15

SUMMARY OF REDDS: No Redds seen on this reach.

NUMBER: ______
Time: ______ Width and Lenght: ______
Approximate Location: ______
Comments: ______

NUMBER: ______
Time: ______ Width and Lenght: ______
Approximate Location: ______
Comments: ______

NUMBER: ______
Time: ______ Width and Lenght: ______
Approximate Location: ______
Comments: ______

NUMBER: ______
Time: ______ Width and Lenght: ______
Approximate Location: ______
Comments: ______

NUMBER: ______
Time: ______ Width and Lenght: ______
Approximate Location: ______
Comments: ______

OTHER NOTES (number and location of pools, log-jams, rapids, falls, etc.):

11:25 — Weather is overcast - Temp. is 40-45° F. Libby Creek is 30' wide, 18" → 24"+ deep. Creek is higher than average due to recent rains.

12:25 — Observed a nice eagle or osprey nest. It is located in a broken topped, mistletoe infested western larch on the east bank above a large cut bank of sand + silt immediately adjacent to Libby Creek - Road #231 is nearby, but nest will not be visible from road.

12:50 — Libby Creek flows thru rocky gorge 25' → 50' tall. Lots of white water, deep pools, + strong current. For safety reasons, I'm forced to leave stream and walk + climb west bank.

13:15 I come to Bridge over Libby Creek. Meet Tina and end this Reach

Libby Creek Bull Trout Survey

Reach # 1
10-22-95
R.D.S.

THURSDAY
10-17-96
WALKING DOWNSTREAM

BULL TROUT REDD SURVEY

CREEK NAME: Libby Creek EXAMINER: ______ DATE: 10-18-96

AREA COVERED: - STARTING POINT DESCRIPTION: Steel Bridge About 8 miles up Libby Creek near Junction of Roads #231 + #278

- FINISHING POINT DESCRIPTION: Ended Reach near the S ¼ corner of Section 18. This was point classed as beginning of Scott's Re[ach]
- STARTING TIME: 11:30
- FINISHING TIME: 1530

SUMMARY OF REDDS:

NUMBER: 1 ?
Time: 14:45 Width and Lenght: 18"-24" * (Maybe at best)
Approximate Location: 1/10 mile up stream from Confluence of Little Cherry Cre[ek]
Comments: This is a "maybe" at best. See notes on back - I did observe what I thought was a bull trout (18"+) swimming upstream about ½ hr. earlier. See additional notes on back

NUMBER: ______
Time: ______ Width and Lenght: ______
Approximate Location: ______
Comments: ______

NUMBER: ______
Time: ______ Width and Lenght: ______
Approximate Location: ______
Comments: ______

NUMBER: ______
Time: ______ Width and Lenght: ______
Approximate Location: ______
Comments: ______

NUMBER: ______
Time: ______ Width and Lenght: ______
Approximate Location: ______
Comments: ______

OTHER NOTES (number and location of pools, log-jams, rapids, falls, etc.):

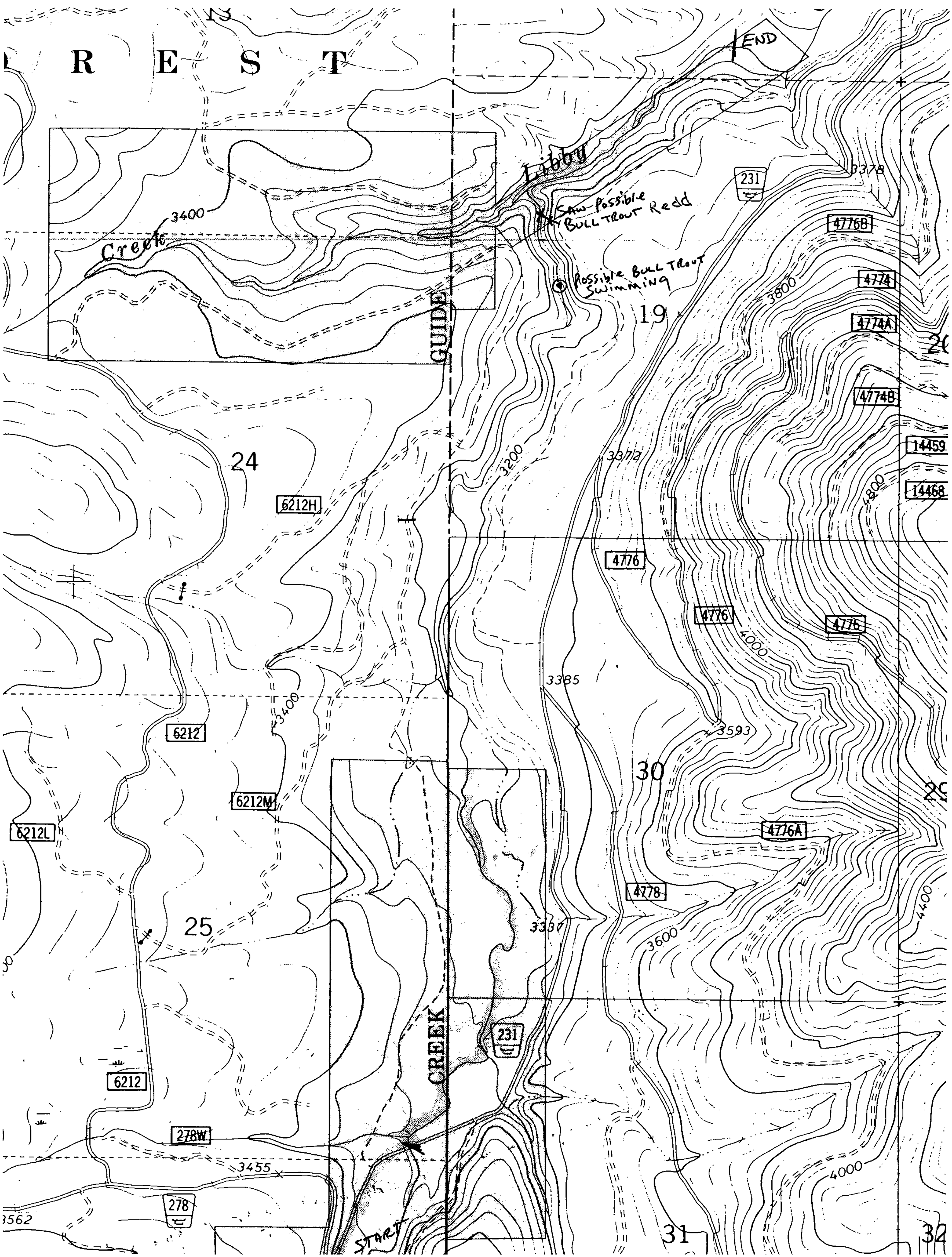
11:30 - Began walking down stream - Clear, sunny, + cool - Temp = 52°F.

12:00 - At footing of old wooden bridge - New channels occassionally cut thru dense forest - Mostly runs + riffles over cobble - gravel bar + pools generally absent!

12:35 - Stream is in wide flat valley bottom - Stream channel often 100+ yds wide. Virtually no live vegetation of any kind from bank to bank, stream is at low flow, shallow, and mostly runs + riffles over cobble. Western dipper birds observed occassionally - saw 1 wood duck. Scattered large woody debri frequent in stream course.

1:15 - Stream channel 100+ yds wide - Large, scattered woody debri - lots of signs of major bed load transport in very recent past - Few pools or entrenched woody debri.

1:40 - Floodplain narrows + stream gradient increases as ... Dense Forest + steep



R E S T
END
Libby
Creek
3400
Saw Possible Bull Trout Redd
Possible Bull Trout Swimming
231
3378
4776B
4774
4774A
4774B
14459
14468
3800
19
GUIDE
24
6212H
3200
3372
4776
4000
3385
3593
3400
6212
6212M
6212L
30
4776A
4778
3337
3600
4400
25
231
CREEK
6212
278W
3455
278
3562
START
31
4000

Bull Trout Redd Survey 10-17-96
PORTION of LIBBY CREEK

Number	Time	Probable	Possible	Size	Comments

~~Confluence~~

U.S. 2 upstream approx. 2 miles

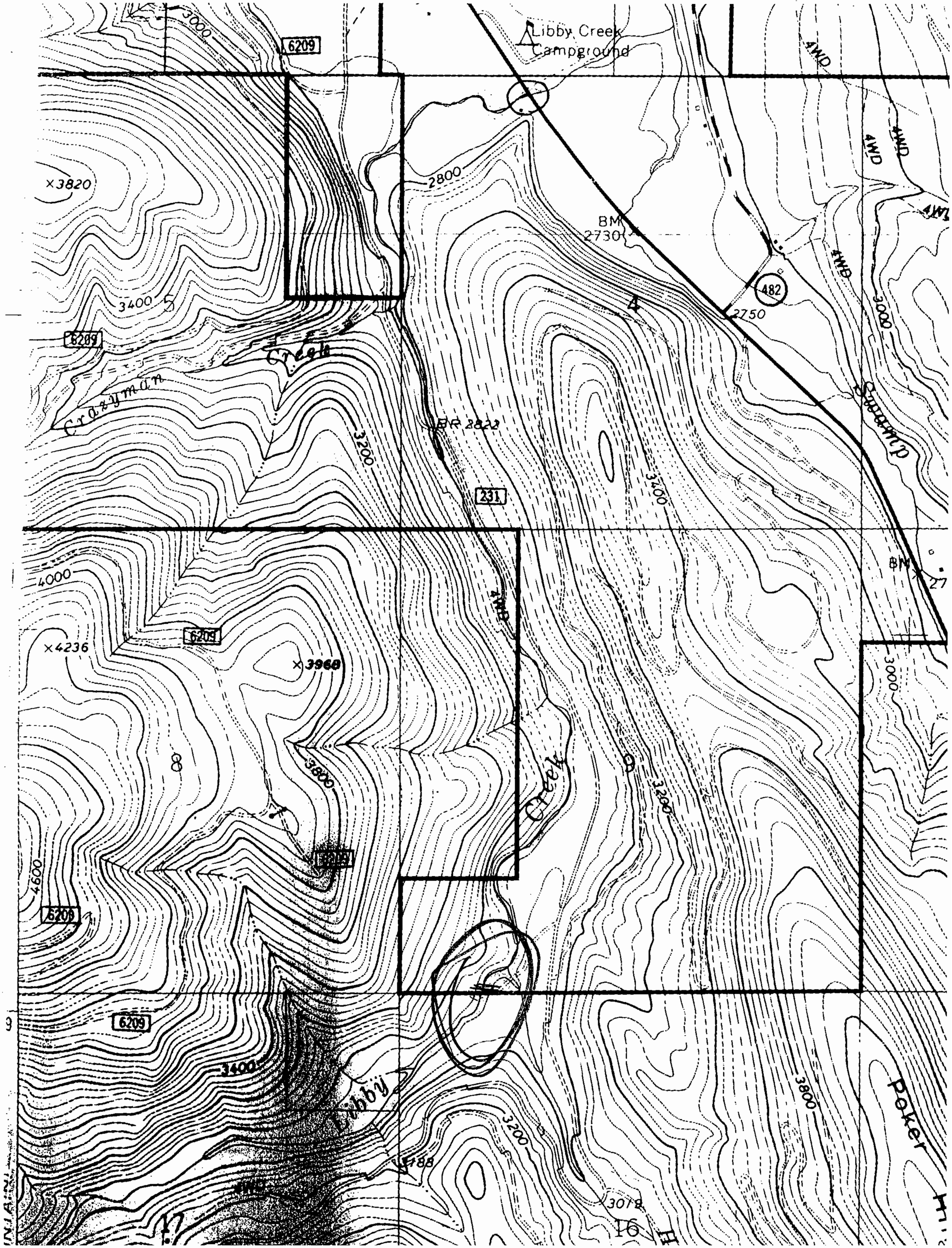
NO REDDS were observed on this portion of creek

STREAMBED was ~~made up of boulders with~~ mostly, with very few gravels ~~[illegible]~~

Many nice pools, but most of them had little or no ~~[illegible]~~ hiding cover, no fish were observed.

observer:

PAUL BRADT



Libby Creek
Campground
6209
3000
4WD
2800
×3820
BM
2730
482
2750
3400
5
Crazyman
Creek
BM 2822
3200
231
4
Swamp
BM
4000
×4236
×3968
8
9
3800
4600
Creek
Libby
3078
16
17
Poker

Libby Creek Bull Trout Redd Survey 10-17-96

Number	Time	Probable	Possible	Size	Comments

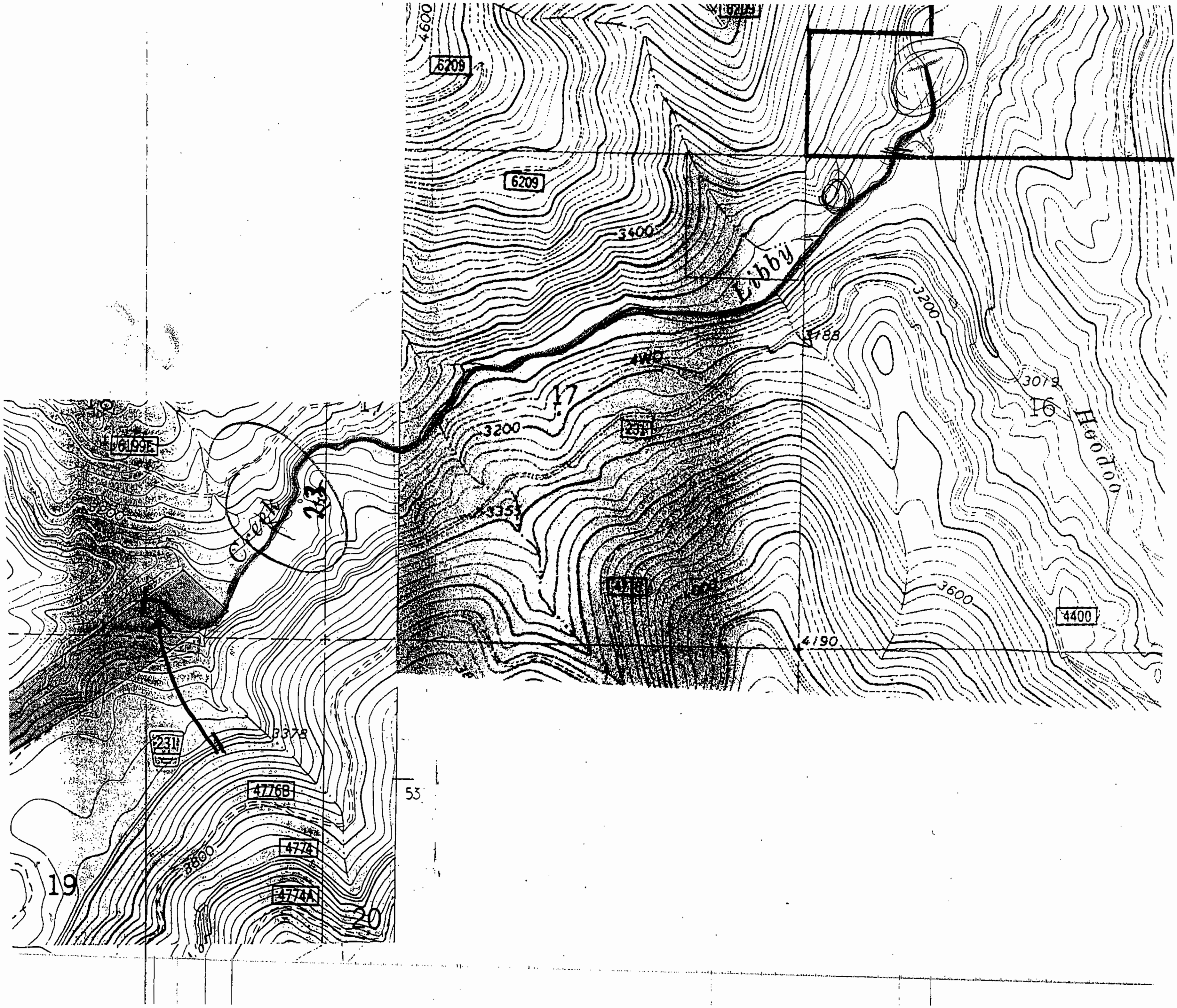
Survey began above confluence with Bear Creek. Continued down appx 2 mi.

~~Observed major stream re routing in top section.~~

Most of survey conducted from bank as numerous deep pools and sheet rock banks kept me out of water. Where gravel exists it is mostly larger 14"-10" gravel. Much of stream bed is solid rock.

Saw no fish or Redds.

Scott Ghormley



Libby
Creek
Hoodoo
6209
6209
4600
3400
3200
3200
3600
3019
16
17
4400
4190
6199E
2311
2311
4776B
4774
4774A
3800
3378
19
20
53

17 Oct 96

Ramsey Ck Bull Trout Redd Survey

Number	Time	Probable	Possible	Size	Comments
Start	10:36				
	10:53		3		Probably Brook 13"
	11:47				Stop

15 Oct 96

Poorman CK Bull Trout Redd Survey

Number	Time	Probable	Possible	Size	Comments
					Walked from bridge on Little Cherry loop to confluence w/ Libby CK No redds seen

BULL TROUT REDD SURVEY

CREEK NAME: Little Cherry CK / Libby CK EXAMINER: Ghormley / Pardy DATE: 10-25-95

AREA COVERED: - STARTING POINT DESCRIPTION: ~~Downstream~~ From Point where Little Cherry Creek Crossed Rd # 6212 downstream to, ---

- FINISHING POINT DESCRIPTION: Point where Bear Creek Joins Libby CK

- STARTING TIME: 1009
- FINISHING TIME: 1400

SUMMARY OF REDDS: No Redds Located

NUMBER: ______
Time: ______ Width and Lenght: ______
Approximate Location: ______
Comments: ______

NUMBER: ______
Time: ______ Width and Lenght: ______
Approximate Location: ______
Comments: ______

NUMBER: ______
Time: ______ Width and Lenght: ______
Approximate Location: ______
Comments: ______

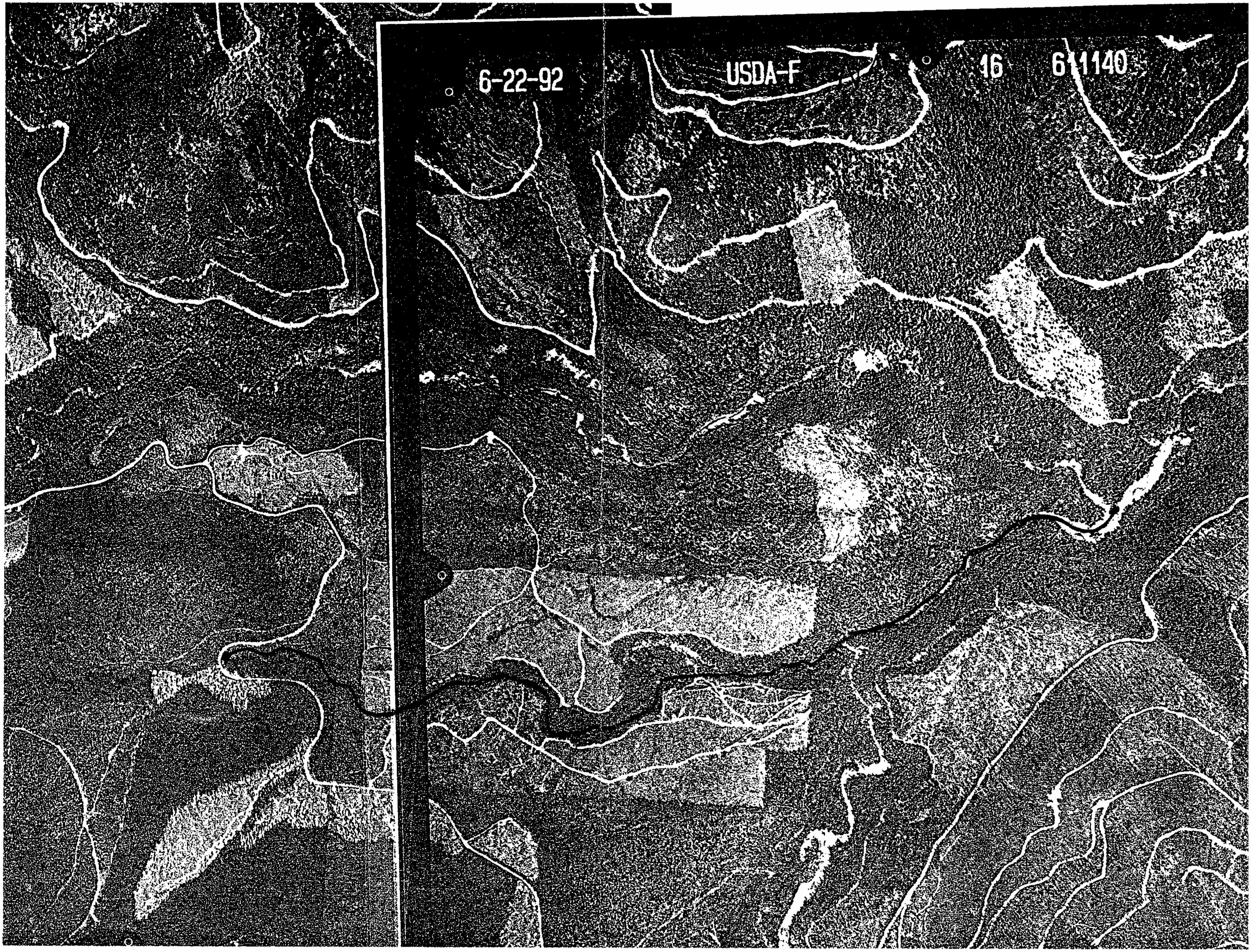
NUMBER: ______
Time: ______ Width and Lenght: ______
Approximate Location: ______
Comments: ______

NUMBER: ______
Time: ______ Width and Lenght: ______
Approximate Location: ______
Comments: ______

OTHER NOTES (number and location of pools, log-jams, rapids, falls, etc.):

All on Little Cherry:
- 1152 5' Cascade 1' wide - may be diffFcult For Bull Trout to pass upstream
- 1206 4' waterFall
- 1214 2' waterFall

This Creek (Little Cherry) is covered with blow down.


6-22-92
USDA-F
16
611140

Appendix H.
Miscellaneous reports and correspondence.

Noranda Mining and Exploration Inc.
Brenda Mines Division
Suite 718, 22 - 2475 Dobbin Road
Westbank, B.C. V4T 2E9

noranda

Tel: (250) 317-0187
Fax: (250) 317-0188

June17, 1998

RTE.	CC	DATE
	FILE	
ADM.	WTR.	AIR

Mr. Gary Ingman
Montana Department Of Environmental Quality
Monitoring and Data Management Bureau
2209 Phoenix Avenue
P.O. Box 200901
Helena, Montana 59620-0901

Re: Petition To Remove Upper Libby Creek From The Montana 303(d) List

Dear Mr. Ingman:

Noranda has received correspondence regarding our petition for the removal of the upper reach of Libby Creek from the Montana 303(d) listing, from Mark Simonich dated May 5, 1998. We have reviewed the departments findings, and prepared additional data and information to further support our petition, which is attached to this letter.

Please consider this additional information in you evaluations of our petition. Should you have any questions or comments please call at (250) 470-7656.

Sincerely,

NORANDA MINERALS CORP.
MONTANORE PROJECT

John Stroiazzo, P. Eng.
Project Manager

cc: Mark Simonich, Director, MDEQ
Bob Bukantis, MDMB
Van Jamison, PPAD
Bob Raisch, PPAD

RECEIVED
JUN 22 1998
DEQ / PPA
Monitoring & Data Management Bureau

SUPPLEMENTAL DATA AND INFORMATION TO SUPPORT DELISTING UPPER LIBBY CREEK, MONTANA TOTAL MAXIMUM DAILY LOAD (TMDL) DEVELOPMENT

June 11, 1998

This report contains additional data and information in support of a petition to the Montana Department of Environmental Quality (MDEQ or department) to remove (delist) upper Libby Creek from the 1996 *List of Waterbodies in Need of Total Maximum Daily Load Development* (i.e., "303(d) List"; MDEQ 1996) and the 1998 Draft List (MDEQ 1998). This report is a supplement to information submitted to MDEQ by Noranda Minerals Corporation (Noranda) on March 5, 1998. The MDEQ responded to Noranda's petition with a letter dated May 5, 1998 that outlines rationale for MDEQ's decision that the petition was incomplete due to a lack of sufficient supporting data. The deficient data are associated with three general categories: 1) biology; 2) physical/habitat; and 3) chemistry. A "Level of Information Accumulative Score" of 4 was assigned by MDEQ, with most of the data deficiencies determined for biology (i.e., macroinvertebrate, periphyton, and fisheries data), fisheries habitat, and toxicological studies.

The information provided in this report is to be used in conjunction with data provided in Noranda's original petition for delisting to MDEQ dated March 5, 1998. Relevant additional data are summarized in this report, including citations of the referenced information. This information and data on-file with the department should be adequate, in our opinion, to support the delisting of upper Libby Creek.

Based on Montana statutes, if credible data do not support one of the following three conditions, the stream should not be on the 303(d) list for total maximum daily load (TMDL):

1. Impaired -- exceedence of applicable water quality standards;
2. Threatened -- not subject to a MPDES permit or other applicable requirements; or
3. Threatened -- adverse pollution trends are documented.

BACKGROUND

Libby Creek (Montana waterbody number MT76D002-6; U.S. Geological Survey (USGS) hydrologic unit code number 17010101) is listed as "moderate priority" for TMDL development in MDEQ's 1996 and Draft 1998 TMDL lists. The entire 28-mile reach of the stream is designated as "partial use support", with probable impaired uses for aquatic life support and cold water fishery (trout). The initial MDEQ assessment date was November 1989. Probable causes of impairment listed by MDEQ include: flow alteration, metals, nutrients, siltation, and other habitat alterations. Probable sources of impairment include: agriculture, land development, pasture land, resource extraction, removal of riparian vegetation, and silviculture.

Surface water in Libby Creek is classified as B-1 water according to Montana Water-Use Classifications (Administrative Rules of Montana [ARM] 17.30.607). B-1 waters are protected for drinking, culinary and food processing purposes after conventional treatment; bathing, swimming, and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl, and furbearers; and agricultural and industrial water supply. Specific water quality standards for B-1 waters are contained in ARM 17.30.623.

The biological, physical/habitat, and chemical data used in this petition are primarily found in the following reports or databases:

(1) Draft, Supplemental, and Final Environmental Impact Statements (EISs) for the Montanore Project (U.S. Forest Service (USFS) 1990, 1991, & 1992); these documents should be on-file at MDEQ because the Dept. of State Lands, Dept. of Natural Resources and Conservation, and Dept. of Health & Environmental Sciences were all involved with preparation of the documents.

(2) Application for a Hard Rock Mining Permit (Noranda Minerals Corp. 1989); this document contains baseline information for water chemistry and biological resources; the Baseline Aquatic Biology Study (Western Resource Development Corp., 1989) is contained in Appendix D of the permit application; this permit application should be on-file with MDEQ.

(3) Annual Water Resources Monitoring Reports for the Montanore Project (Chen-Northern, Inc. 1990, 1991, 1992 & 1993; Huntingdon Chen-Northern, Inc. 1994; Huntingdon Engineering & Environmental, Inc. 1995; Maxim Technologies, Inc. 1996 & 1997); these reports have been submitted to MDEQ on an annual basis and should be on-file at MDEQ.

(4) Interim Aquatic Biological Monitoring Reports for 1990 through 1994 (Farmer 1991, 1992, 1993; Farmer et al., 1994, 1995); these reports have been submitted to MDEQ on an annual basis and should be on-file at MDEQ.

(5) STORET data (EarthInfo, Inc., 1997) for surface water quality of Libby Creek; selected data from Libby Creek monitoring station LB-3000 are included as an attachment in Noranda's March 5, 1998 petition for delisting to MDEQ.

BIOLOGICAL DATA

A considerable amount of biological data were collected in upper Libby Creek during the baseline period 1988-89 to meet mine permitting requirements for the Montanore Project (Western Resource Development Corporation (WRDC), 1989). Objectives for this baseline data collection program were to assemble a database for physical habitat, benthic macroinvertebrates and periphyton, and fisheries in streams within the upper Libby Creek drainage. These studies are summarized in draft and final EISs prepared by the U.S. Forest Service (USFS, 1990 & 1992) for the Montanore Project.

A supplement to the draft EIS (USFS 1991) made recommendations for future aquatic monitoring; afterwhich, an interim aquatic biological monitoring program was designed and implemented. Annual monitoring occurred during the period 1990-94, with results presented in annual reports by Farmer (1991, 1992 & 1993) and Farmer et al. (1994 & 1995). These reports contain macroinvertebrate and periphyton data that were collected each year at several locations on upper Libby Creek and some of its tributaries.

MACROINVERTEBRATES

Summary of 1988-89 Baseline Period (WRDC 1989):
A sparse but diverse group of macroinvertebrates was found in study area streams, indicating very good water quality. Macroinvertebrate densities in Libby Creek are relatively low, averaging approximately 180 organisms per Hess sample in October 1988, and about 250 organisms per Hess sample in August 1988 and April 1989. These densities are a consequence of the low productivity (i.e., low nutrient/organic enrichment) and seasonal extreme flow events. A total of nearly 40,000 organisms and 144 taxa were identified during the macroinvertebrate baseline study. Most of the taxa were considered intolerant of fine sediments, heavy metals, and organic pollution. The low benthic macroinvertebrate populations directly reflect the low nutrient concentrations in study area streams, and the potential to support fisheries is rated as poor (USFS 1992).

Summary of Interim Monitoring from 1990-94 (Farmer 1991, 1992 & 1993; Farmer et al. 1994 & 1995):
Interim monitoring of invertebrates and periphyton was conducted in Libby Creek during the period 1990 through 1994. Both high and low densities of macroinvertebrates (relative to baseline period) have been observed during the interim monitoring program. Specific attention was made to nitrate levels in Libby Creek because of increases from mine exploration activities at the Libby exploration adit. Peak nitrate concentrations in the 1 to 5 mg/L range occurred in 1991-92. Overall, the nutrient loading of Libby Creek in 1991 affected invertebrates immediately downstream of the Libby adit; initially, the effects were positive in terms of enhancing overall population numbers and diversity of taxa. These positive effects continued to diminish in 1993-94 as Libby Creek near the adit rebounded to "normal" conditions. Adverse effects on macroinvertebrate populations were not observed in Libby Creek near station LB-3000 (near U.S. Highway 2). In 1994, macroinvertebrate samples from Libby Creek contained over 900 organisms and 70 taxa.

PERIPHYTON

Summary of 1988-89 Baseline Period (WRDC 1989):
Periphyton sampled in study area streams during August-October 1988 and April 1989 were sparse but characteristic of high-elevation mountain streams. Algae occurred throughout the study area, and diatoms were present in all samples but were relatively sparse. In general, the algae and diatom taxa were typical of clean, soft-water mountain streams.

Summary of Interim Monitoring from 1990-94 (Farmer 1991, 1992 & 1993; Farmer et al. 1994 & 1995):
Interim monitoring of periphyton and invertebrates was conducted in Libby Creek during the period 1990 through 1994. Biological integrity remained good to excellent, with no impairment of aquatic life. In 1994, periphyton samples contained 17 non-diatom algae and 54 species of diatoms.

FISHERIES

Summary of 1988-89 Baseline Period (WRDC 1989):
Fish populations and spawning were evaluated in Libby Creek during the 1988-89 baseline period. Bull trout, rainbow trout, and sculpins were collected in Libby Creek and its tributaries. Bull trout was the only species found in the upper reaches of Libby Creek; whereas, the middle reaches were comprised of 93% rainbow trout. Fish populations in these streams generally are composed of moderate densities of small, young fish that are characteristic of high mountain streams. Spawning fish were surveyed in October 1989, with nine resident and two nonresident bull trout redds observed in upper Libby Creek. Two large nonresident bull trout were observed in Libby and Ramsey creeks in 1988-89. Mountain whitefish are also believed to move up Libby Creek from the Kootenai River for fall spawning.

Metal analyses were conducted on 24 fish tissue (rainbow trout) from Libby Creek to assess toxicity. Mean metal concentrations for the fish were (in parts per million): cobalt = 1.9; copper = 6.5; lead = <0.5; mercury = 0.19; and zinc = 30.1. These metal levels in fish tissue generally were similar to those reported from fish in other Montana streams and do not exceed any regulatory criteria (USFS 1992).

PHYSICAL/HABITAT DATA

Summary of 1988-89 Baseline Period (WRDC 1989):
For the initial baseline period of 1988-89, physical habitats were evaluated using the USFS (1985 & 1988) General Aquatic Wildlife System (GAWS) level 3 assessment. A total of 24 stream reaches along Libby Creek and its tributaries were identified and classified by major geomorphic features, including Rosgen (1985) stream type. Most reaches were characterized as having moderate to high gradient, predominantly gravel, cobble and boulder substrate, and excellent riparian habitat. Gravel substrates generally accounted for 20 to 40 percent of the Libby Creek streambed. Woody debris provided most of the instream cover and pool habitat.

Riparian habitat condition, an index of habitat quality on the banks of streams, was good or excellent for all 24 stream reaches in the study area, except one braided reach of Libby Creek below its confluence with Poorman Creek (rated fair due to effects from historic placer mining). Values for the *habitat condition index*, a general measure of potential fishery habitat, ranged from average to good; higher values generally were for bank cover and stability, with lower scores for pool quantity and quality. The *habitat vulnerability index* is a measure of a stream's susceptibility to aquatic habitat degradation; the reaches along Libby Creek were generally rated as moderate vulnerability.

Summary of Historic Impacts on Fisheries (USFS 1992):
The Final EIS for the Montanore Project reports that numerous years of mining and wildfire in upper Libby Creek adversely affected fish habitat in the Libby Creek drainage. In 1867, placer mining began in Libby Creek, followed by hydraulic mining from 1890 to 1937. A severe wildfire occurred in 1910 that virtually stripped the valley of all standing timber. Since about 1940, few activities have taken place in the upper Libby Creek drainage that would have affected fish habitat; natural processes have restored much of the biological and physical habitat characteristics of pre-1860 conditions.

CHEMICAL DATA

Natural concentrations of dissolved minerals and nutrients in upper Libby Creek and tributary streams generally are near or below their respective detection limits. Consequences of these extremely low concentrations include significant limits on productivity potential for aquatic life (USFS 1992). Station LB-3000 is located on Libby Creek just upstream of U.S. Highway 2 with a drainage area of approximately 60 square miles. Mean annual streamflow at LB-3000 during the period 1988-91 was about 170 cubic feet per second (cfs); minimum and maximum flow rates during this period were 11 and 750 cfs, respectively (USFS 1992).

Libby Creek at LB-3000 has an average specific conductance (SC) of about 40-90 micromhos per centimeter (mmhos/cm) and a neutral pH of about 7.0 standard units. Total suspended sediment (TSS) concentrations measured in Libby Creek at LB-3000 typically are in the 1 to 2 milligrams per liter (mg/L) range; TSS levels increase during spring runoff periods and have been reported up to 50 mg/L during May, June and July. Total hardness and alkalinity for upper Libby Creek typically are in the range of 20-40 mg/L. Nutrient concentrations for nitrate+nitrite, ammonia, and total Kjeldahl nitrogen (TKN) at LB-3000 generally are less than 0.4 mg/L. Table 1 contains water quality data for Libby Creek at station LB-3000 from the STORET database for the period 1988-93. Also contained in this table are Montana's water quality standards from Circular WQB-7 (MDEQ 1995).

Concentrations of metals in upper Libby Creek are low or below detection levels. The metals data summarized in Table 1 show that chronic aquatic life standards for aluminum (three samples) and cadmium (one sample) occasionally have been slightly exceeded in Libby Creek. One sample also showed a slight exceedence of the human health standard for iron. No specific trends are evident from the metals data at LB-3000.

With respect to nitrate+nitrite, elevated levels were detected in upper Libby Creek at station LB-300 (located downgradient of Libby exploration adit) in the early 1990s as a result of blasting material residue in discharge water from the Libby adit. Nitrate concentrations measured at Libby Creek station LB-300 for the period 1993-97 are summarized in Table 2. Construction of the adit was suspended in 1991, followed by sealing of the portal and flooding of the adit. Discharge from the adit during 1997 averaged approximately 25 gallons per minute (gpm).

A Consent Decree (Cause No. DV-92-46) was issued by MDEQ in 1993 that included monthly water resources monitoring requirements of Libby Creek near the adit (i.e., LB-300). Subsequently, a MPDES Permit (No. MT-0030279) was issued for this discharge, with a total inorganic nitrogen (i.e., ammonia and nitrate+nitrite) effluent limit of 2.2 mg/L for direct discharge. The average load for total inorganic nitrogen from the Libby Adit must not exceed 13.3 pounds per day. According to MDEQ (1997), these nitrogen levels will not cause undesirable effects in Libby Creek. In the Consent Decree, the MDEQ and Board of Environmental Review established an instream concentration limit of 1.0 mg/L for total inorganic nitrogen in Libby Creek.

During 1991-93, a slight increase in nitrate+nitrite concentrations was observed in Libby Creek at LB-3000 near U.S. Highway 2 (Table 1). Nitrate+nitrite concentrations at LB-300 near the Libby adit typically were in the range of 1 to 5 mg/L in 1991-92. Monthly monitoring data for Libby Creek at station LB-300 during the period 1993-97 (Table 2) show that average nitrate+nitrite concentrations were 0.54, 0.48, 0.25, 0.14, and 0.14 mg/L in 1993, 1994, 1995, 1996, and 1997 respectively. During 1997, concentrations of ammonia and nitrate+nitrite from the adit discharge typically were below the respective laboratory detection limit of 0.05 mg/L.

TABLE 1
SUMMARY LIBBY CREEK WATER QUALITY AND STANDARDS
STATION LB-3000

Parameter[1]	Concentration in milligrams per liter (mg/L) [2]						Water Quality Standard[3] (mg/L)
	8/88	8/89	2/90	4/91	4/92	3/93	
General Parameters							
SC (μmhos/cm)	86	71	65	45	48	36	-- / -- / --
Turbidity (NTU)	0.2	0.4	4.7	3.0	0.3	21	-- / -- / --
pH (std units)	7.8	7.2	7.1	6.5	6.7	7.3	-- / -- / --
Total Hardness	36	35	33	23	20	25	-- / -- / --
Total Alkalinity	46	39	30	24	22	23	-- / -- / --
Sulfate	2	<1	2	3	2	4	-- / -- / --
Chloride	1	1	1	<1	<1	4	-- / 860 / 230
Nutrients							
Nitrate+Nitrite	0.02	0.06	0.07	0.28	0.35	0.23	10 / -- / --
Ammonia	<0.05	<0.05	<0.05	<0.05	0.29	0.09	-- / ** / **
TKN	<0.2	0.31	<0.2	0.61	0.27	<0.2	-- / -- / --
Total Phosphorous	0.005	0.011	0.100	0.007	0.005	0.066	-- / -- / --
Metals							
Aluminum	<0.1	<0.1	0.2	0.1	<0.1	0.7	-- / 0.75 / 0.087
Arsenic	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.018 / 0.36 / 0.19
Cadmium	0.003	0***	<0***	0***	<0***	0***	0.005 / 0.0039* / 0.0011*
Chromium	<0.02	<0.02	NR	<0.02	<0.02	<0.04	0.10 / 1.7* / 0.21*
Copper	<0.001	<0.001	0.001	<0.001	0.002	0.002	1.0 / 0.018* / 0.012*
Iron	<0.05	<0.05	0.22	0.10	<0.02	0.74	0.30 / -- / 1.0
Lead	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	0.015 / 0.082* / 0.0032*
Manganese	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.05 / -- / --
Mercury	<0***	<0***	<0***	<0***	<0***	<0***	0.00014 /0.0024 /0.000012
Silver	<0.001	<0***	<0***	<0***	<0***	0***	-- / 0.0041* / --
Zinc	<0.02	<0.02	<0.02	<0.02	0.03	<0.02	5.0 / 0.12* / 0.11*

Notes:

[1] SC = specific conductance; μmhos/cm = micromhos per centimeter; NTU = nephelometric turbidity units; TKN = total Kjeldahl nitrogen.
[2] parameter concentrations in milligrams per liter (mg/L) unless otherwise noted; NR = not reported.
[3] human health std. / acute aquatic life std. / chronic aquatic life std. from Montana Dept. of Environmental Quality (MDEQ), 1995. Circular WQB-7, Montana Numeric Water Quality Standards. Water Quality Division. December 1995.
* = aquatic life standards based on hardness (100 mg/L hardness conservatively used for calculations).
** = ammonia aquatic life standards based on pH and temperature.
*** = values of zero (0) or less than zero (<0) are reported as such in the STORET database.
-- = no water quality standard in WQB-7.

Source: EarthInfo Inc., 1997; MDEQ 1995.

TABLE 2 SUMMARY OF NITRATE+NITRITE CONCENTRATIONS AT LIBBY CREEK STATION LB-300 -- MONTANORE PROJECT					
Month	**1993**	**1994**	**1995**	**1996**	**1997**
Jan.	0.52	0.57	0.49	0.22	0.19
Feb.	1.52	0.58	0.55	0.15	0.17
Mar.	0.76	---	0.28	0.11	0.18
Apr.	0.58	0.48	0.32	0.17	0.16
May	0.19	0.20	0.16	0.14	0.34
June	0.19	---	0.10	0.15	0.08
July	0.20	0.23	0.06	<0.1	<0.05
Aug.	0.29	0.50	0.23	0.07	0.05
Sept.	0.54	0.49	0.30	0.12	0.06
Oct.	0.44	0.48	0.21	0.11	0.09
Nov.	0.63	0.86	0.24	0.21	0.15
Dec.	0.59	0.41	0.14	0.18	---
Average	0.54	0.48	0.25	0.14	0.14
Minimum	0.19	0.20	0.06	0.07	<0.05
Maximum	1.52	0.86	0.55	0.22	0.34

Note: All concentrations of nitrate+nitrite in milligrams per liter.
Station LB-300 is located on Libby Creek downgradient of Libby exploration adit.

Source: MDEQ 1997; Maxim Technologies, Inc. 1998.

SUMMARY OF BIOLOGICAL, CHEMICAL, AND PHYSICAL DATA

Upper Libby Creek above U.S. Highway 2 has been subjected to a considerable amount of biological, chemical, and physical/habitat data collection that began in 1988 as a result of baseline studies for the Montanore mine project. Some of these studies (i.e., macroinvertebrate, periphyton, and water quality) continued through 1994 as part of an "interim" monitoring program. Draft, supplemental, and final environmental impact statements were prepared for the Montanore project in 1990, 1991, and 1992, respectively. These documents summarize much of the biological, chemical, and physical data associated with the Libby Creek drainage.

Macroinvertebrates and periphyton sampled in study area streams are relatively sparse, but are indicative of very good water quality in high-elevation mountain streams. Libby Creek has very low concentrations of dissolved minerals and nutrients. Most of the macroinvertebrate taxa present in upper Libby Creek are intolerant of fine sediments, heavy metals, and organic pollution. Elevated nitrate concentrations in the creek near the Libby exploration adit in 1991-92 resulted in short-term positive enhancement of overall macroinvertebrate population numbers and diversity of taxa.

With respect to fisheries, bull trout, rainbow trout, and sculpins were collected in Libby Creek and its tributaries during the 1988-89 baseline period. The fish populations generally are composed of moderate densities of small, young fish that are characteristic of high mountain streams. Metal content analyzed in fish tissue from Libby Creek are similar to levels reported from fish in other Montana streams; no regulatory standards have been exceeded for metals in fish.

After cessation of exploration activities in the Libby adit in 1991, nitrate+nitrite concentrations in Libby Creek near the adit decreased from an average of 1 to 5 mg/L in 1991-92 to less than 0.15 mg/L in 1996-97. Currently, a MPDES permit authorizes discharge of Libby adit water to an infiltration system near Libby Creek in the vicinity of the adit. Metals data for Libby Creek show that chronic aquatic life standards have been exceeded occasionally for two parameters (aluminum and cadmium). No specific trends are evident for the metals data associated with Libby Creek.

Major geomorphic features of Libby Creek were evaluated during the baseline period in 1988-89. Most stream reaches were characterized as having moderate to high gradient, predominantly gravel, cobble and boulder substrate, and excellent riparian habitat. Woody debris provided most of the instream cover and pool habitat. Index values for habitat condition and vulnerability were average or good.

It appears that sufficient and credible data exist for upper Libby Creek to support the removal of this stream segment from the Montana 303(d) list for TMDL using the following three conditions:

1. Impaired -- exceedence of applicable water quality standards;
2. Threatened -- not subject to a MPDES permit or other applicable requirements; or
3. Threatened -- adverse pollution trends are documented.

For the impairment criterion, water quality data for Libby Creek indicate occasional exceedences of chronic aquatic life criteria for aluminum and cadmium. These intermittent exceedence values appear to occur irregularly throughout the drainage basin and likely are the result of natural background concentrations. Aquatic life standards for metals that are based on hardness are very low because the hardness for Libby Creek generally is less than 40 mg/L. No adverse impacts to aquatic life appear to be occurring in upper Libby Creek, with the creek continuing to support identified beneficial uses including cold water fishery.

The MDEQ 303(d) list cites probable causes of impairment for Libby Creek as: flow alteration, metals, nutrients, siltation, and other habitat alterations. Probable sources of impairment include: agriculture, land development, pasture land, resource extraction, removal of riparian vegetation, and silviculture. Based on information presented in this report, there is no evidence for impairment from the probable causes and sources listed above. Historic placer mining and major forest fires have occurred in the drainage basin; however, these actions generally took place prior to 1940. Since that time, few activities have taken place in the upper Libby Creek drainage that would cause adverse impacts to Libby Creek.

Upper Libby Creek should not be considered a threatened water body because there are no known proposed sources that would not be subject to permitting requirements, nondegradation provisions, or reasonable land, soil and water conservation practices. There is no evidence of adverse trends in metal, nutrient, or sediment concentrations in upper Libby Creek. Metals typically are below detection limits in the creek and exceedence of water quality standards is irregular and infrequent. While historic placer mining and fires may have impacted stream bed conditions and increased sedimentation, there are no evident recent adverse trends.

Based on a review of available data which exist on-file at MDEQ, upper Libby Creek does not appear to be impaired or threatened. Therefore, listing upper Libby Creek as a 303(d) water quality limited stream in need of TMDL development beyond that included in the current MPDES process is not warranted.

REFERENCES

EarthInfo, Inc., 1997. Computer CD Database: U.S. Environmental Protection Agency (EPA) STORET. Boulder, Colorado.

Farmer, C., M. Newcomb, and E. Weber, 1995. Montanore Project, Continued Interim Aquatic Biological Monitoring 1994. Prepared for Noranda Minerals, Missoula, MT.

Farmer, C.E., and E. Weber, 1994. Montanore Project, Continued Interim Aquatic Biological Monitoring 1993. Prepared for Noranda Minerals, Missoula, MT.

Farmer, C.E., 1993. Montanore Project, Aquatic Biological Interim Monitoring 1992. Western Technology and Engineering, Inc. Prepared for Noranda Minerals, Missoula, MT.

Farmer, C.E., 1992. Montanore Project, Aquatic Biological Monitoring 1991. Western Technology and Engineering, Inc. Prepared for Noranda Minerals, Missoula, MT.

Farmer, C.E., 1991. Montanore Project, Aquatic Macroinvertebrate Monitoring Study 1990. Westech Tech. Report. Prepared for Noranda Minerals, Missoula, MT.

Maxim Technologies, Inc., 1998. Montanore Project, Noranda Minerals Corporation, 1997 Water Resources Monitoring Program, Summary Report. Prepared for Noranda Minerals Corporation, Kelowna, BC, Canada.

Montana Department of Environmental Quality (MDEQ), 1997. Authorization to Discharge under the Montana Pollutant Discharge Elimination System (MPDES). Permit No. MT-0030279 for Noranda Minerals Corp. (Montanore Mine - Libby Creek Adit); including Response to Comments and Statement of Basis. September 1997.

MDEQ, 1995. Circular WQB-7, Montana Numeric Water Quality Standards. Water Quality Division. December.

U.S. Forest Service (USFS), 1992. Final Environmental Impact Statement; Noranda Minerals Corp., Montana Reserves Company, Joint Venture; Montanore Project. Prepared by U.S. Forest Service, Montana Dept. of State Lands, Montana Dept. of Health and Environmental Sciences, and Montana Dept. of Natural Resources and Conservation. October 1992.

USFS, 1991. Montanore Project Supplemental Draft Environmental Impact Statement. Kootenai National Forest, Montana Dept. of State Lands, Montana Dept. of Natural Resources and Conservation, and Montana Dept. of Health and Environmental Sciences.

USFS, 1990. Montanore Project Draft Environmental Impact Statement. Kootenai National Forest, Montana Dept. of State Lands, Montana Dept. of Natural Resources and Conservation, and Montana Dept. of Health and Environmental Sciences.

Western Resource Development Corporation, 1989. Aquatic Biology Study, Montana Project, Lincoln and Sanders Counties, Montana. Prepared by D.L. McGuire, T.P. Hightower, and R.W. Thompson. Prepared for Noranda Minerals Corp., Reno, NV.

ATTACHMENT
RESPONSE TO NORANDA'S PETITION TO DE-LIST UPPER LIBBY CREEK.

August 18, 1998

I. Sufficient Credible Data Review of Upper Libby Creek Information

In their letter of June 17, 1998, Noranda Minerals Corp. Submitted a list of documents containing data collected on Libby Creek over the past 10 years. These documents were on file at the Department of Environmental Quality (DEQ). Noranda also submitted a report summarizing the findings of the above documents. Before undertaking an evaluation of the data, we first determined if sufficient and credible data had been provided. The details of our review process have been provided to Noranda in an earlier correspondence (May 5, 1998). The results of our review are summarized as follows:

1. Biological Assessment

Long term monitoring data on two biological assemblages (periphyton, macro-invertebrates) was provided, along with a fisheries survey conducted as part of the baseline data collection.

Level of Information = 4 (Reference Table 3-1)

2. Habitat Assessment

Most of the information on habitat in Upper Libby Creek was contained in the baseline study (Hydrometrics, 1989) and in the U.S. Forest Service Environmental Impact Statement (1992). This included riparian assessments, stream bed composition, and stream morphology.

Level of Information = 3 (Reference Table 3-2)

3. Physical/Chemical Data

A number of sampling stations along Upper Libby Creek were monitored for numerous chemical parameters, including an analysis for metals in fish tissues. This sampling took place over a 9 year period, although the number of sampling stations and frequency of sampling was reduced over time.

Level of Information = 3 (Reference Table 3-4)

The accumulative level of information score is 10. The DEQ requires a minimum of 6 in order to make aquatic life use-support decisions. Therefore, the information provided by Noranda is more than sufficient to make an evaluation of Libby Creek.

II. Evaluation of the Aquatic Life Use-Support Data for Libby Creek

Noranda Minerals Corp. indicated in their letter of March 5, 1998 that the upper 13 miles of Libby Creek is not impaired. They further stated that for §303(d) listing purposes, Libby Creek should be split into two segments; the upper half would begin at the headwaters and end downstream at the U.S. Highway 2 crossing (approximately 13 river miles). Noranda indicated that below the highway crossing the stream has different morphological characteristics, and is surrounded by homes and businesses.

In their letter of June 17, 1998, Noranda again states, based on their review of the data, that there is no evidence for impairment on Libby Creek from the probable causes and sources listed on the §303(d) list. However, they do note that historic placer mining did occur in the creek, and that such mining (along with forest fires) may have impacted stream bed conditions.

The following is a review of all of the data provided by Noranda to the DEQ, and our conclusions as to the listing of Libby Creek on the Montana §303(d) list.

A. Splitting of Libby Creek into Two Segments

Noranda's request that Libby Creek be split into two segments is reasonable. The lower half of the creek (below the U.S. Highway 2 bridge) has different characteristics and is subjected to different uses. Therefore, DEQ will split Libby Creek into upper and lower halves for purposes of this evaluation and the Montana §303(d) list. The dividing line, as stated, will be the U.S. Highway 2 crossing. Our current data review (below) will focus on Upper Libby Creek. The submitted data further suggest splitting "Upper" Libby Creek into subsections, as explained in **III** below.

B. Metals Data

Noranda submitted analyses of 24 fish tissues for cobalt, copper, lead, mercury, and zinc. None of the metals exceeded any regulatory criteria (USFS, 1992). However, it should be noted that in this same document (page 160) it is stated that "samples today reveal residual mercury concentrations in and around stream channels". This mercury is remnant from historic mining. Noranda also notes that water quality standards for aluminum and cadmium have been exceeded. However, our review indicates that these two metals do not constitute an impairment (see below).

Aluminum. In Table 1 of their June 17th letter, Noranda notes that the aluminum concentrations in 1990, 1991 and 1993 exceeded chronic and/or acute aquatic life standards. This information came from STORET data (EarthInfo Inc. 1997), collected at water quality monitoring station LB3000 on Libby Creek. The station was located about 1.5 miles upstream from the U.S. Highway 2 crossing. The metals data in the EarthInfo document is actually total recoverable metals, not dissolved metals. The aquatic life standards for aluminum (as found in circular WQB-7, Montana Numeric Water Quality Standards) are written for dissolved, not total recoverable concentrations. A review of the total suspended solids (TSS) data collected with the aluminum data at LB3000 indicates that there is a tight coupling ($r^2 = .98$) between TSS and total recoverable aluminum. This suggests that total recoverable aluminum values rise with increasing TSS due to greater concentrations of aluminum-containing silicate minerals (i.e., clays) in the water. Therefore, it does not appear that water quality standards for dissolved aluminum have been exceeded.

Cadmium. In Table 1 of their June 17th letter (see above), Noranda reports that cadmium concentrations exceeded the chronic aquatic life standards on one occasion (1988). No other exceedances were found in 5 years of subsequent data collection. As for aluminum, this value was thought to be a dissolved cadmium concentration, when in fact it was total recoverable cadmium. Again, no water quality standard have been exceeded.

C. Nutrients

Noranda is permitted to release total inorganic nitrogen (N) into Libby Creek (MPDES Permit No. MT0030279), with a limit of 2.2 mg-N/L for direct discharge. In stream concentrations are not to exceed 1.0 mg-N/L. There was some exceedance of this in-stream limit in the early 1990's; however, the concentrations have since dropped dramatically and have been below 1.0 mg-N/L since 1993. In stream concentrations of total phosphorus (P) also increased somewhat in 1990, but have dropped to pre mine- construction values. Overall, it would appear that nutrient concentrations are demonstrating a declining pollution trend.

D. Periphyton and Macroinvertebrates

A number of sampling stations for periphyton and macroinvertebrates were established along Libby Creek (Farmer, 1991-92; Farmer et al., 1995). Site L10 is upstream from the main adit of the mine, while site L9 is just downstream. Using protocols established for Montana streams (Bahls, 1993), and site L10 as a "pristine" upstream reference, periphyton at site L9 showed severe impairment in 1991. However, there was only minor or no impairment in subsequent years (1992-4).

Macroinvertebrates showed a similar trend. A Shannon Diversity Index value < 3 usually indicates organic pollution (Farmer et al., 1995). For the macro invertebrates at site L9, This value dropped to 1.93 (Hess sample) and 2.32 (kick sample) in 1991, but rebounded to > 3.7 in subsequent years. The more recent values compared favorably to site L10.

It would appear that sites both site L10 and L9 have minor impairments to macro- invertebrate populations for the period 1991-4 (Farmer and Farmer et al.). Typically, decreases in biotic indicators (SDI, etc.) at site L10 are reflected at site L9. This suggests that factors unrelated to the mine adit were influencing environmental conditions. Overall, the faunal changes resulting from the introduction of nutrients (mainly N) from the mine adit appear to have subsided in recent years.

III. Justification for Maintaining part of Upper Libby Creek on the §303(d) List of Impaired Water Bodies

As noted above, most of the data from the collection sites referenced by Noranda do not indicate any particular impairments. However, a review of the baseline data assessment (Hydrometrics, 1989) indicates that there is still a significant reach of Upper Libby Creek which shows a fair degree of habitat degradation. This approximately 4.8 mile reach stretches from the confluence of Howard Creek downstream to the confluence with Little Cherry Creek (Figure 1). The source of the habitat degradation is historic placer mining. This reach is located between the sampling stations (i.e., L1, L9, L10, LB-300 and LB-3000) which Noranda had used to present the majority of their data. The following is an explanation of our procedure for making beneficial use determinations, and a justification as to why this segment of Upper Libby Creek will be listed as partially supporting its aquatic life and cold water fisheries beneficial uses. The reaches of Upper Libby Creek above and below this section will be listed as fully supporting their beneficial uses (see Figure 1).

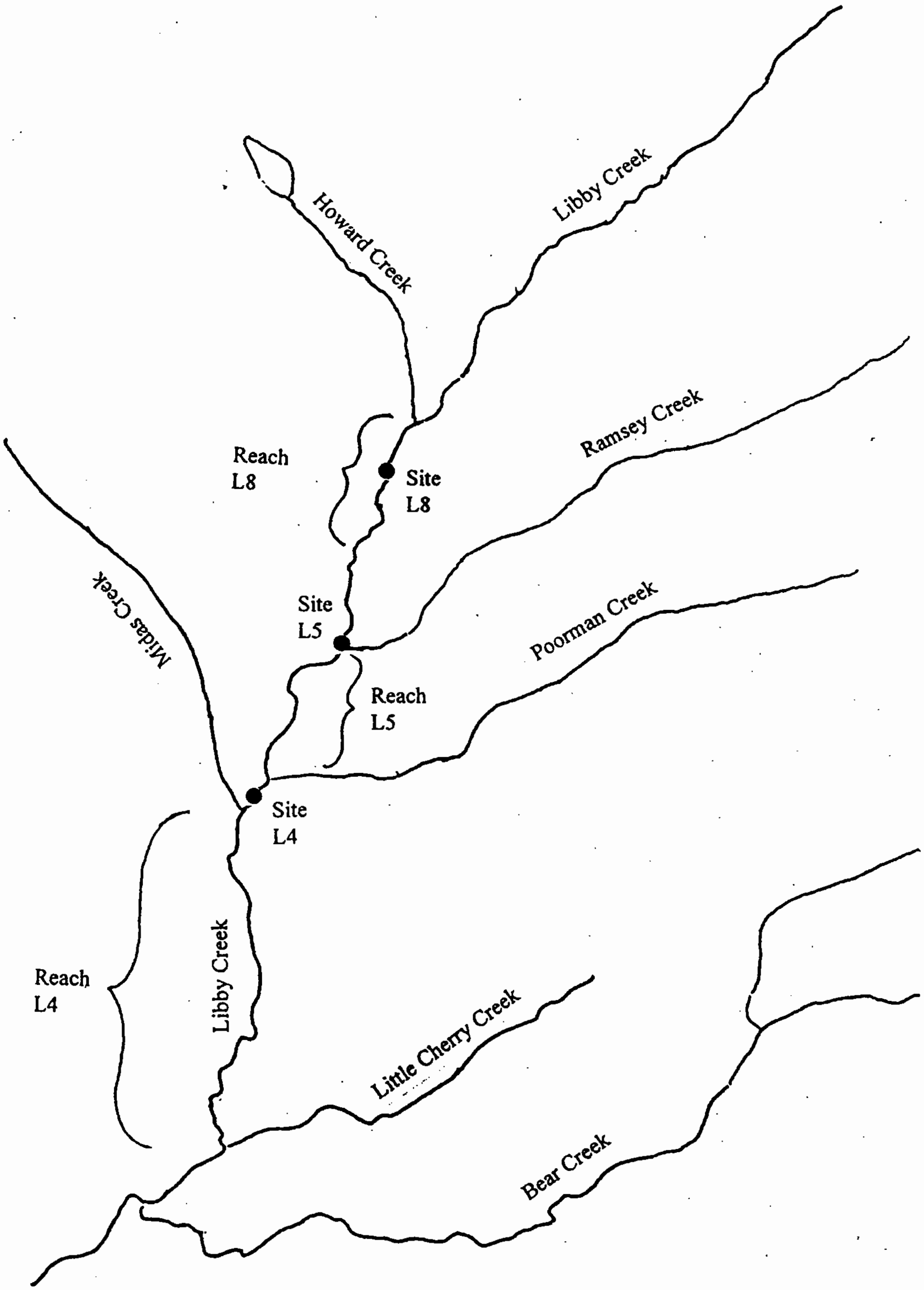


Figure 1. Upper Libby Creek. Impaired Section from Howard Creek to Little Cherry Creek

BENEFICIAL WATER USE SUPPORT EVALUATION:

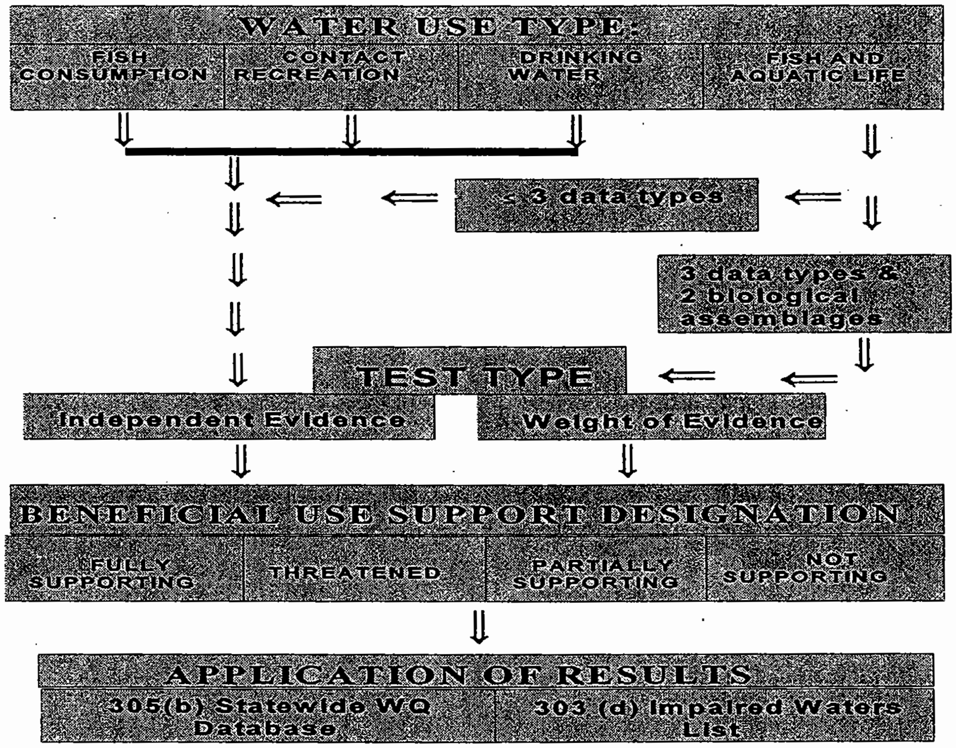


Figure 2. Water Body Assessment Decision Process.

A. Water Body Assessment Process

Figure 2 represents the evaluation process for data that have been deemed sufficient and credible. As three data types and at least two biological assemblages were provided by Noranda, we selected the weight of evidence test-type to determine the beneficial-use support designation. In order for a water body to receive a designation of "partially supporting", one of the following must apply:

1. Of the three data-type categories (habitat, chemical/physical parameters, biological assemblages), two of the categories must be partially impaired.

2. There is complete impairment of one of the above mentioned categories.

3. If multiple biological-assemblage data is available, two biological assemblages (i.e. fish, macroinvertebrates) have been modified significantly beyond the natural range of the reference condition.

In the case of Upper Libby Creek, the data indicated that there was partial impairment of the habitat (both in stream and riparian) and partial impairment of a biological assemblage (macroinvertebrates). Per case #1 above, the 4.8 mile reach between Howard Creek and Little Cherry Creek is partially supporting its beneficial uses (in this case, aquatic life and cold water fisheries).

B. Partial Habitat Degradation

A total of 18 stream reaches on six streams were assessed in the Upper Libby Creek area as part of the baseline data collection for the Montanore project. The Habitat Condition Index (HCI) is a Forest Service index composite of pool/riffle ratio, pool structure, stream-bottom composition, streambank soil stability, and riparian stability (Hydrometrics, 1989). The score has a possible range of 0-100 (100 being the best). Upper Libby Creek received generally good scores for habitat condition, however, reach L4 (downstream from the Poorman Creek confluence, Figure 1) received the second lowest score (55.4) for the 18 reaches assessed. Reach L5 (upstream from the Poorman Creek confluence) received a moderate score of 66.8. Reach L4, "unlike most study area stream reaches, had unstable banks and little or no protective cover" (Hydrometrics, 1989).

The report also assesses Riparian Habitat Condition. This rating is derived from an evaluation of up to nine components of the plant community, as well as the substrate of the riparian zone. Scores range from 0-36; > 30 is excellent, 22-30 is good, 5-21 is fair, and ≤ 4 is poor. Reach L4 had the lowest score among 18 reaches assessed on six area streams, receiving a score of 18 (fair). The two reaches immediately upstream and downstream of reach L4 scored considerably higher (29 and 33, respectively). The impairment to reach L4 damage was the result of "extensive, historic placer mining" (Hydrometrics, 1989).

These data indicate partial riparian and stream bank degradation of Upper Libby Creek, mostly in the area of reach L4 (Little Cherry Creek to Poorman Creek). The area upstream from Poorman Creek (reach L5) has improved riparian conditions; however, it has relatively poor stream channel stability (see below).

C. Partial Impairment to Macroinvertebrate Population

The Hydrometrics (1989) report also contained data on 20 sampling stations on the same six streams in the Upper Libby Creek area. Three stations (L4, L5 and L8) had relatively high macroinvertebrate diversity in August 1988 after a three month period of stable flows. However, diversity at these sites declined markedly relative to other stations in October and April. The decline was attributed to scouring and bedload transport during periods of high flow. The biotic potential of this portion of Upper Libby Creek was substantially reduced by the unstable stream channel. Furthermore, L5 had one of the lowest EPT index (number of distinct taxa in the orders

Ephemeroptera, Plecoptera and Trichoptera) among the 20 stations mentioned above. EPT is an indication of pollution intolerance (Hydrometrics, 1989).

There is also some indication that trout may be impaired by the stream conditions. There were typically 2.0 bull trout reds/mile in Upper Libby Creek (Hydrometrics 1989), although 16 reds/mile is considered "good" on the N. Fork Flathead River.

Taken as a whole, there is substantial data to suggest that macroinvertebrate populations are partially impaired due to an unstable stream bottom that is susceptible to excessive bedload transport. In combination with the impairment to the riparian habitat, there is sufficient data to indicate that this region of Upper Libby Creek (from reach L4 to L8) is only partially supporting its aquatic life beneficial uses.

IV. Conclusions

Currently , 28 miles of Libby Creek are listed as partially impaired, the cause of the impairment being flow alteration, metals, nutrients, siltation, and other habitat alteration. Sources of this impairment are listed as agriculture, land development, pasture land, resource extraction, removal of riparian vegetation, and silviculture.

Noranda Minerals Corp. has submitted sufficient credible data to make a beneficial use-support decision for (Upper) Libby Creek. The data that they provided scored a 10, whereas only a 6 is required to commence with the data evaluation. Noranda has requested that Libby Creek be divided into two segments (Upper and Lower), and that the upstream half should be removed from the §303(d) list as partially supporting for aquatic life support and cold water fisheries. We have found that Noranda's request to split the stream into two working areas for beneficial use decisions is reasonable. The dividing point will be the point where Libby Creek crosses U.S. Highway 2. In this review, DEQ has focused only on issues related to the "upper" half of Libby Creek.

Noranda's data revealed that there is no apparent contamination from metals, and that nutrient concentrations (which are currently regulated by a MPDES permit) have declined substantially in Upper Libby Creek in the past four years. Furthermore, periphyton and macroinvertebrate populations, after having shown some changes during the early activities of the mine, appear to be returning to a state found prior to the mine's activity.

However, there still remains a significant reach (~4.8 miles) of Upper Libby Creek (between Howard Creek and Little Cherry Creek) that is moderately impaired. The cause of this impairment is habitat degradation to the stream bed and riparian zone, and alterations to a biological assemblage (macroinvertebrates). The main source of this impairment appears to be historic placer mining and channel alteration, and to some degree, wildfires (a natural source).

Based on the available information, this section of Upper Libby Creek (from Little Cherry to Howard Creeks) will be listed on the next (year 2000) §303(d) list as partially supporting its beneficial uses. The remaining reaches of Upper Libby Creek (Little Cherry Creek downstream to Highway 2, and from Howard Creek upstream to the headwaters) will be removed from the list. These reaches appear to be fully supporting their beneficial uses.

The impacted section of Upper Libby Creek will eventually be subject to a Total Maximum Daily Load (TMDL) watershed plan. At that time, all individuals and organizations along the stream may be asked to voluntarily participate in the plan. We hope that we can count on your participation in any future improvement plans for Upper Libby Creek.

Michael W. Suplee
DEQ Water Quality Specialist

REFERENCES

Bahls, L.L. 1993. Periphyton bioassessment methods for Montana streams. Montana Department of Health and Environmental Sciences, Water Quality Bureau, Helena.

EarthInfo, Inc. 1997. Computer CD database: U.S. Environmental Protection Agency STORET. Boulder, CO.

Farmer, C. E. 1991. Montanore Project. Aquatic macroinvertebrate monitoring project. Western Technology and Engineering , Helena, MT.

Farmer, C. E. 1992. Montanore Project. Aquatic biological monitoring 1991. Western Technology and Engineering, Helena, MT.

Farmer, C.E., and M. Newcomb. 1995. Montanore Project. Continued interim aquatic biological monitoring 1994. Western Technology and Engineering, Helena, and Phycologic, East Helena, MT.

Hydrometrics, Inc. 1989. Application for a hard rock mining permit and proposed plan of operation. Montana project, Lincoln and Sanders counties, Montana. Submitted by Noranda Minerals, Inc.

Montana Department of Environmental Quality. 1998. Circular WQB-7, Montana numeric water quality standards. Helena, MT.

Maxim Technologies, Inc. 1997. Montanore Project. Noranda Minerals Corporation. 1996 water resources monitoring program summary report.

United States Forest Service (USFS). 1992. Final environmental impact statement; Noranda Minerals Corp., Montana Reserves Company joint venture; Montanore Project. Prepared by US Forest Service, Montana Dept. of Health and Environmental Sciences, and the Montana Dept. of Natural Resources and Conservation.

POORMAN STREAM MANAGEMENT PLAN

Statement of Problem

The lower 2.5 miles of the stream is severely destabilized. The banks are eroded, timber recruitment is excessive, and bedload transport is very high. This condition appears to be recent and worsening.

Stream Description

This is a stream of short length (<6miles) draining the east face of the Cabinet Range. It can be neatly divided into two reaches. The headwater reach is of higher gradient and drains a steep, glacially carved valley. The lower reach is depositional, has a lower gradient, and begins abruptly at the sharp transition from glacially carved valley to depositional flat. The channel type and riparian vegetation differ by reach also. The upper reach is controlled by frequent avalanche activity which successionally retards a high percentage of the riparian vegetation, maintaining it in a shrub stage. Consequently timber recruitment is minimal and danger of debris accumulation is slight since the input is small, and the high energy bedrock controlled channel has a flushing capacity that precludes excessive accumulation of debris.

In contrast, the lower reach is not bedrock controlled, the gradient lessens, and the riparian stands are largely in an old growth condition. Excessive recruitment in the lower reach is compounded by deposition of debris transported from the upper reach.

Hydrologic and Biological Effects of Current Condition

The clogging of the channel with debris has both beneficial and detrimental effects. The scouring associated with organic debris usually produces high quality pools. However, debris can also be detrimental and tends to be so when the following conditions exist: 1) it is poorly anchored, 2) the diameter is too large, 3) it is excessive, 4) it is positioned to catch additional debris, or 5) it destabilizes the banks by tree-fall which removes rootwads.

Hydrologically, the result of this condition is reduced water quality due to the increased production of sediment from the destabilized and weakened banks. The other result is a change in valley bottom topography as terraces and various other alluvial deposits are eroded and reworked.

Barry Hansen
11/83

Biologically there may be some improvement of resident fish habitat resulting from the increase in pools created by debris. Otherwise the condition has an overall negative effect biologically. Regarding spawning habitat, there may be some increase in gravels deposited at the outlet of pools, but this will be negated by the increased sediment production, barriers to spawning migrations, channel changes, and bedload movement. Rearing habitat may improve due to the increase in shallow secondary channels (braiding) which provides areas of escape. Resident habitat may also show some improvement due to pool forming processes and cover related to the debris. Otherwise, braiding and channel migration tend to decrease water depth magnifying the stress periods during summer low flow and winter freeze out. In addition, the debris loading will reduce the ability of fish to migrate, to adjust to population density changes, or to seek out optimum habitat.

Cause of the Problem

Two basically different explanations exist to describe how the current condition came about. One possibility is that there has been an increase in water yield which set off an instability in the channel as it adjusted to accomodate the increased runoff. The instability is severely aggravated by the size and quantity of the riparian stand, but the timber recruitment is not the original cause of the instability.

The other possibility suggests no change in flow, but instead a change in the riparian timber. This explanation contends that the riparian trees have matured to the point at which they are decadent, of a diameter out of balance with the size of the stream course, and have a high likelihood of falling over. Should they fall into the stream, they are too large to form pools or to be flushed from the system. The result is a diversion of flow into banks initiating the unravelling process and the decadent stand begins to fall like dominoes.

Neither of these possibilities adequately explains the situation on Poorman Creek. The first is unlikely since there are no disturbances (unnatural openings) upstream of the point at which the instability begins.

The second possibility is also unlikely since size and decadency in a timber stand develop slowly, while the current condition seems to have developed very recently.

The most plausible explanation is a combination of the two possibilities. The riparian stand is clearly of the volume and decadency to be characterized as high risk. Recruitment even without any initial channel adjustment would probably result in localized instability and some unravelling. The extent to which the instability exists on Poorman Creek though strongly suggests that there has been some channel adjustment driving the unravelling process. The cause in this case was probably the rain on snow peak flow event of December 1980. The excessive flows of that period probably initiated some abrupt channel adjustment which could not be smoothly accomplished due to the constraints of the valley shape and the condition of the riparian timber.

Correcting the Problem

Regardless the exact cause of the instability in Poorman Creek, the quantity of debris presently in the stream delays the natural recovery process and maintains the stream at a level below its biological potential. The best solution to the problem is the least costly one that not only accomplishes a reduction in instream debris, but also a reduction in the potential for excessive future recruitment.

Removal of instream debris is expensive. Complete removal is inadvisable since it constitutes making the choice to trade lateral cutting for downcutting. The objective is to reduce erosion, not just to change its form. In-channel storage of alluvium is generally advantageous and increases as the quantity of in-channel debris increases. Storage of bedload behind debris barriers contributes to the maintenance of the base level of the channel. Management through instream debris manipulation alone is not an optimum solution since it is expensive, may have some detrimental effects, and would be a continuous process.

Treatment of the riparian timber through staggered, block cutting has been initiated, but is also inadequate to correct the existing problem since the entire stream length is in a high-risk old growth condition. Another problem with block cutting is that it represents a loss to the valuable riparian old growth component.

The best solution to the problem on Poorman Creek involves careful debris removal and select cutting of the riparian timber. Those trees with large diameter and a high likelihood of being recruited to the stream are considered hazard trees and should be removed. It is thought that removing the hazard trees along the stream corridor will not sacrifice the value of the old growth, specifically meaning that the riparian stand will still have at least 15 trees of 20 plus inch diameter per acre. Merchantable trees already recruited to the stream and serving no hydrologic or fishery value should be removed. The remaining trees in the channel should be treated with post-sale money. Unmerchantable debris serving no constructive purpose, and having little potential to do so, should be removed to a point above the high water line. Debris serving a constructive purpose should be protected. Constructive debris is all that is stable, and acts to reduce stream energy or provide fish habitat. Before removal of debris, it should be considered whether or not it can be manipulated such that it can be anchored, or stabilized, and made to contribute to channel stability or fish habitat whenever possible.

Goals and Anticipated Results from Treatment

The dynamic interaction of flowing water, channel adjustment, and riparian timber is so complex that one cannot predict with a high degree of confidence the results of a particular action.

The proposed treatment for Poorman Creek is expected to reduce to minimal the detrimental timber recruitment that is currently taking place. The treatment will maintain the riparian timber stand though, protecting that component with the highest likelihood of providing constructive future recruitment.

The reduction in instream debris is expected to bring about a reduction in channel movement and bank erosion. Manipulation and anchoring of instream debris is expected to provide energy breaks, habitat improvement, and check the streams renewed tendency to downcut.

In summary, the environmental values of Poorman Creek will be affected in the following ways: 1) the old growth riparian habitat will be maintained although some volume will be lost, 2) achieving the biological potential of the stream in terms of spawning, rearing, and resident habitats will be better facilitated, and 3) erosion, both lateral and downcutting, will be moderated, slowing the rapid valley bottom change now taking place.

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE

S.O.

REPLY TO: 2540 Water Uses and Development — August 28, 1979

SUBJECT: Libby-Bear Timber Sale

TO: District Ranger, D-5

Jim Wardensky submitted the following report through me for your use.

Purpose:

On August 15-17 I visited the Libby-Bear timber sale area to compile discharge and temperature data on Bear, Cable, Ramsey, Poorman, and Little Cherry Creeks. This data was used with Brown's Temperature Model to determine if timber could be removed from riparian zones and still be within temperature constraints.

Recommendations:

The following are recommendations on each stream with maps and diagrams attached for further explanation.

Ramsey Creek:

This stream flows east to northeast in the area proposed for silvicultural treatment. The bank stability is fair to good with some evidence of high spring runoff. The snow is still melting upstream in the Cabinets as of August 15 in a dry year. There is a clearcut on the southeast side of the stream stocked with 3-6 foot tall regeneration. Between the clearcut and the stream is a narrow buffer strip.

Working through Brown's temperature Model, 20 percent of the crown cover could be removed increasing the stream temperature 1.74^{o}F. This is slightly deceiving. The buffer strip on the southeast side of the stream (the major deflection of solar radiation) is relatively narrow. Combined with the small height of the clearcut regeneration, any removal of timber here would increase the stream temperature beyond the allowable two degrees.

The north and northwest side of the stream is more heavily timbered and supplies very little shading to the stream. Therefore, some thinning of this side is acceptable while still maintaining a satisfactory amount of stream shading. Thinning of this area would probably cause considerable windthrow due to the soil types. My suggestion would be to cut 1.5 chain wide strips separated by leave strips 3 to 4 chains wide along the north and northwest sides of the stream. These strips would be at 120^{o} angles to the flow of the stream. (See diagram.) These strips would allow us to remove decadent and high risk trees from the leave strips with minimal soil disturbance. After regeneration has been established in the leave strips, we could remove timber from these also.

The reason for angling the cut strips is to baffle down canyon winds in an attempt to minimize blowdown and to protect against a major snowmelt flush which could cause increased runoff, soil loss, and sediment loading of Ramsey Creek. These small strips are known to accumulate large amounts of snow. The leave strips will provide protection from solar radiation and the angle of the cut strips combined with the natural topography should retard spring runoff.

Poorman Creek:

This stream flows east to northeast with the critical protection from solar radiation being vegetation on the south and southeast streamsides. This stream is broken into two areas; one primarily in section 34 and the other in sections 25 and 35.

The area in section 34 allows an 8 percent crown cover removal while remaining within the 2^{O}F temperature constraint. This means that up to 8 percent of the tree crowns that are providing stream shading (primarily afternoon) can be removed. The stream gradient and banks are steep with evidence of past sloughing. The areas of primary concern are tongue shaped ridges extending into the stream which receive pressure from high flows and groundwater movement. Some of these areas are semi-stable due to the tree roots. Any use of heavy equipment on these ridges, near the stream, should be avoided. Timber removal on the south side of the stream will be almost individual tree removal or small one acre cutting units scattered through the area within 75-100 feet of the stream. The north side of the stream has similar soil problems as the stream bottom. The trees on this north side offer little protection from a shading standpoint, allowing some thinning. The windthrow hazard and soils constraints are the main concerns. The north side of the stream should be patch cut (one acre and scattered) within 100 feet of the stream. A feathering effect could then be created with a shelterwood up to 4000 feet of elevation to try to control windthrow. A further protection of the sensitive soils would be to stress winter logging.

The section 25 and 35 area has the same stream bottom constraints with the exception of only a 5 percent canopy cover removal on the south side of the stream. North side stream plots in these sections can be thinned as above.

Cable Creek:

This stream flows primarily north in the area proposed for silvicultural treatment. Only 4 percent of the canopy can be removed to stay within the 2^{O}F temperature constraint. Streambank stability is poor to fair with undercutting of banks evident in several places. The stream bottom area has steep slopes and unstable soils with several groundwater seep areas. Within 100 feet of the stream, this is an individual tree and salvage operation at best.

Bear Creek:

This stream flows primarily northeast in the area of proposed treatment. The area upstream from the Recreation Area is in need of stream rehabilitation work. Several blowdowns in the area have created stream blocks which have produced two prominent stream channels and an increase in sediment loading of the stream. The stream has a meandering path with varying banks. Steep slopes on the southeast side of the stream probably will allow only salvage logging of blowdown material. The allowable canopy removal is 10 percent but with the blowdown we are close to approaching this figure. The more level areas on the northwest side of the stream could be patch cut (1-2 acre scattered) within 100 feet of the stream. Winter logging should be emphasized to protect fragile soils in the area.

The same constraints apply to the area below the Recreation Area with the exception that 18 percent of the canopy cover could be removed. The stream channel is in better shape in this area with less blowdown problems.

Little Cherry Creek:

This stream flows northeast in the area proposed for treatment. The streambanks are generally stable due to low stream gradient and small watershed area. The slow velocity of the stream allows us to remove only one percent of crown cover along the stream channel (within 50 feet) to meet temperature constraints.

Further recommendations would be for District foresters to lay out patch cuts to minimize blowdown potential based on their knowledge of localized wind patterns. Patch cuts should be irregularly shaped (kidney or teardrop shaped) to minimize visual impacts.

We are including a page from the Temperature Modification Section which is included in the Soil and Water Handbook which is currently being distributed to the Districts.

Jim Wardensky will be available to help lay out and mark these streamside areas.

TVT

TIMOTHY V. TOLLE
Forest Hydrologist

cc: Wardensky
Christophersen, D-5
✓Rainville

Basin	Stream	RiverMile	BarrierType	Height (ft)	Species	BlockageExtent	Position	Significance	Comment
	Granite Creek 1153205481839								
		6.590	Waterfall		Westslope Cutthroat Trout	Unknown	Unknown		
	Howard Creek 1153234480714								
		0.540	Waterfall						
	Lake Creek 1155237482706								
		0.710	Waterfall		Bull Trout	Unknown	Unknown		WATERFALL
		1.050	Manmade Dam		Bull Trout	Unknown	Unknown		Dam
	Leigh Creek 1153413481322								
		0.330	Waterfall						
	Lewis Creek 1144458485536								
		0.000	Unknown						
	Libby Creek 1153213482331								
		25.150	Waterfall	60	Bull Trout	Unknown	Unknown		
	Little North Fork 1152218484505								
		0.430	Waterfall						No fish observed above falls
	Midas Creek 1153119480906								
		0.890	Waterfall						
	O'Brien Creek 1155157482654								
		0.000	Waterfall	20	Bull Trout	Unknown	Unknown		
		11.010	Waterfall						
	Parmenter Creek 1153429482428								
		5.920	Insufficient flow						
	Parsnip Creek 1152016483956								
		0.910	Waterfall						
	Pinkham Creek 1151440484943								
		4.650	Waterfall	40	Rainbow Trout	Unknown	Unknown		
	Ross Creek 1155126481304								
		1.290	Waterfall						
	Ruby Creek 1155636483058								
		0.530	Waterfall		Bull Trout	Unknown	Unknown		
	Stahl Creek 1144755485343								
		0.400	Waterfall	9					NEAR MOUTH
	Star Creek 1155834483330								
		0.570	Waterfall						BARRIER .25 MILES FROM MOUTH
	Sullivan Creek 1151411485229								
		0.740	Waterfall						