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Appendix A. Dewatered Stream List for the Blackfoot Subbasin.

Stream Name	Affected Length	Natural	Human	Both
Arkansas Creek	2		2	
Ashby Creek	2		2	
Arrastra Creek (sm 4.5-2.0)	2.5	2.5		
Bear Creek (North Fork)	1	1	1	x
Blackfoot River (Seven-Up Pete-Poorman Creek)	11	11	3	x
Blackfoot River (54.1 - 84.9)	30.8		30.8	
Blanchard Creek	1.2		1.2	
Burnt Bridge Creek	1		1	
Chamberlain Creek	1		1	
Chimney Creek (Nevada Creek)	0.5		0.5	
Chimney Creek (Douglas Creek)	3.5		3.5	
Clearwater River	3.5		3.5	
Copper Creek	1	1		
Cottonwood Creek rm 43.0 (sm 10.0-4.4)	5.6	2.8	2.8	x
Cottonwood Creek (Douglas Creek)	5		5	
Dick Creek (sm 3.5-6.0)	2.5	2.5	2.5	x
Douglas Creek	14		14	
Dry Creek (trib to Rock Creek)	0.5	0.5		
Dry Fork (trib to North Fork)	2	2		
Dunham Creek	5	4	1	x
Elk Creek	3		3	
Fish Creek	0.3		0.3	
Frazier Creek	1.5		1.5	
Frazier Creek, North Fork	0.5		0.5	
Gallagher Creek	3		3	
Hoyt Creek	1		1	
Humbug Creek	1	1		
Jefferson Creek	1		1	
Keep Cool	2		2	
Landers Fork (3.6-4.5)	1	1		
McCabe Creek	2		2	
McElwain Creek	1		1	
Monture Creek (12.0-15.0)	3	3		
Murray Creek	3	3		
Nevada Creek (sm 31.7-6.4)	25.3		25.3	
Nevada Creek (sm 40.0-34)	6		6	
North Fork of Blackfoot River (rm 12.0-6.2)	5.8	5.8	5.8	x
Pearson Creek	2	2		
Poorman Creek	2	2	2	x
Rock Creek (1.4-7.0)	5.6	5.6	5.6	x
Shanley Creek	1.6		1.6	
Spring Creek (trib to Cottonwood Creek)	1		1	
Spring Creek (trib to North Fork)	2.5		2.5	
Snowbank Creek	0.4		0.4	

Appendix A (continued).

Stream Name	Affected Length	Natural	Human	Both
Stonewall Creek	2	1	1	x
Sucker Creek	1		1	
Union Creek (sm 7.0-0.5)	6.5		6.5	
Wales Creek	1.9		1.9	
Warm Springs Creek	1		1	
Warren Creek	6		6	
Washington Creek (Section 24 and 26)	1		1	
Wasson Creek	2		2	
Willow Creek (lower)	2		2	
Wilson Creek	0.8		0.8	
Yourname Creek	1		1	
Totals	**196.3**	**51.7**	**164.5**	

Appendix B. List of Wildlife Species.

The following list of wildlife species found in the Blackfoot Subbasin is based on records compiled by the Montana Natural Heritage Program (2009).

Common Name	Scientific Name
MAMMALS	
Masked Shrew	*Sorex cinereus*
Preble's Shrew	*Sorex preblei*
Vagrant Shrew	*Sorex vagrans*
Dusky or Montane Shrew	*Sorex monticolus*
Water Shrew	*Sorex palustris*
Pygmy Shrew	*Sorex hoyi*
Little Brown Myotis	*Myotis lucifugus*
Long-eared Myotis	*Myotis evotis*
Fringed Myotis	*Myotis thysanodes*
Long-legged Myotis	*Myotis volans*
Western Small-footed Myotis	*Myotis ciliolabrum*
Silver-haired Bat	*Lasionycteris noctivagans*
Big Brown Bat	*Eptesicus fuscus*
Hoary Bat	*Lasiurus cinereus*
Townsend's Big-eared Bat	*Corynorhinus townsendii*
Pika	*Ochotona princeps*
Mountain Cottontail	*Sylvilagus nuttallii*
Snowshoe Hare	*Lepus americanus*
White-tailed Jack Rabbit	*Lepus townsendii*
Least Chipmunk	*Tamias minimus*
Yellow-pine Chipmunk	*Tamias amoenus*
Red-tailed Chipmunk	*Tamias ruficaudus*
Yellow-bellied Marmot	*Marmota flaviventris*
Hoary Marmot	*Marmota caligata*
Columbian Ground Squirrel	*Spermophilus columbianus*
Golden-mantled Ground Squirrel	*Spermophilus lateralis*
Red Squirrel	*Tamiasciurus hudsonicus*
Northern Flying Squirrel	*Glaucomys sabrinus*
Northern Pocket Gopher	*Thomomys talpoides*
Beaver	*Castor canadensis*
Deer Mouse	*Peromyscus maniculatus*
Bushy-tailed Woodrat	*Neotoma cinerea*
Southern Red-backed Vole	*Clethrionomys gapperi*
Heather Vole	*Phenacomys intermedius*
Meadow Vole	*Microtus pennsylvanicus*
Montane Vole	*Microtus montanus*
Long-tailed Vole	*Microtus longicaudus*
Muskrat	*Ondatra zibethicus*
Northern Bog Lemming	*Synaptomys borealis*
Western Jumping Mouse	*Zapus princeps*
Porcupine	*Erethizon dorsatum*

Common Name	Scientific Name
MAMMALS (CONT.)	
Coyote	*Canis latrans*
Gray Wolf	*Canis lupus*
Red Fox	*Vulpes vulpes*
Black Bear	*Ursus americanus*
Grizzly Bear	*Ursus arctos*
Raccoon	*Procyon lotor*
Marten	*Martes americana*
Fisher	*Martes pennanti*
Short-tailed Weasel	*Mustela erminea*
Long-tailed Weasel	*Mustela frenata*
Mink	*Mustela vison*
Wolverine	*Gulo gulo*
Badger	*Taxidea taxus*
Striped Skunk	*Mephitis mephitis*
Northern River Otter	*Lontra canadensis*
Canada Lynx	*Lynx canadensis*
Bobcat	*Lynx rufus*
Mountain Lion	*Puma concolor*
Elk or Wapiti	*Cervus canadensis*
Mule Deer	*Odocoileus hemionus*
White-tailed Deer	*Odocoileus virginianus*
Moose	*Alces alces*
BIRDS	
Common Loon	*Gavia immer*
Pied-billed Grebe	*Podilymbus podiceps*
Horned Grebe	*Podiceps auritus*
Red-necked Grebe	*Podiceps grisegena*
Eared Grebe	*Podiceps nigricollis*
Western Grebe	*Aechmophorus occidentalis*
Clark's Grebe	*Aechmophorus clarkii*
American White Pelican	*Pelecanus erythrorhynchos*
Double-crested Cormorant	*Phalacrocorax auritus*
American Bittern	*Botaurus lentiginosus*
Great Blue Heron	*Ardea herodias*
Great Egret	*Ardea alba*
White-faced Ibis	*Plegadis chihi*
Tundra Swan	*Cygnus columbianus*
Trumpeter Swan	*Cygnus buccinator*
Snow Goose	*Chen caerulescens*
Ross's Goose	*Chen rossii*
Canada Goose	*Branta canadensis*
Wood Duck	*Aix sponsa*
Green-winged Teal	*Anas crecca*
Mallard	*Anas platyrhynchos*
Northern Pintail	*Anas acuta*
Blue-winged Teal	*Anas discors*

Common Name	Scientific Name
BIRDS (CONT.)	
Cinnamon Teal	*Anas cyanoptera*
Northern Shoveler	*Anas clypeata*
Gadwall	*Anas strepera*
Eurasian Wigeon	*Anas penelope*
American Wigeon	*Anas americana*
Redhead	*Aythya americana*
Ring-necked Duck	*Aythya collaris*
Lesser Scaup	*Aythya affinis*
Harlequin Duck	*Histrionicus histrionicus*
Surf Scoter	*Melanitta perspicillata*
White-winged Scoter	*Melanitta fusca*
Common Goldeneye	*Bucephala clangula*
Barrow's Goldeneye	*Bucephala islandica*
Bufflehead	*Bucephala albeola*
Hooded Merganser	*Lophodytes cucullatus*
Common Merganser	*Mergus merganser*
Red-breasted Merganser	*Mergus serrator*
Ruddy Duck	*Oxyura jamaicensis*
Turkey Vulture	*Cathartes aura*
Osprey	*Pandion haliaetus*
Bald Eagle	*Haliaeetus leucocephalus*
Northern Harrier	*Circus cyaneus*
Sharp-shinned Hawk	*Accipiter striatus*
Cooper's Hawk	*Accipiter cooperii*
Northern Goshawk	*Accipiter gentilis*
Swainson's Hawk	*Buteo swainsoni*
Red-tailed Hawk	*Buteo jamaicensis*
Ferruginous Hawk	*Buteo regalis*
Rough-legged Hawk	*Buteo lagopus*
Golden Eagle	*Aquila chrysaetos*
American Kestrel	*Falco sparverius*
Merlin	*Falco columbarius*
Peregrine Falcon	*Falco peregrinus*
Prairie Falcon	*Falco mexicanus*
Gray Partridge	*Perdix perdix*
Ring-necked Pheasant	*Phasianus colchicus*
Spruce Grouse	*Falcipennis canadensis*
Dusky Grouse	*Dendragapus obscurus*
White-tailed Ptarmigan	*Lagopus leucura*
Ruffed Grouse	*Bonasa umbellus*
Greater Sage-Grouse	*Centrocercus urophasianus*
Sharp-tailed Grouse (Columbian)	*Tympanuchus phasianellus columbianus*
Wild Turkey	*Meleagris gallopavo*
Virginia Rail	*Rallus limicola*
Sora	*Porzana carolina*
Common Moorhen	*Gallinula chloropus*
American Coot	*Fulica americana*

Common Name	Scientific Name
BIRDS (CONT.)	
Sandhill Crane	*Grus canadensis*
Semipalmated Plover	*Charadrius semipalmatus*
Killdeer	*Charadrius vociferus*
Black-necked Stilt	*Himantopus mexicanus*
American Avocet	*Recurvirostra americana*
Greater Yellowlegs	*Tringa melanoleuca*
Lesser Yellowlegs	*Tringa flavipes*
Solitary Sandpiper	*Tringa solitaria*
Willet	*Tringa semipalmata*
Spotted Sandpiper	*Actitis macularius*
Long-billed Curlew	*Numenius americanus*
Marbled Godwit	*Limosa fedoa*
Least Sandpiper	*Calidris minutilla*
Long-billed Dowitcher	*Limnodromus scolopaceus*
Wilson's Snipe	*Gallinago delicata*
Wilson's Phalarope	*Phalaropus tricolor*
Red-necked Phalarope	*Phalaropus lobatus*
Franklin's Gull	*Leucophaeus pipixcan*
Ring-billed Gull	*Larus delawarensis*
California Gull	*Larus californicus*
Sabine's Gull	*Xema sabini*
Caspian Tern	*Hydroprogne caspia*
Common Tern	*Sterna hirundo*
Forster's Tern	*Sterna forsteri*
Black Tern	*Chlidonias niger*
Long-billed Murrelet	*Brachyramphus perdix*
Ancient Murrelet	*Synthliboramphus antiquus*
Rock Pigeon	*Columba livia*
Band-tailed Pigeon	*Patagioenas fasciata*
Mourning Dove	*Zenaida macroura*
Flammulated Owl	*Otus flammeolus*
Great Horned Owl	*Bubo virginianus*
Snowy Owl	*Bubo scandiacus*
Northern Hawk Owl	*Surnia ulula*
Northern Pygmy-Owl	*Glaucidium gnoma*
Barred Owl	*Strix varia*
Great Gray Owl	*Strix nebulosa*
Long-eared Owl	*Asio otus*
Short-eared Owl	*Asio flammeus*
Boreal Owl	*Aegolius funereus*
Northern Saw-whet Owl	*Aegolius acadicus*
Common Nighthawk	*Chordeiles minor*
Common Poorwill	*Phalaenoptilus nuttallii*
Black Swift	*Cypseloides niger*
Vaux's Swift	*Chaetura vauxi*
White-throated Swift	*Aeronautes saxatalis*
Black-chinned Hummingbird	*Archilochus alexandri*

Common Name	Scientific Name
BIRDS (CONT.)	
Calliope Hummingbird	*Stellula calliope*
Rufous Hummingbird	*Selasphorus rufus*
Belted Kingfisher	*Megaceryle alcyon*
Lewis's Woodpecker	*Melanerpes lewis*
Lewis's Woodpecker	*Melanerpes lewis*
Lewis's Woodpecker	*Melanerpes lewis*
Lewis's Woodpecker	*Melanerpes lewis*
Williamson's Sapsucker	*Sphyrapicus thyroideus*
Red-naped Sapsucker	*Sphyrapicus nuchalis*
Downy Woodpecker	*Picoides pubescens*
Hairy Woodpecker	*Picoides villosus*
Black-backed Woodpecker	*Picoides arcticus*
American Three-toed Woodpecker	*Picoides dorsalis*
Northern Flicker	*Colaptes auratus*
Northern Flicker (Red-shafted)	*Colaptes auratus cafer*
Pileated Woodpecker	*Dryocopus pileatus*
Olive-sided Flycatcher	*Contopus cooperi*
Western Wood-Pewee	*Contopus sordidulus*
Willow Flycatcher	*Empidonax traillii*
Least Flycatcher	*Empidonax minimus*
Hammond's Flycatcher	*Empidonax hammondii*
Dusky Flycatcher	*Empidonax oberholseri*
Cordilleran Flycatcher	*Empidonax occidentalis*
Say's Phoebe	*Sayornis saya*
Western Kingbird	*Tyrannus verticalis*
Eastern Kingbird	*Tyrannus tyrannus*
Scissor-tailed Flycatcher	*Tyrannus forficatus*
Horned Lark	*Eremophila alpestris*
Tree Swallow	*Tachycineta bicolor*
Violet-green Swallow	*Tachycineta thalassina*
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*
Bank Swallow	*Riparia riparia*
Cliff Swallow	*Petrochelidon pyrrhonota*
Barn Swallow	*Hirundo rustica*
Gray Jay	*Perisoreus canadensis*
Steller's Jay	*Cyanocitta stelleri*
Blue Jay	*Cyanocitta cristata*
Clark's Nutcracker	*Nucifraga columbiana*
Black-billed Magpie	*Pica hudsonia*
American Crow	*Corvus brachyrhynchos*
Common Raven	*Corvus corax*
Black-capped Chickadee	*Poecile atricapillus*
Mountain Chickadee	*Poecile gambeli*
Boreal Chickadee	*Poecile hudsonica*
Chestnut-backed Chickadee	*Poecile rufescens*
Red-breasted Nuthatch	*Sitta canadensis*
White-breasted Nuthatch	*Sitta carolinensis*

Common Name	Scientific Name
BIRDS (CONT.)	
Pygmy Nuthatch	*Sitta pygmaea*
Brown Creeper	*Certhia americana*
Rock Wren	*Salpinctes obsoletus*
Canyon Wren	*Catherpes mexicanus*
House Wren	*Troglodytes aedon*
Winter Wren	*Troglodytes troglodytes*
Marsh Wren	*Cistothorus palustris*
American Dipper	*Cinclus mexicanus*
Golden-crowned Kinglet	*Regulus satrapa*
Ruby-crowned Kinglet	*Regulus calendula*
Western Bluebird	*Sialia mexicana*
Mountain Bluebird	*Sialia currucoides*
Townsend's Solitaire	*Myadestes townsendi*
Veery	*Catharus fuscescens*
Swainson's Thrush	*Catharus ustulatus*
Hermit Thrush	*Catharus guttatus*
American Robin	*Turdus migratorius*
Varied Thrush	*Ixoreus naevius*
Gray Catbird	*Dumetella carolinensis*
Brown Thrasher	*Toxostoma rufum*
American Pipit	*Anthus rubescens*
Bohemian Waxwing	*Bombycilla garrulus*
Cedar Waxwing	*Bombycilla cedrorum*
Northern Shrike	*Lanius excubitor*
Loggerhead Shrike	*Lanius ludovicianus*
European Starling	*Sturnus vulgaris*
Warbling Vireo	*Vireo gilvus*
Red-eyed Vireo	*Vireo olivaceus*
Cassin's Vireo	*Vireo cassinii*
Solitary Vireo	*Vireo solitarius*
Tennessee Warbler	*Vermivora peregrina*
Orange-crowned Warbler	*Vermivora celata*
Nashville Warbler	*Vermivora ruficapilla*
Yellow Warbler	*Dendroica petechia*
Black-throated Blue Warbler	*Dendroica caerulescens*
Yellow-rumped Warbler	*Dendroica coronata*
Audubon's Warbler	*Dendroica coronata auduboni*
Black-throated Gray Warbler	*Dendroica nigrescens*
Townsend's Warbler	*Dendroica townsendi*
American Redstart	*Setophaga ruticilla*
Ovenbird	*Seiurus aurocapilla*
Northern Waterthrush	*Seiurus noveboracensis*
MacGillivray's Warbler	*Oporornis tolmiei*
Common Yellowthroat	*Geothlypis trichas*
Wilson's Warbler	*Wilsonia pusilla*
Western Tanager	*Piranga ludoviciana*
Rose-breasted Grosbeak	*Pheucticus ludovicianus*

Common Name	Scientific Name
BIRDS (CONT.)	
Black-headed Grosbeak	*Pheucticus melanocephalus*
Lazuli Bunting	*Passerina amoena*
Green-tailed Towhee	*Pipilo chlorurus*
Spotted Towhee	*Pipilo maculatus*
American Tree Sparrow	*Spizella arborea*
Chipping Sparrow	*Spizella passerina*
Clay-colored Sparrow	*Spizella pallida*
Brewer's Sparrow	*Spizella breweri*
Vesper Sparrow	*Pooecetes gramineus*
Lark Sparrow	*Chondestes grammacus*
Lark Bunting	*Calamospiza melanocorys*
Savannah Sparrow	*Passerculus sandwichensis*
Grasshopper Sparrow	*Ammodramus savannarum*
Fox Sparrow	*Passerella iliaca*
Song Sparrow	*Melospiza melodia*
Lincoln's Sparrow	*Melospiza lincolnii*
White-throated Sparrow	*Zonotrichia albicollis*
Golden-crowned Sparrow	*Zonotrichia atricapilla*
White-crowned Sparrow	*Zonotrichia leucophrys*
Harris's Sparrow	*Zonotrichia querula*
Dark-eyed Junco	*Junco hyemalis*
Dark-eyed Junco (Gray-headed)	*Junco hyemalis caniceps*
Dark-eyed Junco (Oregon)	*Junco hyemalis oreganus*
Dark-eyed Junco (Pink-sided)	*Junco hyemalis mearnsi*
Snow Bunting	*Plectrophenax nivalis*
Bobolink	*Dolichonyx oryzivorus*
Red-winged Blackbird	*Agelaius phoeniceus*
Western Meadowlark	*Sturnella neglecta*
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*
Brewer's Blackbird	*Euphagus cyanocephalus*
Common Grackle	*Quiscalus quiscula*
Brown-headed Cowbird	*Molothrus ater*
Bullock's Oriole	*Icterus bullockii*
Gray-crowned Rosy-Finch	*Leucosticte tephrocotis*
Pine Grosbeak	*Pinicola enucleator*
Cassin's Finch	*Carpodacus cassinii*
House Finch	*Carpodacus mexicanus*
Red Crossbill	*Loxia curvirostra*
White-winged Crossbill	*Loxia leucoptera*
Pine Siskin	*Carduelis pinus*
American Goldfinch	*Carduelis tristis*
Evening Grosbeak	*Coccothraustes vespertinus*
House Sparrow	*Passer domesticus*
FISH	
Mottled Sculpin	*Cottus bairdi*
Slimy Sculpin	*Cottus cognatus*

Common Name	Scientific Name
FISH (CONT.)	
Westslope Cutthroat Trout	*Oncorhynchus clarkii lewisi*
Yellowstone Cutthroat Trout*	*Oncorhynchus clarkii bouvieri*
Rainbow Trout*	*Oncorhynchus mykiss*
Mountain Whitefish	*Prosopium williamsoni*
pygmy Whitefish	*Prosopium coulteri*
Brown Trout*	*Salmo trutta*
Bull Trout	*Salvelinus confluentus*
Brook Trout*	*Salvelinus fontinalis*
Northern Pikeminnow	*Ptychocheilus oregonensis*
Longnose Dace	*Rhinichthys cataractae*
Redside Shiner	*Richardsonius balteatus*
Longnose Sucker	*Catostomus catostomus*
Largescale Sucker	*Catostomus macrocheilus*
White Sucker*	*Catostomus commersoni*
Peamouth	*Mylocheilus caurinus*
Kokanee*	*Oncorhynchus nerka*
Coho Salmon*	*Oncorhynchus kisutch*
Arctic Grayling*	*Thymallus arcticus*
Fathead Minnow*	*Pimephales promelas*
Northern Pike*	*Esox lucius*
Brook Stickleback*	*Culaea inconstans*
Pumpkinseed*	*Lepomis gibbosus*
Largemouth Bass*	*Micropterus salmoides*
Yellow Perch*	*Perca flavescens*
AMPHIBIANS AND REPTILES	
Long-toed Salamander	*Ambystoma macrodactylum*
Rocky Mountain Tailed Frog	*Ascaphus montanus*
Western Toad	*Bufo boreas*
Pacific Treefrog	*Pseudacris regilla*
Columbia Spotted Frog	*Rana luteiventris*
Painted Turtle	*Chrysemys picta*
Rubber Boa	*Charina bottae*
Terrestrial Gartersnake	*Thamnophis elegans*
Common Gartersnake	*Thamnophis sirtalis*
Prairie Rattlesnake	*Crotalus viridis*
Eastern Racer	*Coluber constrictor*
INVERTEBRATES	
A Leech	*Helobdella stagnalis*
Virile Crayfish	*Orconectes virilis*
An Amphipod	*Hyalella azteca*
Signal Crayfish	*Pacifastacus leniusculus*
A Riffle Beetle	*Zaitzevia parvula*
A Riffle Beetle	*Heterlimnius corpulentus*
A Riffle Beetle	*Cleptelmis addenda*

Common Name	Scientific Name
INVERTEBRATES (CONT.)	
A Riffle Beetle	*Lara avara*
A Riffle Beetle	*Narpus concolor*
A Riffle Beetle	*Optioservus quadrimaculatus*
A Riffle Beetle	*Ordobrevia nubifera*
A Eukiefferiellan Chironomid	*Eukiefferiella brehmi*
A Mayfly	*Serratella tibialis*
A Mayfly	*Ephemerella excrucians*
A Mayfly	*Baetis bicaudatus*
A Mayfly	*Epeorus longimanus*
A Mayfly	*Drunella coloradensis*
A Mayfly	*Drunella doddsi*
A Mayfly	*Drunella grandis*
A Mayfly	*Drunella spinifera*
A Mayfly	*Acentrella turbida*
Hagen's Small Minnow Mayfly	*Diphetor hageni*
A Mayfly	*Timpanoga hecuba*
A Mayfly	*Plauditus punctiventris*
Northern Rocky Mountains Refugium Mayfly	*Caudatella edmundsi*
A Mayfly	*Caudatella hystrix*
Large Marble	*Euchloe ausonides*
Gillette's Checkerspot	*Euphydryas gillettii*
Hayden's Ringlet	*Coenonympha haydenii*
Pacific Spiketail	*Cordulegaster dorsalis*
Blue-eyed Darner	*Rhionaeschna multicolor*
Mountain Emerald	*Somatochlora semicircularis*
White-faced Meadowhawk	*Sympetrum obtrusum*
Last Best Place Damselfly	*Enallagma optimolocus*
A Stonefly	*Despaxia augusta*
A Stonefly	*Amphinemura banksi*
A Stonefly	*Zapada cinctipes*
A Stonefly	*Zapada columbiana*
A Stonefly	*Zapada oregonensis*
A Stonefly	*Yoraperla brevis*
A Stonefly	*Doroneuria theodora*
A Stonefly	*Hesperoperla pacifica*
A Stonefly	*Claassenia sabulosa*
A Stonefly	*Setvena bradleyi*
A Caddisfly	*Rhyacophila betteni*
A Rhyacophilan Caddisfly	*Rhyacophila brunnea*
An Agapetus Caddisfly	*Agapetus montanus*
A Caddisfly	*Hydropsyche confusa*
A Caddisfly	*Parapsyche elsis*
A Caddisfly	*Lepidostoma cascadense*
A Caddisfly	*Lepidostoma unicolor*
A Caddisfly	*Chyrandra centralis*
A Caddisfly	*Dicosmoecus atripes*
A Caddisfly	*Dicosmoecus gilvipes*

Common Name	Scientific Name
INVERTEBRATES (CONT.)	
A Rhyacophilan Caddisfly	*Rhyacophila alberta*
A Caddisfly	*Anagapetus debilis*
A Caddisfly	*Arctopsyche grandis*
A Rhyacophilan Caddisfly	*Rhyacophila narvae*
A Rhyacophilan Caddisfly	*Rhyacophila verrula*
A Caddisfly	*Neophylax splendens*
A Caddisfly	*Neothremma alicia*
A Caddisfly	*Micrasema bactro*
A Limnephilid Caddisfly	*Nemotaulius hostilis*
A Caddisfly	*Hesperophylax designatus*
A Caddisfly	*Onocosmoecus unicolor*
A Caddisfly	*Brachycentrus americanus*
A Caddisfly	*Brachycentrus occidentalis*
Western Pearlshell	*Margaritifera falcata*
Grooved Fingernailclam	*Sphaerium simile*
Forest Disc	*Discus whitneyi*
Magnum Mantleslug	*Magnipelta mycophaga*
Smoky Taildropper	*Prophysaon humile*
Brown Hive	*Euconulus fulvus*
Quick Gloss	*Zonitoides arboreus*
Meadow Slug	*Deroceras laeve*
Spruce Snail	*Microphysula ingersolli*
Alpine Mountainsnail	*Oreohelix alpina*
Carinate Mountainsnail	*Oreohelix elrodi*
Rocky Mountainsnail	*Oreohelix strigosa*
Subalpine Mountainsnail	*Oreohelix subrudis*
Lyre Mantleslug	*Udosarx lyrata*
Wrinkled Marshsnail	*Stagnicola caperata*
Two-ridge Rams-horn	*Helisoma anceps*
A Millipede	*Corypus cochlearis*
A Millipede	*Ergodesmus compactus*
A Millipede	*Lophomus laxus*
A Millipede	*Endopus parvipes*
A Freshwater Sponge	*Ephydatia cooperensis*

* non-native species

Appendix C. Explanation of Montana Natural Heritage Program Ranks.

The Montana Natural Heritage Program employs a standardized ranking system to denote global (G) and state (S) status. Species are assigned numeric ranks ranging from 1 (critically imperiled) to 5 (demonstrably secure), reflecting the relative degree to which they are "at-risk." Rank definitions are given below. A number of factors are considered in assigning ranks - the number, size and distribution of known "occurrences" or populations, population trends (if known), habitat sensitivity, life history traits and threats.

G1 S1

At high risk because of extremely limited and potentially declining numbers, extent and/or habitat, making it highly vulnerable to global extinction or extirpation in the state.

G2 S2

At risk because of very limited and potentially declining numbers, extent and/or habitat, making it vulnerable to global extinction or extirpation in the state.

G3 S3

Potentially at risk because of limited and potentially declining numbers, extent and/or habitat, even though it may be abundant in some areas.

G4 S4

Uncommon but not rare (although it may be rare in parts of its range), and usually widespread. Apparently not vulnerable in most of its range, but possibly cause for long-term concern.

G5 S5

Common, widespread and abundant (although it may be rare in parts of its range). Not vulnerable in most of its range.

GX SX

Presumed Extinct or Extirpated - Species is believed to be extinct throughout its range or extirpated in Montana. Not located despite intensive searches of historical sites and other appropriate habitat, and small likelihood that it will ever be rediscovered.

GH SH

Possibly Extinct or Extirpated - Species is known only from historical records, but may nevertheless still be extant; additional surveys are needed.

GNR SNR

Not yet ranked.

GU SU

Unrankable - Species currently unrankable due to lack of information or due to substantially conflicting information about status or trends.

GNA SNA

A conservation status rank is not applicable for one of the following reasons:
The taxa is of Hybrid Origin; is Exotic or Introduced; is Accidental or is Not Confidently Present in the state. (see other codes below)

Other Codes and Modifiers:

HYB

Hybrid-Entity not ranked because it represents an interspecific hybrid and not a species.

T

Infraspecific Taxon (trinomial) - The status of infraspecific taxa (subspecies or varieties) are indicated by a "T-rank" following the species' global rank.

?

Inexact Numeric Rank - Denotes inexact numeric rank.

Q

Questionable taxonomy that may reduce conservation priority-Distinctiveness of this entity as a taxon at the current level is questionable; resolution of this uncertainty may result in change from a species to a subspecies or hybrid, or inclusion of this taxon in another taxon, with the resulting taxon having a lower-priority (numerically higher) conservation status rank.

C

Captive or Cultivated Only - Species at present is extant only in captivity or cultivation, or as a reintroduced population not yet established.

A

Accidental - Species is accidental or casual in Montana, in other words, infrequent and outside usual range. Includes species (usually birds or butterflies) recorded once or only a few times at a location. A few of these species may have bred on the one or two occasions they were recorded.

SYN

Synonym - Species reported as occurring in Montana, but the Montana Natural Heritage Program does not recognize the taxon; therefore the species is not assigned a rank.

B

Breeding - Rank refers to the breeding population of the species in Montana.

N

Nonbreeding - Rank refers to the non-breeding population of the species in Montana.

M

Migratory - Species occurs in Montana only during migration.

Appendix D. Vascular Plant Species Associated with Glacial Wetlands in the Ovando Valley (Lesica 1994).

Alismataceae
Alisma gramineum
Alisma plantago-aquatica
Sagittaria cuneata

Amaranthaceae
Amaranthus californicus

Apiaceae
Cicuta bulbifera
Cicuta douglasii
Sium suave

Asteraceae
Antennaria microphylla
Artemisia biennis
Artemisia ludoviciana
Aster brachyactis
Aster occidentalis
Aster pansus
Bidens cernua
Cirsium arvense*
Cirsium vulgare*
Conyza canadensis
Coreopsis atkinsoniana
Crepis runcinata
Erigeron lonchophyllus
Gnaphalium palustre
Grindellia howellii
Grindelia squarrosa
Haplopappus integrifolius
Helenium autumnale
Petasites sagittatus
Senecio debilis
Senecio foetidus
Senecio indecorus
Solidago canadensis
Solidago nana
Sonchus uliginosus*
Taraxacum officinale*

Betulaceae
Alnus incana
Betula glandulosa

Boraginaceae
Plagiobothrys scouleri

Brassicaceae
Hutchinsia procumbens
Rorippa curvisiliqua
Rorippa islandica
Rorippa obtusa

Callitrichaceae
Callitriche hermaphroditica
Callitriche heterophylla

Chenopodiaceae
Atriplex truncata
Chenopodium glaucum
Chenopodium rubrum
Salicornia rubra

Cyperaceae
Carex atherodes
Carex athrostachya
Carex aurea
Carex buxbaumii
Carex canescens
Carex chordorhiza
Carex cusickii
Carex diandra
Carex disperma
Carex flava
Carex interior
Carex lasiocarpa
Carex lanuginosa
Carex limosa
Carex microptera
Carex nebrascensis
Carex parryana
Carex praegracilis
Carex sartwellii
Carex scirpoidea
Carex stipata
Carex vesicaria
Eleocharis acicularis
Eleocharis palustris
Eriophorum viridicarinatum
Scirpus acutus
Scirpus americanus
Scirpus maritimus
Scirpus microcarpus

Droseraceae
Drosera anglica

Equisetaceae
Equisetum fluviatile
Equisetum variegatum

Fabaceae
Astragalus tenellus
Medicago lupulina*
Trifolium longipes

Gentianaceae
Swertia perennis

Haloragaceae
Myriophyllum spicatum

Hippuridaceae
Hippuris vulgaris

Iridaceae
Iris missouriensis
Sisyrinchium angustifolium

Juncaceae
Juncus alpinus
Juncus balticus
Juncus bufonius
Juncus ensifolius
Juncus longistylis
Juncus tenuis

Juncaginaceae
Triglochin maritima

Lamiaceae
Mentha arvensis
Prunella vulgaris
Scutellaria galericulata
Stachys palustris

Lemnaceae
Lemna minor
Lemna trisulca

Lentibulariaceae
Utricularia intermedia
Utricularia minor
Utricularia vulgaris

Liliaceae
Zigadenus elegans

Menyanthaceae
Menyanthes trifoliata

Najadaceae
Najas flexilis

Nymphaeaceae
Nuphar polysepalum

Onagraceae
Epilobium glaberrimum
Epilobium palustre

Orchidaceae
Habenaria dilatata
Habenaria hyperborea
Spiranthes romanzoffiana

Plantaginaceae
Plantago major*

Poaceae
Agrostis alba
Agrostis scabra
Alopecurus aequalis
Alopecurus pratensis*
Beckmannia syzigachne
Calamagrostis canadensis
Calamagrostis inexpansa
Calamagrostis neglecta
Deschampsia cespitosa
Distichlis stricta
Festuca pratensis*
Festuca rubra
Glyceria borealis
Glyceria grandis
Glyceria striata
Hierocloe odorata
Hordeum brachyantherum
Hordeum jubatum
Muhlenbergia asperifolia
Muhlenbergia richardsonis
Panicum capillare
Phalaris arundinacea*
Phleum pratense*
Poa nevadensis
Poa palustris*
Poa pratensis*
Polypogon monspeliensis
Puccinellia distans
Sphenopholis obtusata

Polygonaceae
Polygonum amphibium
Rumex crispus*
Rumex maritimus
Rumex occidentalis
Rumex salicifolius
Potamogetonaceae
Potamogeton crispus*
Potamogeton friesii
Potamogeton foliosus
Potamogeton gramineus
Potamogeton natans
Potamogeton pectinatus
Potamogeton pusillus
Potamogeton richardsonii
Potamogeton zosteriformis

Ranunculaceae
Ranuculus acriformis
Ranunculus aquatilis
Ranunculus cymbalaria
Ranunculus flammula
Ranunculus gmelinii
Ranunculus macounii
Ranunculus sceleratus
Rosaceae
Geum macrophyllum
Potentilla biennis
Potentilla gracilis
Potentilla palustris
Rubiaceae
Galium trifidum

Ruppiaceae
Ruppia maritima

Salicaceae
Salix bebbiana
Salix boothii
Salix candida
Salix drummondiana
Salix exigua
Salix planifolia

Scrophulariaceae
Mimulus guttatus
Mimulus moschatus
Pedicularis groenlandica
Veronica americana
Veronica catenata
Veronica peregrina

Sparganiaceae
Sparganium emersum
Sparganium minimum

Typhaceae
Typha latifolia

(* exotic species)

Appendix E. Native Salmonid Viability: Definitions of Key Attributes.

Notes excerpted from Native Salmonid Work Group Meetings.

Condition

(The following four elements of condition are bull trout population demographic characteristics influencing the risk of local extinction).

Abundance:

Very Good: Spawning adults consistently abundant (average more than 100).
Good: Spawning adults common. (average more than 10 but less than 100)
Fair: Spawning adults low or highly variable (average less than 10 or vary substantially between less than and more than 10; but are consistently present)
Poor: Spawning adults occur only occasionally, or adult numbers are unknown

Note: The number includes the adults in the local population associated with or including this 6^{th} code. The extent of the local population may extend beyond a single 6th field or may be contained entirely within it. Suitable spawning habitats that are discontinuous but within a few kilometers could be expected to exchange adults through dispersal (e.g., Whiteley et al. 2004). The numbers are based on the 50:500 rules of thumb from conservation biology and the approximation of effective population size given demographic characteristics of typical bull trout populations (Rieman and Allendorf 2003). Specifically a consistent average of effective spawners higher than 50 is believed important to minimize the effects of inbreeding depression and 500 is important to maintain long-term genetic diversity. Few populations will exceed 500 adults so this number must be maintained through dispersal, gene flow and the demographic linkage among populations at a broader level. This should be a contextual variable considered later when we roll up the major population groups. The number is an average (strictly the harmonic mean) of the adults spawning over an extended period of time. Because of generation times, reproductive and other demographic characteristics a conservative estimate of the effective population size is approximately twice the average number of adults spawning per year (See Rieman and Allendorf 2001 for details). If the population reaches these numbers but varies a lot and is commonly lower, the effective population size is lower. The number of adults should include both migratory and resident fish, males and females. The number might be approximated through regular or periodic redd counts, but that will require some assumption or observation of the number of adults per redd count (some estimates range from 2 to 3 total adults for observed redd). If there is no information to judge abundance, the estimates should be conservative. If bull trout are known to occur at numbers that exceed a threshold, but no long term perspective is possible, the next lower class should be selected, e.g., Morrell Creek and West Fork Clearwater have supported redd counts or adult population estimates that would represent more than 50 adults and conceivably more than 100, but long term averages are not available and the populations are also known to fluctuate dramatically from year to year. They would be classified as either fair or good depending on the interpretation of existing data. Estimates of abundance in tributaries could be extrapolated to approximate adult numbers based on typical age structure information. For example the number of adults in any population might be assumed to be approximately 10% of the fish $\geq$ age 1. So an extrapolation of at least 1,000 resident fish could equate to an adult population of approximately 100. Generally populations with average to high abundance and roughly 10 km of available habitat would be close.

Life History Expression

Very Good: All potential migratory life histories are abundant or dominant

Good: Migratory life histories occurs, but access through corridors or to rearing areas occasionally limited

Fair: Migratory life history occurs, but relative abundance is low or adult access is blocked or limited during typical migration periods

Poor: No migratory life histories. Local population is isolated by permanent impassible barrier; OR life history expression unknown

Note: The full expression of life history is believed to represent important biological diversity in bull trout populations. Migratory life histories also contribute to the resilience of populations because they tend to be more fecund, may resist hybridization with brook trout or competition with other species. If migratory adults occur resident life histories probably occur as well, but may be restricted in abundance or distribution by the presence of the migratory form. Thus the occurrence of the migratory life history should really reflect the full expression and diversity of the population. Life history diversity may be an important hedge against habitat loss or degradation, non-native invasion, and climate change (Fausch et al. 2006; Hilborn et al. 2003) and a primary mechanism facilitating gene flow and dispersal among local populations (Rieman and Dunham 2000).

Genetic Integrity

Not Applicable for bull trout

Note: available information indicates hybridization is primarily limited to F1. When post F1 hybridization does occur, it does not appear to progress to full introgression.

Resilience

Very good- Population is stable and moderate to high abundance, or when reduced has the capacity to grow back quickly. Habitat is in excellent condition and expected to stay that way. Nonnative salmonids are not important.

Good- Population is stable at moderate abundance or growing slowly. When reduced in abundance, population does slowly rebuild. Habitat is in good condition and nonnatives are not present or rare.

Fair- Population is stable at low to moderate abundance and or habitat is degraded, but not destroyed. Non-natives may be relatively abundant, but not dominant.

Poor- Population is declining and or habitat is in poor condition and nonnatives are abundant or dominate the community. OR nothing is known about resilience.

Size

Extent of habitat network within the 6th code

Very Good- the length of the interconnected stream network supporting spawning and rearing is > 20 km.

Good- the length of the interconnected stream network supporting spawning and rearing habitat is between 10 and 20 km in length.

Fair- the length is between 3 and 10 km.
Poor- the length is less than 3 km.

Note: The persistence of bull trout has been strongly associated with the size of the spawning and rearing habitat network or patch (Dunham and Rieman 1999, Dunham et al. 2002). The reasons may include the size of the population and the mitigation of small population effects and the diversity and extent of habitat minimizing the threat of catastrophic disturbances. This metric can be estimated from the extent of fish distribution identified in the existing MFWP inventories. Likely will require a GIS analysis, but might be done with a quick approximation using a mapped hydrography in each 6th code, the fish distribution maps, a map of existing barriers and a scale that can be placed on the mapped stream network.

Landscape Context

Water quality: Temperature, Sediment, and Chemical Contaminants
Very Good- all three elements are considered functioning acceptably
Good- two elements are functioning acceptably, one is functioning at risk
Fair- two or more elements are functioning at risk, none at unacceptable risk
Poor- one or more elements is functioning at unacceptable risk

Note: this would be based on the Forest Service Assessment for the encompassing 6th field (subwatershed). It might be modified with additional information if available, i.e., streams that are 303 d listed would be considered poor.

Habitat Structure: Large wood, width-depth, floodplain connectivity, stream bank condition
Very Good- all four elements are considered functioning acceptably
Good- three elements are functioning acceptably, one is functioning at risk
Fair- two or more elements are functioning at risk, none at unacceptable risk
Poor- one or more elements is functioning at unacceptable risk

Note: this would be based on the Forest Service Assessment for the encompassing 6th field (subwatershed). I've included only some of the elements in habitat and channel condition. Substrate, pools and off channel habitat were dropped because presumably they are correlated or represented by those selected.

Hydrology: Flow and Hydrology
Very Good- both elements are considered functioning acceptably
Good- One is functioning acceptable and one is functioning at risk
Fair- Two or more elements are functioning at risk,
Poor- One or more elements is functioning at unacceptable risk

Note: this would be based on the Forest Service Assessment for change in peak/base flows and drainage network increase for the encompassing 6th field (subwatershed). Additional data on water diversion might be used to consider condition.

Connectivity: Physical barriers

Very good- there are no barriers or impediments to fish migration from the 6th field to the lake or river environment where migratory life histories could be expected to rear or stage.

Good- Temporary or partial impediments or barriers may exist for juvenile movement, but only occasionally. There are no barriers to adult movements, or they exclude less than 25% of the 6th field spawning habitat

Fair- Temporary or partial impediments or barriers may exist for juvenile and adult movements; or permanent barriers may exist that exclude adult migrants from 25% to 75% of the 6th field spawning habitat

Poor-Permanent barriers exclude adult movement to spawning habitat in more than 75% of the 6th code.

Note: presumably this would be based on Forest Service inventory of fish passage barriers.

Appendix F. Invertebrate Species of Concern and Potential Species of Concern Associated with Herbaceous Wetlands West of the Continental Divide.[1]

Group	Common Name	Scientific Name	MT Status[2]	Global Rank[3]	MT Rank	Habitat	Blackfoot	Seeley
Snails	Mountain Marshsnail	*Stagnicola montanensis*	SOC	G3	S1S3	wetlands/marshes	?	**X**
Butterflies	Eyed Brown	*Satyrodes eurydice*	SOC	G4	S2S3	wetlands/marshes	?	?
Butterflies	Frigga Fritillary	*Boloria frigga*	SOC	G5	S1S3	mountain wetlands	?	?
Butterflies	Gillett's Checkerspot	*Euphydryas gillettii*	SOC	G2G3	S2S3	wet meadows	**X**	**X**
Dragonflies	Boreal Whiteface	*Leucorrhinia borealis*	SOC	G5	S1	Wetlands	?	?
Dragonflies	Brush-tipped Emerald	*Somatochlora walshii*	SOC	G5	S1S2	Wetlands	?	?
Dragonflies	Subarctic Darner	*Aeshna subarctica*	SOC	G5	S1S2	Wetlands	?	?
Dragonflies	Western Pondhawk	*Erythemis collocata*	SOC	G5	S1S2	Wetlands	?	?
Dragonflies	California Darner	*Aeshna californica*	PSOC	G5 S3S5		wetland/lake w/ emergent vegetation	?	?
Dragonflies	Chalk-fronted Corporal	*Ladona julia*	PSOC	G5 S3S4		wetland/lake w/ emergent vegetation	?	?
Dragonflies	Crimson-ringed Whiteface	*Leucorrhinia glacialis*	PSOC	G5 S3		wetland/lake w/ emergent vegetation	**X**	**X**
Dragonflies	Lake Darner	*Aeshna eremita*	PSOC	G5 S3S4		wetland/lake w/ emergent vegetation	?	?
Dragonflies	Lance-tipped Darner	*Aeshna constricta*	PSOC	G5 S1S3		wetland/lake w/ emergent vegetation	?	?
Dragonflies	Hudsonian Emerald	*Somatochlora hudsonica*	PSOC	G5 S2S4		wetland/lake w/ emergent vegetation	**X**	**X**
Dragonflies	Mountain Emerald	*Somatochlora semicircularis*	PSOC	G5 S3S5		Wetlands	**X**	**X**
Dragonflies	Ocellated Emerald	*Somatochlora minor*	PSOC	G5 S2S4		wetland/lake w/ emergent vegetation	?	?
Dragonflies	Red-veined Meadowhawk	*Sympetrum madidum*	PSOC	G4 S2S3		wetland/lake w/ emergent vegetation	?	?
Dragonflies	Ringed Emerald	*Somatochlora albicincta*	PSOC	G5 S1S3		wetlands	?	?
Dragonflies	Sedge Darner	*Aeshna juncea*	PSOC	G5 S3S5		Wetlands	?	?
Dragonflies	Spiny Baskettail	*Epitheca spinigera*	PSOC	G5 S3S5		wetland/lake w/ emergent vegetation	?	?

[1] Source: Dave Stagliano, Montana Natural Heritage Program
[2] SOC: Species of Concern/Conservation Need; PSOC: Potential Species of Concern/Conservation Need
[3] Global (G) and state (S) ranks are explained in Appendix C.

Appendix G. Montana State Noxious Weed List (3/27/08).

Category 1.
Category 1 noxious weeds are weeds that are currently established and generally widespread in many counties of the state. Management criteria include awareness and education, containment and suppression of existing infestations and prevention of new infestations. These weeds are capable of rapid spread and render land unfit or greatly limit beneficial uses.

(a) Canada thistle (*Cirsium arvense*)
(b) Field bindweed (*Convolvulus arvensis*)
(c) Whitetop or Hoary cress (*Cardaria draba*)
(d) Leafy spurge (*Euphorbia esula*)
(e) Russian knapweed (*Centaurea repens*)
(f) Spotted knapweed (*Centaurea maculosa*)
(g) Diffuse knapweed (*Centaurea diffusa*)
(h) Dalmatian toadflax (*Linaria dalmatica*)
(i) St. Johnswort (*Hypericum perforatum*)
(j) Sulfur (Erect) cinquefoil (*Potentilla recta*)
(k) Common tansy (*Tanacetum vulgare*)
(l) Oxeye-daisy (*Chrysanthemum leucanthemum* L.)
(m) Houndstongue (*Cynoglossum officinale* L.)
(n) Yellow toadflax (*Linaria vulgaris*)
(o) Hoary alyssum (*Berteroa incana)*

Category 2.
Category 2 noxious weeds have recently been introduced into the state or are rapidly spreading from their current infestation sites. These weeds are capable of rapid spread and invasion of lands, rendering lands unfit for beneficial uses. Management criteria include awareness and education, monitoring and containment of known infestations and eradication where possible.

(a) Purple loosestrife or lythrum (*Lythrum salicaria*, *L. virgatum*, and any hybrid crosses thereof).
(b) Tansy ragwort (*Senecio jacobea* L.)
(c) Meadow hawkweed complex (*Hieracium pratense*, *H. floribundum*, *H. piloselloides*)
(d) Orange hawkweed (*Hieracium aurantiacum* L.)
(e) Tall buttercup (*Ranunculus acris* L.)
(f) Tamarisk [Saltcedar] (*Tamarix* spp.)
(g) Perennial pepperweed (*Lepidium latifolium*)
(h) Rush skeletonweed (*Chondrilla juncea*)
(i) Yellowflag iris (*Iris pseudacorus*)
(j) Blueweed (*Echium vulgare)*

Category 3.
Category 3 noxious weeds have not been detected in the state or may be found only in small, scattered, localized infestations. Management criteria include awareness and education, early detection and immediate action to eradicate infestations. These weeds are known pests in nearby states and are capable of rapid spread and render land unfit for beneficial uses.

(a) Yellow starthistle (*Centaurea solstitialis*)
(b) Common crupina (*Crupina vulgaris*)
(c) Eurasian watermilfoil (*Myriophyllum spicatum*)
(d) Dyer's woad (*Isatis tinctoria*)
(e) Flowering rush (*Butomus umbellatus)*
(f) Japanese knotweed complex (*Polygonum cuspidatum, sachalinense & polystachyum)*

Category 4.
Category 4 noxious weeds are invasive plants and may cause significant economic or environmental impacts if allowed to become established in Montana. Management criteria include prohibition from sale by the nursery trade. Research and monitoring may result in the plant being listed in a different category.

(a) Scotch broom (*Cytisus scoparius)*

Appendix H. Blackfoot River Valley Conservation Area Monitoring Plan (DRAFT 2007).

Indicator	Target (s)	Key Attribute	Threats Reference	Methods	Priority	Who monitors
Fish Population Measures						
Connectivity of fluvial trout populations	native salmonids	Connectivity within tributaries and to the Blackfoot River	• Construction and operation of drainage or diversion systems, dikes and ditches. • Roads – stream crossings • Milltown Dam	Refer to FWP methods to obtain fisheries data	High	MT DFWP gathers fish data. Obtain data and summarize from their reports
Distribution of fluvial trout populations	native salmonids	Distribution of pure-strain westslope cutthroat and bull trout populations	• Construction and operation of drainage or diversion systems, dikes and ditches. • Grazing Practices • Roads – stream crossings • Invasive/ Alien Species • Milltown dam	Assess the current distribution of native salmonid species to an historic one. Need to develop measures that place percent of unoccupied habitat into appropriate category. Work with FWP.	High	Data gathered by MT DFWP. Summarized by TNC
Trout redd and juvenile counts	native salmonids	Reproduction Success	• (none – viability measure)	This is a count of reproductive measures (redds/ juveniles) that is related to a baseline condition. Measures need to be developed. Work with FWP to see how we can use their data.	High	MT DFWP gathers data, TNC summarize

Indicator	Target (s)	Key Attribute	Threats Reference	Methods	Priority	Who monitors
Grizzly Bear Habitat Measures						
Grizzly bear use of available habitat	grizzly bear	Secure Available Habitat	• Road development/use • Livestock production • Residential development • Second home resort development • Recreational use • Parasites/pathogens	Use CEM Model to determine	High	USFS, FWP CEM Model will provide data
Grizzly Bear Population Measures						
Grizzly bear linkage zone intactness and/or number of barriers to g bear movement	grizzly bear	Habitat Connectivity	• Road development/use • Livestock production • Residential development • Second home resort development • Recreational use	Need to identify linkage zones and barriers to movement, then determine method to measure. Can use CEM model to help determine these.	High	USFS, FWP CEM Model will provide data
Grizzly bear population demography: Reproductive success/ mortality	grizzly bear	Viable population	• Viability measure • Poaching	Use FWP observation and population trend monitoring data. Consult the annual reports.	High	FWP
Grizzly bear population and population trend	grizzly bear	Population size and trend	• Viability measure	Population Trend monitoring Study and DNA Study	High	NPS, FWP, USFWS

Indicator	Target (s)	Key Attribute	Threats Reference	Methods	Priority	Who monitors
Grizzly bear incidences or conflicts with livestock/ residences	grizzly bear	Bear/ Human Harmony	• Livestock production • Residential development • Second home resort development • Recreational use	Use FWP annual conflict data reports	High	FWP
Bird Nesting Measures						
Nesting and fledgling success of loons and trumpeter swans	herbaceous wetlands	Quality of bird nesting (and rearing) habitat	• (none – viability measure)	Loons are monitored and likely USFWS monitors Trumpeter Swans, refer to USFWS reports for the information on nesting and fledgling success	Medium	FWP? USFWS?
Blackfoot River Measures (Water Quality/Quantity)						
Seasonal surface river flow volumes	native salmonids	Functioning Hydrologic Regime- sufficient instream flows	• Construction and operation of drainage or diversion systems, dikes and ditches.	Obtain USGS water flow data for Blackfoot River Gauge near Bonner MT (available on-line). Obtain an annual low flow (CFS) average for the months of June, July, August for the last 7 years. Average these low flows for the 7 year period. Place in appropriate category.	High	Data collected by USGS, to be summarized by TNC

Indicator	Target (s)	Key Attribute	Threats Reference	Methods	Priority	Who monitors
Water temperature and particulate level (TMDL)	native salmonids	Water quality	• Grazing/ livestock production practices • Mining practices • Milltown dam • Roads – stream crossings	Obtain TMDL plans and data. Still need to develop indicator ratings and methods	High	Data gathered by Blackfoot Challenge Contractors? Summarized by TNC
Vegetation Community Measures – Invasive Species						
Amount of aggressive exotic species	herbaceous wetlands native grasslands/ sagebrush communities aspen and riparian woody vegetation	Native Vegetation Community	• Invasive/ alien species • Construction and operation of drainage or diversion systems, dikes and ditches. • Crop production Practices • Recreational Use • Residential development • Grazing Practices	No methods developed yet. Would need to see if anyone is monitoring weeds at this scale. If not would need to develop sampling protocol to estimate area affected by aggressive exotic species. This probably will involve sampling	High	?
Vegetation Community Measures – Wetlands Condition						
Amount of filled, altered, or drained or otherwise disturbed herbaceous wetlands	herbaceous wetlands	Functional Hydrologic Regime: Intactness of wetland	• Construction and operation of drainage or diversion systems, dikes and ditches. • Crop production Practices • Conversion to agriculture • Filling	Try to obtain information through aerial photo interp. If not possible a field sample may be required. Develop standards for what constitutes a drained, filled or altered wetland. This is simply a count of how many have been impaired.	Medium	?

Indicator	Target (s)	Key Attribute	Threats Reference	Methods	Priority	Who monitors
Number, distribution, and size of wetlands	herbaceous wetlands	Number, distribution and size of wetlands	• Construction and operation of drainage or diversion systems, dikes and ditches. • Crop production Practices • Conversion to agriculture • Filling	Aerial Photo interp or NWI assessment of wetland area	Medium	?
Age class distribution of aspen, and riparian woody vegetation types	aspen and riparian woody vegetation	Functioning disturbance regime (fire, browsing, beaver)	• Construction and operation of drainage or diversion systems, dikes and ditches. • Channelization of rivers and streams • Residential development • Conversion to agriculture • Fire suppression • Grazing practices	None developed yet. Need to field measure condition of woody riparian and aspen stands.	Medium	?
Miles/acres of aspen and riparian woody vegetation	aspen and riparian woody vegetation	Number, Size, or Area of aspen and riparian woody vegetation	• Construction and operation of drainage or diversion systems, dikes and ditches. • Channelization of rivers and streams • Residential development • Conversion to agriculture • Grazing practices	Methods not developed. May be able to complete with aerial photo interpretation.	Medium	?

Indicator	Target (s)	Key Attribute	Threats Reference	Methods	Priority	Who monitors
Vegetation Community Measures – Grasslands/ Sagebrush Condition						
Fire Return Interval of grassland/ sagebrush communities	native grasslands/ sagebrush communities	Functioning fire regime	• Fire suppression	Not developed	Medium	?
Areal extent of grasslands/ sagebrush communities	native grasslands/ sagebrush communities	Area/ Size of grasslands/ sagebrush communities	• Fire suppression • Conversion to agriculture • Grazing practices • Invasive/ alien species • Residential development	Need to calculate HRV and compare current coverage. Need to determine resolution of veg mapping (community level) and method of sampling (remote sensing? aerial photos?). Not sure how HRV is determined in open country (consult with EMRI)	Medium	?
Vegetation Community Measures – Forest Condition						
Amount and distribution of cone producing whitebark pine stands	mid to high elevation coniferous forest	Areal extent of cone producing white bark pine stands	• Fire suppression • Parasites/ pathogens	Use USFS vegetation surveys to determine covertype/ PNV type distribution in conjunction with cone production surveys (they may be on a different monitoring interval)	Medium	USFS inventory for data?

Indicator	Target (s)	Key Attribute	Threats Reference	Methods	Priority	Who monitors
Fire Regime Condition of forest types	mid to high elevation coniferous forest	Functioning disturbance regime - fire	• Fire suppression • Forestry practices	Utilize USFS FRCC models	Medium	USFS has models that can be summarized
Departure from Historic Range of Variability of forest types	mid to high elevation coniferous forest low-elevation ponderosa pine/western larch	Patch size and distribution of forest cover types and age classes	• Fire suppression • Forestry practices	Use patch dynamic analyses, HRV, veg mapping and Fragstats etc. need to explore these methods and if they are available. Emphasize the presence of large diameter trees/stands in the low-elevation forest targets	Medium	?
Percent of ponderosa pine/larch stands that have fire/fire surrogate treatment	low-elevation ponderosa pine/western larch	Functioning disturbance regime - fire	• none (viability measure)	Not sure: Aerial photo interp, USFS Models, FRCC, field sampling?	High	USFS has models that can be summarized

Appendix I. Acronyms and Abbreviations.

BBCTU	Big Blackfoot Chapter, Trout Unlimited
BBS	Breeding Bird Survey
BC	Blackfoot Challenge
BCCA	Blackfoot Community Conservation Area
BFS	Basin fill sediment unit
BLM	U.S. Bureau of Land Management
BLM	U.S. Bureau of Land Management
BMP	best management practice
BPA	Bonneville Power Administration
CBWTP	Columbia Basin Water Transaction Program
COCE	Crown of the Continent Ecosystem
CRC	Clearwater Resource Council
CRP	Conservation Reserve Program
CWA	Clean Water Act
EPA	Environmental Protection Agency
EQIP	Environmental Quality Incentives Program
ESA	Endangered Species Act
ESU	evolutionarily significant unit
FERC	Federal Energy Regulatory Commission
FLPMA	Federal Land and Policy Management Act
FRI	fire-return interval
FVLT	Five Valleys Land Trust
GRP	Grasslands Reserve Program
GLCI	Grazing Lands Conservation Initiative
HCP	Habitat Conservation Plan
INFISH	Inland Native Fish Strategy
ITEEM	Integrated Transportation and Ecosystem Enhancements for Montana
LWCF	Land and Water Conservation Fund
MBTRT	Montana Bull Trout Restoration Team
MBTSG	Montana Bull Trout Scientific Group
MCA	Montana Code Annotated
MDEQ	Montana Department of Environmental Quality
MDNRC	Montana Department of Natural Resource Conservation
MDT	Montana Department of Transportation
MEPA	Montana Environmental Policy Act
MFWP	Montana Department of Fish, Wildlife and Parks
MLR	Montana Land Reliance
MTNHP	Montana Natural Heritage Program
NCDE	Northern Continental Divide Ecosystem
NEPA	National Environmental Policy Act
NOAA	National Oceanic and Atmospheric Administration

NPCC	Northwest Power and Conservation Council
NPS	National Park Service
NRCS	Natural Resources Conservation Service
PCTC	Plum Creek Timber Company
RLI	Rural Living Institute
RMEF	Rocky Mountain Elk Foundation
RRAFT	River Recreation Advisory for Tomorrow
SSURGO	Soil Survey Geographic Database
STATSGO	State Soil Geographic Database
TMDL	total maximum daily load
TNC	The Nature Conservancy
TU	Trout Unlimited
USFS	United States Forest Service
USFWS	U.S. Fish and Wildlife Service
WHIP	Wildlife Habitat Incentives Program
WMA	Wildlife Management Area
WRP	Wetlands Reserve Program
WUI	wildland-urban interface

APPENDIX J

An integrated stream restoration and native fish conservation strategy for 182 streams in the Blackfoot Basin, Montana

Introduction

The Blackfoot River Fisheries Initiative continues to expand with restoration and conservation becoming more inclusive of native fish, water quality, instream flows and landscape protection. As such, the need for an inclusive clearly defined native fish conservation strategy for Blackfoot Basin has emerged. This need originates from 1) an expanded number (and scope) of watershed interest groups, 2) a cadre of federal, state and regional fisheries management directives, and 3) the recent development of drought, sub-basin and TMDL plans, NRCS fisheries-related EQIP projects and the recent development of Native Fish Habitat Conservation Plan (HCP) strategies.

To foster fisheries-related conservation endeavors, FWP recently developed an integrated stream restoration and native fish conservation strategy for 108 waterbodies of the Blackfoot Basin (Pierce et al. 2005). Although valuable to the broader restoration program, this planning document was also deficient because it failed to include large areas of the Blackfoot Basin where fisheries data was lacking. These areas include the Clearwater River Basin, the "backcountry" and heavily damaged streams in the upper Blackfoot Mining complex. With the recent initiation of native fish telemetry studies and the completion of fisheries data collections in these areas (Clearwater Basin (49 streams), the backcountry (19 streams), and mining areas (6 streams)), we are now able to generate a prioritization strategy for the entire Blackfoot River Basin.

The guiding purpose of this planning document is to develop a cohesive restoration and conservation strategy that directs stakeholder involvement to common priorities involving the needs of native fish. Native fisheries are indicators of ecosystem heath, and their recovery has become an FWP Fisheries Division priority. To this end, this plan provides a basin-wide, native fisheries-based, priority-driven template for restoration projects and expands upon the gains of the existing Blackfoot River Restoration Program. Our rationale for generating this report was that by integrating all fisheries-related restoration programs into a single guiding strategy, the Blackfoot Cooperators could better meet a common suite of conservation goals. For detailed review of restoration prioritization, we refer the reader to the original strategy (Pierce, Aasheim and Podner 2005).

Specific objectives of this report are to:

1. Provide a planning strategy to guide restoration activities of the Montana Fish, Wildlife and Parks (FWP), U.S. Fish and Wildlife Service, Blackfoot Challenge, The Nature Conservancy, Big Blackfoot Chapter of Trout Unlimited and other restoration partners.
2. Expand on an existing fisheries-based stream restoration prioritization ranking system (Pierce, Aasheim and Podner 2005) to include all inventories waters of the Blackfoot Basin
3. Re-prioritize all FWP currently inventoried streams to a hierarchical strategy that includes the Clearwater Basin.

Procedures

We incorporated 74 additional tributaries inventoried since 2005 into the original matrix of 108 streams (Appendix K). The new matrix includes five reaches of the Clearwater River 1) mouth to the Salmon Lake outlet, 2) Salmon lake to Seeley Lake outlet, 3) Seeley lake to the outlet of Lake Inez (fish barrier), 4) Lake Inez to outlet of Rainy Lake (fish barrier), and, 4) Rainy lake to the headwaters. We then re-prioritized and ranked all inventoried waterbodies on a hierarchical point system that includes 1) native fish values (70 points), 2) total fisheries values (90 points), 3) total biological values (150 points), and finally 4) total values (200 possible points).

FWP fisheries personnel were given the job of assigning data input and corresponding point values to the matrix. Scoring of some criteria (primarily social and financial considerations) necessarily relied on past landowner interviews, direct knowledge of tributaries, along with professional expertise and judgment for inventoried non-project streams.

For the biological benefits section of the matrix, streams with documented bull trout use received scores of 10, 20, 30 or 40 points, depending on whether the stream supported spawning (20 points), rearing (10 points) or is a designated bull trout "core area" stream (10 points). Compared with other criteria, streams supporting bull trout received more points due to their: 1) "threatened" status under ESA along with State and Federal priorities for the recovery of this species; 2) high potential for improvement in the Blackfoot watershed; and 3) downstream and sympatric benefits to other species resulting from bull trout recovery efforts.

For streams supporting WSCT, an additional zero, 10 or 20 points were possible, depending on whether a stream supported no WSCT (zero points), resident WSCT (10 points) or fluvial WSCT use (20 points). Fluvial WSCT streams received a higher score than streams supporting resident fish due to 1) the precarious status of the fluvial life-history, 2) high sport fish value to the Blackfoot River, and 3) downstream and sympatric benefits to other species resulting from WSCT recovery efforts. Streams with fluvial WSCT status (20 points) were those identified through 1) telemetry studies, 2) direct observations of fluvial-sized fish by FWP fisheries personnel, or 3) direct tributaries to the Blackfoot River and biologically connected during high flows periods.

Streams received an additional zero, 10 or 20 points based on sport fishery value to the Blackfoot River. Streams with no sport fishery value (disjunct from the Blackfoot River) received zero points, single species sport fishery value (non-disjunct usually with WSCT) received 10 points, while non-disjunct streams that provide recruitment of multiple species (bull trout, WSCT, rainbow and brown trout) to the Blackfoot River received 20 points. We assumed connected streams supporting rainbow trout, brown trout and bull trout provided sport fishery value to the Blackfoot River. We assumed small non-direct and non-fluvial headwater tributaries to support primarily resident WSCT, and as such, these were not considered as providing sport fishery value to the Blackfoot River. We did not consider brook trout in this ranking due to their limited use of the Blackfoot River and adverse biological impacts to native species.

Stream restoration technical feasibility was also considered with zero points for not feasible and 20 points for streams considered technically feasible to restore. Large instream reservoirs (e.g. upper Nevada Creek, Frazier Creek, and Wales Creek), over-appropriated water rights (e.g. lower Nevada Creek), major highway problems (eg. Chimney Creek), and fully restored (e.g. Grantier Spring Creek) were considered not technically feasible to restore for the purposes of this report.

In addition to fisheries and feasibility criteria, streams with potential to increase instream flows (e.g. irrigation salvage potential) in the Blackfoot River were allotted 20 points. Finally, under the biological ranking section, streams with potential to improve downstream water quality by reducing 1) instream sediment (10 points), 2) water temperature (10 points), and 3) nutrient loading (10 points) could earn up to an additional 30 points. This water quality point system is based on FWP assessments and judgment based on field observations

For social and financial considerations, we used three criteria: 1) landowner and land manager cooperation (5, 10, 15 or 20 points) - a measure of perceived landowner cooperation; 2) cost-effectiveness (5, 10 or 20 points) – an estimate of project cost/mile; and 3) demonstration/educational value of potential projects (5 or 10 points) - a measure of project uniqueness, judgments of landowner interest and project access.

We transferred matrix values of all 182 streams to an EXCEL spreadsheet and then spatially converted the matrix to an Arcview GIS shape-file where priorities were classified and displayed. Streams were classified hierarchically first by: 1) native species score, 2) then by total fisheries score, 3) biological score, and finally 4) total score. All native species scores (7 classes) and total fisheries scores (9 classes) are presented. Biological scores and total scores were grouped by class values that approximated the 0-33, 34-66, and 67-100 cumulative percentiles, and these were assigned a respective *high*, *moderate* and *low* priority values.

Prioritization shortcomings

It is important to note that our ranking criteria does not consider many complex restoration-related issues, such as: 1) fisheries potential of sites, 2) potential contribution to connected systems, 3) severity of impacts, 4) population size, 5) native and non-native species interactions, 6) WSCT genetic composition, 6) numerical water quality standards and criteria, or 7) industrial-scale timber harvesting practices, public land or hard-rock mine drainage issues, or 8) other specific agency programs geared toward fisheries and water quality improvements. Rather, these issues should be considered at the project development phases. Our prioritization scheme attempts to guide the limited resources of the Blackfoot Cooperators to biologically important tributaries located primarily on private land. Although the prioritization is intended to guide restoration activities, as new information becomes available and as additional limiting factors are identified low priorities may be elevated potentially triggering restoration action. We recognize unique restoration opportunities may be presented, and that continued input from landowners and managers will help guide the Blackfoot River restoration initiative.

Restoration Priorities

The hierarchy of the matrix is summarized below first by native fish priorities (Figure 1, Table 1) followed by total fisheries priorities (Figure 2, Table2) and biological score (Figure 3, Table 3) and finally by total restoration priority groupings (Figure 4, Table 4).

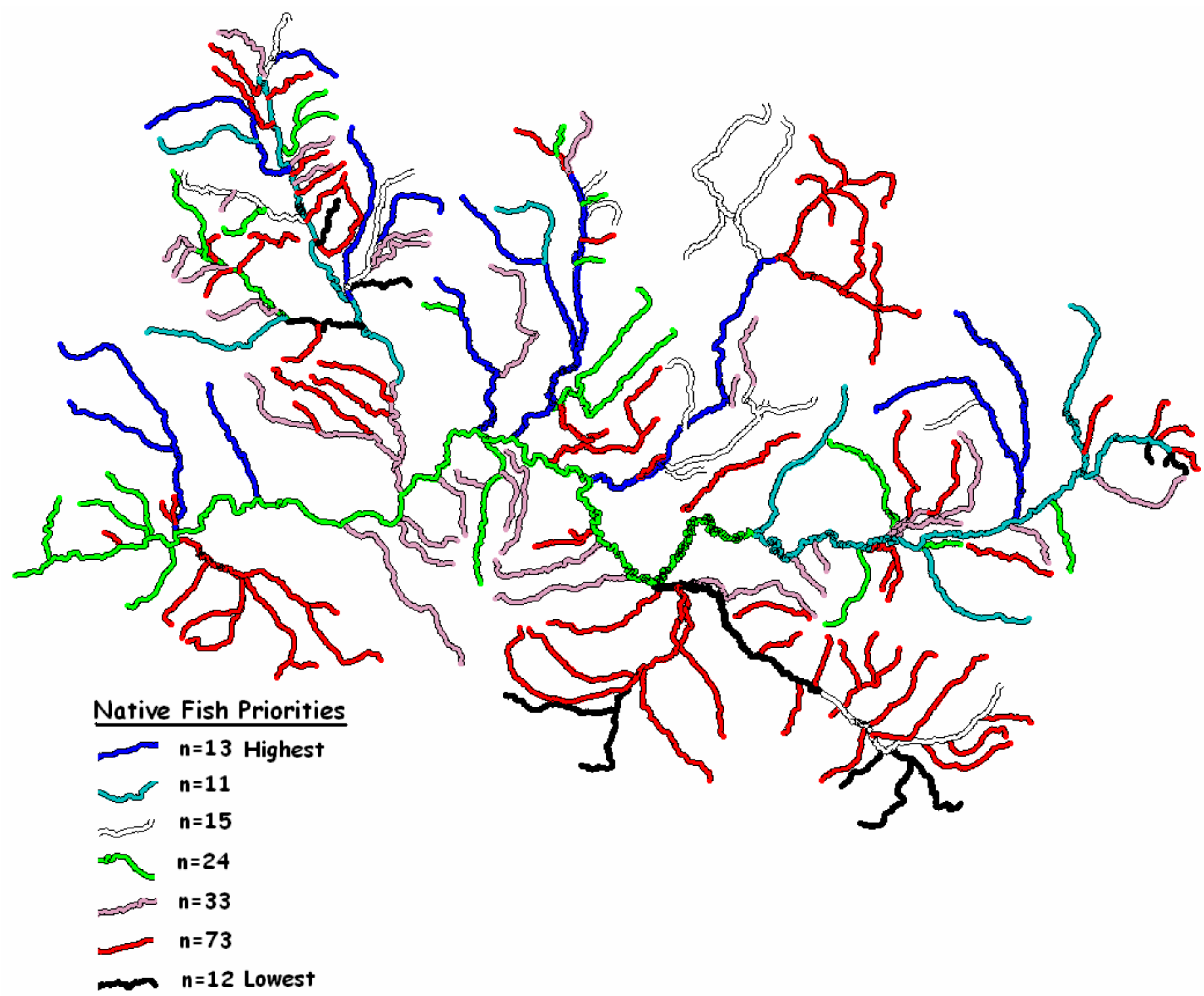

Figure 1. Native fish restoration priorities for the Blackfoot River Basin. Classes show the number of individual streams by priority grouping (Table 1). The highest scores are migratory bull trout and WSCT streams and the lowest scores possess little or no migratory native fish value to the Blackfoot River.

Stream Name	Native Species Total Score	Stream Name	Native Species Total Score	Stream Name	Native Species Total Score	Stream Name	Native Species Total Score
Belmont Creek	60	East Twin Creek	30	Bear Gulch	10	Seeley Creek	10
Clearwater Section 2	60	Ender's Spring Creek	30	Bertha Creek	10	Shaue Gulch	10
Clearwater Section 3	60	Grantier Spring Cr.	30	Blanchard NF	10	Sheep Creek	10
Clearwater Section 4	60	Hogum Creek	30	Braziel Creek	10	Shingle Mill Creek	10
Copper Creek	60	Inez Creek	30	Broadus Creek	10	Smith Creek	10
Cottonwood Cr. (R.M.43)	60	Johnson Creek	30	Buffalo Gulch	10	Sourdough Creek	10
Dunham Creek	60	McCabe Creek	30	Burnt Bridge Creek	10	Stonewall Creek	10
E.F. Clearwater	60	Saurekraut Creek	30	California Gulch	10	Sucker Creek	10
Gold Creek	60	Spring Cr.(Cottonwood)	30	Camas Creek	10	Swamp Creek	10
Gold Creek, W,F	60	Trail Creek	30	Chicken Creek	10	Tamarack Creek	10
Landers Fork	60	Unnamed tributary	30	Chimney Cr. (Douglas)	10	Theodore Creek	10
Monture Creek below the Falls	60	West Twin Creek	30	Chimney Cr. (Nevada)	10	Uhler Creek	10
Morrell Creek	60	Yellowjacket Creek	30	Clear Creek	10	Union Creek	10
North Fork Blackfoot River below the Falls	60	Basin Spring Creek	20	Cold Brook Creek	10	Vaughn Creek	10
W.F. Clearwater	60	Bear Creek trib. to N.F.	20	Colt Creek	10	Warm Springs Cr.	10
Alice Creek	50	Bear Creek (R.M.37.5)	20	Cooney Creek	10	Warren Creek	10
Arrastra Creek	50	Benedict Creek	20	Cottonwood Cr. (Nev.)	10	Warren Creek, Doney Lake trib	10
Blackfoot River 1	50	Blanchard Creek	20	Dobrota Creek	10	Washington Creek	10
Blackfoot River 2	50	Chamberlain EF	20	Douglas Creek	10	Washoe Creek	10
Blind Canyon Creek	50	Chamberlain WF	20	East Fork of North Fork	10	Wedge Creek	10
Boles Creek	50	Clearwater Section 1	20	Finley Creek	10	Willow Cr. (lower)	10
Lodgepole Creek	50	Elk Creek	20	First Creek	10	Wilson Creek	10
Poorman Creek	50	Fawn Creek	20	Frazier Creek	10	Auggie Creek	0
Cabin Creek	40	Findell Creek	20	Frazier Creek, NF	10	Bear Trap Creek	0
Canyon Creek	40	Fish Creek	20	Gallagher Creek	10	Black Bear Creek	0
Clearwater Section 5	40	Keep Cool Creek	20	Game Creek	10	Buck Creek	0
Dry Creek	40	Lincoln Spring Cr.	20	Gleason Creek	10	Drew Creek	0
Dry Fork of the North Fork	40	Little Fish Creek	20	Grouse Creek	10	Finn Creek	0
East Fork of Monture	40	Little Moose Creek	20	Hoyt Creek	10	Halfway Creek	0
Hayden Creek	40	McDermott Creek	20	Humbug Creek	10	Horn Creek	0
Kleinschmidt Cr.	40	Middle Fork of Monture Creek	20	Indian Creek	10	Mike Horse Creek	0
Marshall Creek	40	Moose Creek	20	Jacobsen Spring Creek	10	Nevada Cr. (lower)	0
Nevada Cr.(upper)	40	N.F. Placid Creek	20	Jefferson Creek	10	Owl Creek	0
Rock Creek	40	Nevada Spring Cr.	20	Lost Horse Creek	10	Paymaster Creek	0
Salmon Creek	40	Pearson Creek	20	Lost Pony Creek	10	Sheep Creek	0
Snowbank Creek	40	Placid Creek	20	Lost Prairie Creek	10	Slippery John Creek	0
Spring Creek (N.F.)	40	Seven up Pete Cr.	20	McElwain Creek	10	Strickland Creek	0
Bear Creek (R.M.12.2)	30	Shanley Creek	20	Mitchell Creek	10	Sturgeon Creek	0
Beaver Creek	30	Wales Creek	20	Mountain Creek	10	Ward Creek	0
Blackfoot River 3	30	Wales Spring Creek	20	Murphy Creek	10		
Blackfoot River 4	30	Wasson Creek	20	Murray Creek	10		
Blackfoot River 5	30	Willow Cr. (upper)	20	North Fork above the Falls	10		
Blackfoot River 6	30	Yourname Creek	20	Pass Creek	10		
Burnt Cabin Creek	30	Anaconda Creek	10	Rice Creek	10		
Camp Creek	30	Archibald Creek	10	Richmond Creek	10		
Chamberlain Creek	30	Arkansas Creek	10	Sawyer Creek	10		
Deer Creek	30	Ashby Creek	10	Scotty Creek	10		
Dick Creek	30	Bartlett Creek	10	Second Creek	10		

Table 1. Native fish restoration priority stream sorted alphabetically from high to low priority.

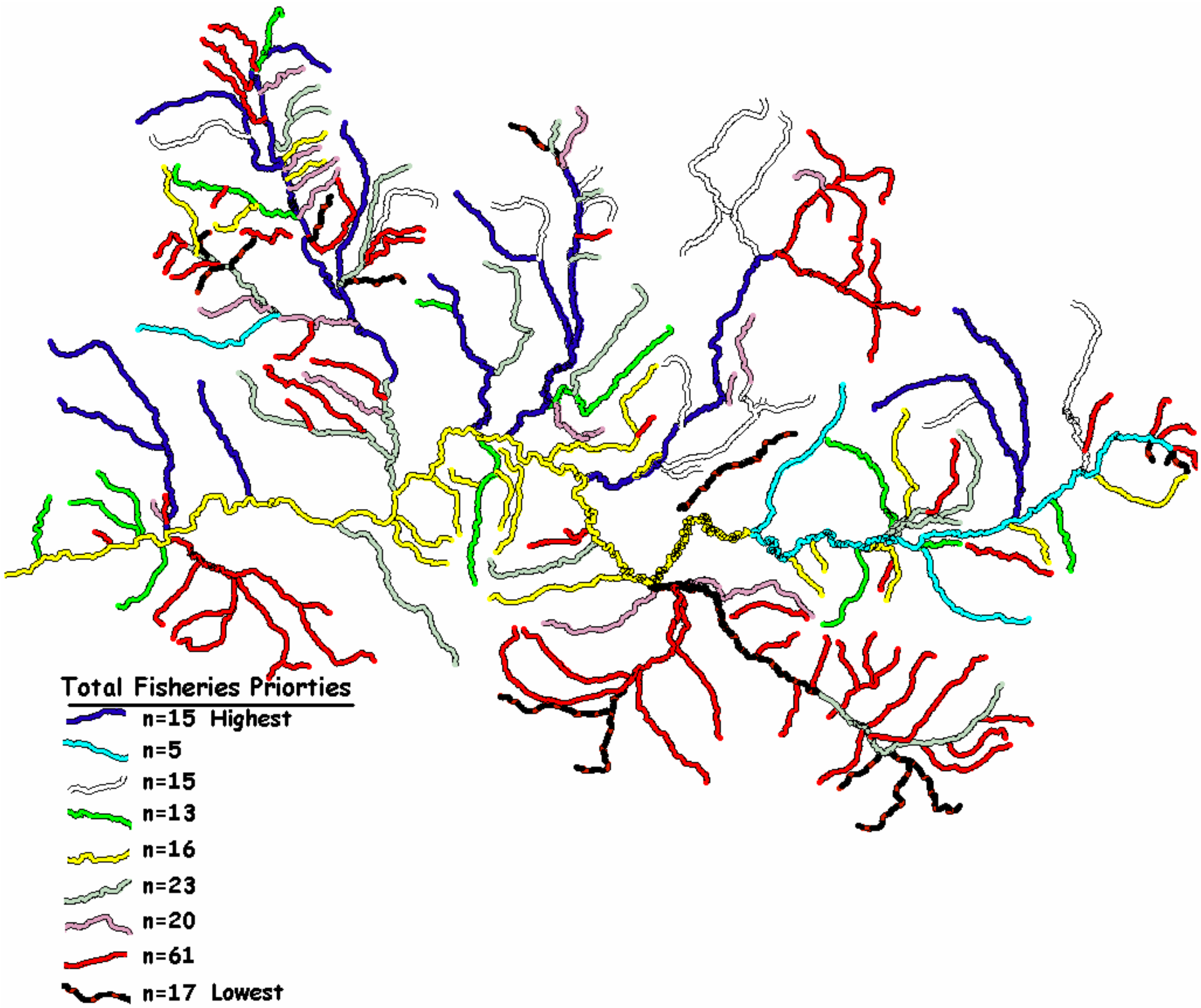

Figure 2. Total fisheries restoration priorities for the Blackfoot River Basin. High priority stream currently support migratory bull trout, WSCT and may recruit of game fish (rainbow and brown trout) to the Blackfoot River (Table 2). Streams near the bottom of the priority list provide very little or no native or recreational (recruitment) value to the Blackfoot River.

Stream Name	Total fisheries score	Stream Name	Total fisheries score	Stream Name	Total fisheries score	Stream Name	Total fisheries score
Belmont Creek	80	Blanchard Creek	40	Murphy Creek	20	Scotty Creek	10
Clearwater Section 2	80	Burnt Cabin Creek	40	Nevada Spring Cr.	20	Second Creek	10
Clearwater Section 3	80	Camp Creek	40	Owl Creek	20	Seeley Creek	10
Clearwater Section 4	80	Clearwater Section 1	40	Rice Creek	20	Shaue Gulch	10
Copper Creek	80	Elk Creek	40	Richmond Creek	20	Sheep Creek	10
Cottonwood Cr. (R.M.43)	80	Inez Creek	40	Sawyer Creek	20	Shingle Mill Creek	10
Dunham Creek	80	Keep Cool Creek	40	Warm Springs Cr.	20	Smith Creek	10
E.F. Clearwater	80	Lincoln Spring Cr.	40	Wasson Creek	20	Sourdough Creek	10
Gold Creek	80	McCabe Creek	40	Anaconda Creek	10	Sucker Creek	10
Gold Creek, W,F	80	Nevada Cr.(upper)	40	Archibald Creek	10	Swamp Creek	10
Landers Fork	80	Placid Creek	40	Arkansas Creek	10	Tamarack Creek	10
Monture Creek below the Falls	80	Shanley Creek	40	Ashby Creek	10	Theodore Creek	10
Morrell Creek	80	Trail Creek	40	Bartlett Creek	10	Uhler Creek	10
North Fork below the Falls	80	Unnamed tributary	40	Bear Gulch	10	Union Creek	10
W.F. Clearwater	80	Wales Creek	40	Bertha Creek	10	Vaughn Creek	10
Arrastra Creek	70	Wales Spring Creek	40	Blanchard NF	10	Warren Creek, Doney Lak	10
Blackfoot River 1	70	Yellowjacket Creek	40	Braziel Creek	10	Washington Creek	10
Blackfoot River 2	70	Basin Spring Creek	30	Buffalo Gulch	10	Washoe Creek	10
Boles Creek	70	Bear Creek (R.M.37.5)	30	Burnt Bridge Creek	10	Wedge Creek	10
Poorman Creek	70	Benedict Creek	30	California Gulch	10	Wilson Creek	10
Alice Creek	60	Blackfoot River 3	30	Camas Creek	10	Auggie Creek	0
Blind Canyon Creek	60	Blackfoot River 4	30	Chicken Creek	10	Bear Trap Creek	0
Cabin Creek	60	Blackfoot River 5	30	Chimney Cr. (Douglas)	10	Black Bear Creek	0
Canyon Creek	60	Blackfoot River 6	30	Chimney Cr. (Nevada)	10	Buck Creek	0
Dry Creek	60	Chamberlain EF	30	Clear Creek	10	Drew Creek	0
Dry Fork of the North Fork	60	Chamberlain WF	30	Cold Brook Creek	10	Finn Creek	0
East Fork of Monture	60	Fawn Creek	30	Colt Creek	10	Halfway Creek	0
Hayden Creek	60	Findell Creek	30	Cooney Creek	10	Horn Creek	0
Kleinschmidt Cr.	60	Fish Creek	30	Cottonwood Cr. (Nev.)	10	Mike Horse Creek	0
Lodgepole Creek	60	Jacobsen Spring Creek	30	Dobrota Creek	10	Nevada Cr. (lower)	0
Marshall Creek	60	Little Fish Creek	30	Douglas Creek	10	Paymaster Creek	0
Rock Creek	60	Little Moose Creek	30	East Fork of North Fork	10	Sheep Creek	0
Salmon Creek	60	Moose Creek	30	First Creek	10	Slippery John Creek	0
Snowbank Creek	60	N.F. Placid Creek	30	Frazier Creek	10	Strickland Creek	0
Spring Creek (N.F.)	60	Pearson Creek	30	Frazier Creek, NF	10	Sturgeon Creek	0
Bear Creek (R.M.12.2)	50	Seven up Pete Cr.	30	Gallagher Creek	10	Ward Creek	0
Beaver Creek	50	Stonewall Creek	30	Game Creek	10		
Chamberlain Creek	50	Warren Creek	30	Gleason Creek	10		
Clearwater Section 5	50	Willow Cr. (lower)	30	Grouse Creek	10		
Deer Creek	50	Willow Cr. (upper)	30	Humbug Creek	10		
Dick Creek	50	Yourname Creek	30	Indian Creek	10		
East Twin Creek	50	Bear Creek trib. to N.F.	20	Jefferson Creek	10		
Ender's Spring Creek	50	Broadus Creek	20	Lost Pony Creek	10		
Grantier Spring Cr.	50	Finley Creek	20	Lost Prairie Creek	10		
Hogum Creek	50	Hoyt Creek	20	Mitchell Creek	10		
Johnson Creek	50	Lost Horse Creek	20	Mountain Creek	10		
Saurekraut Creek	50	McDermott Creek	20	Murray Creek	10		
Spring Cr.(Cottonwood)	50	McElwain Creek	20	North Fork above the Falls	10		
West Twin Creek	50	Middle Fork of Monture Creek	20	Pass Creek	10		

Table 2. Total fisheries scores for the Blackfoot River Basin. Streams are sorted alphabetically from high fisheries value to no current fisheries value to the Blackfoot River.

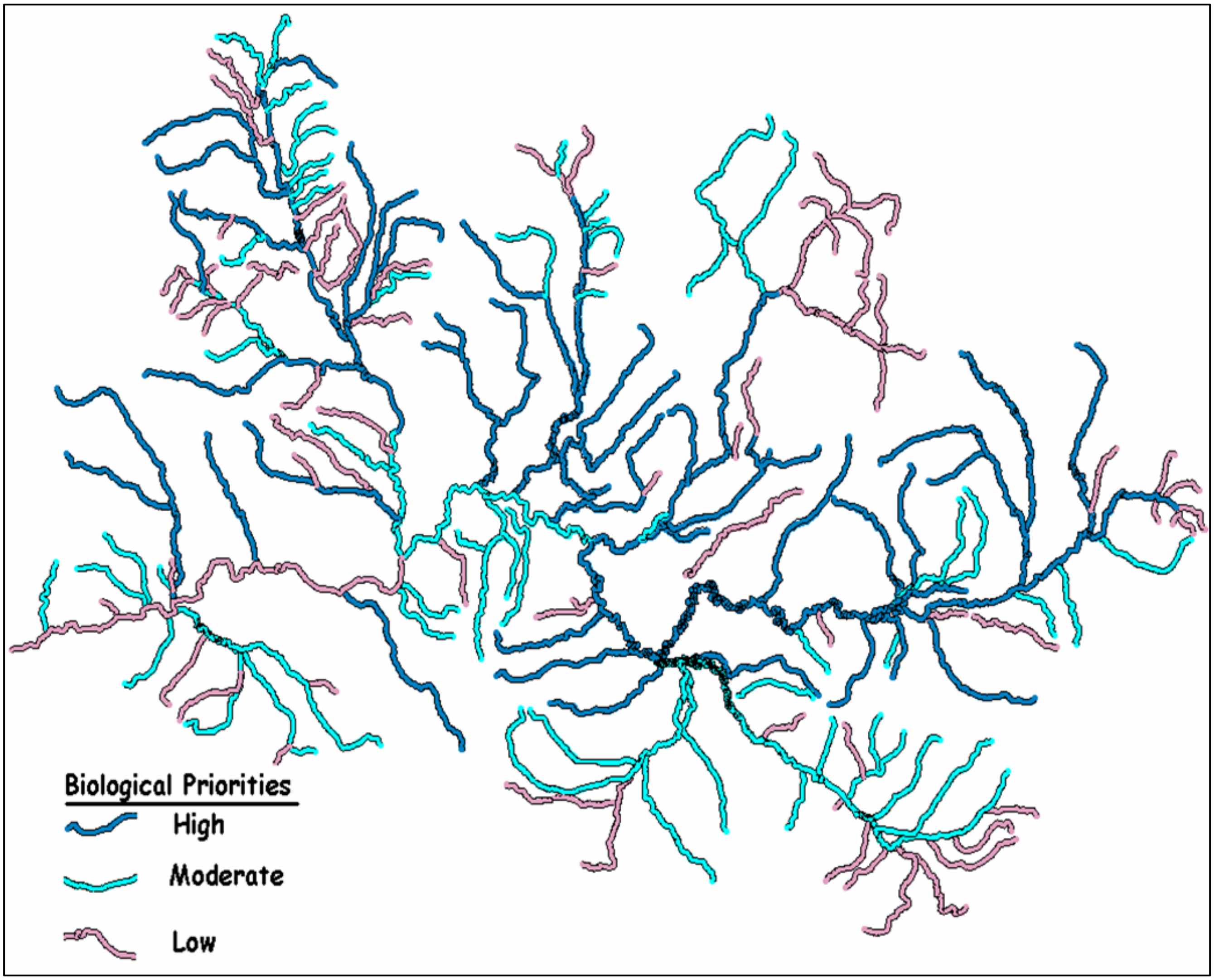

Figure 3. Biologically scores ranked by high, moderate and low values. High priority streams support native and sport fish and most possess high restoration (i.e., flow and water quality) potential. Moderate priority streams possess often posses less valuable fish but high restoration potential (Table 3). Low values may possess restoration potential but provide little current fisheries value to the Blackfoot River.

Stream Name	Bio score	Stream Name	Bio score	Stream Name	Bio score	Stream Name	Bio score
Alice Creek	High	Stonewall Creek	High	Pearson Creek	Moderate	McDermott Creek	Low
Arrastra Creek	High	Wales Creek	High	Placid Creek	Moderate	Middle Fork of Monture Creek	Low
Beaver Creek	High	Wales Spring Creek	High	Richmond Creek	Moderate	Mike Horse Creek	Low
Belmont Creek	High	Wasson Creek	High	Seven up Pete Cr.	Moderate	Mitchell Creek	Low
Blackfoot River 1	High	Bear Creek (R.M.12.2)	Moderate	Sucker Creek	Moderate	North Fork above the Falls	Low
Blackfoot River 2	High	Ashby Creek	Moderate	Union Creek	Moderate	Pass Creek	Low
Blackfoot River 3	High	Basin Spring Creek	Moderate	Unnamed tributary	Moderate	Paymaster Creek	Low
Blackfoot River 4	High	Bear Gulch	Moderate	Warm Springs Cr.	Moderate	Rice Creek	Low
Blanchard Creek	High	Benedict Creek	Moderate	Washington Creek	Moderate	Sawyer Creek	Low
Blind Canyon Creek	High	Bertha Creek	Moderate	West Twin Creek	Moderate	Scotty Creek	Low
Boles Creek	High	Blackfoot River 5	Moderate	Willow Cr. (upper)	Moderate	Second Creek	Low
Clearwater Section 2	High	Braziel Creek	Moderate	Wilson Creek	Moderate	Seeley Creek	Low
Clearwater Section 3	High	Buffalo Gulch	Moderate	Yellowjacket Creek	Moderate	Shaue Gulch	Low
Clearwater Section 4	High	Burnt Cabin Creek	Moderate	Anaconda Creek	Low	Sheep Creek	Low
Copper Creek	High	Cabin Creek	Moderate	Archibald Creek	Low	Sheep Creek	Low
Cottonwood Cr. (R.M.43)	High	California Gulch	Moderate	Arkansas Creek	Low	Shingle Mill Creek	Low
Deer Creek	High	Camas Creek	Moderate	Auggie Creek	Low	Slippery John Creek	Low
Dick Creek	High	Camp Creek	Moderate	Bartlett Creek	Low	Smith Creek	Low
Dry Creek	High	Canyon Creek	Moderate	Bear Creek trib. to N.F.	Low	Sourdough Creek	Low
Dunham Creek	High	Chamberlain Creek	Moderate	Bear Creek (R.M.37.5)	Low	Strickland Creek	Low
E.F. Clearwater	High	Chamberlain EF	Moderate	Bear Trap Creek	Low	Sturgeon Creek	Low
Elk Creek	High	Chamberlain WF	Moderate	Black Bear Creek	Low	Swamp Creek	Low
Ender's Spring Creek	High	Chicken Creek	Moderate	Blackfoot River 6	Low	Tamarack Creek	Low
Gold Creek	High	Chimney Cr. (Douglas)	Moderate	Blanchard NF	Low	Theodore Creek	Low
Gold Creek, W,F	High	Clearwater Section 1	Moderate	Broadus Creek	Low	Uhler Creek	Low
Hoyt Creek	High	Clearwater Section 5	Moderate	Buck Creek	Low	Vaughn Creek	Low
Kleinschmidt Cr.	High	Cottonwood Cr. (Nev.)	Moderate	Burnt Bridge Creek	Low	Ward Creek	Low
Landers Fork	High	Douglas Creek	Moderate	Chimney Cr. (Nevada)	Low	Warren Creek, Doney Lake trib	Low
Lincoln Spring Cr.	High	Dry Fork of the North Fork	Moderate	Clear Creek	Low	Washoe Creek	Low
Marshall Creek	High	East Fork of Monture	Moderate	Cold Brook Creek	Low	Wedge Creek	Low
McCabe Creek	High	East Twin Creek	Moderate	Colt Creek	Low		
McElwain Creek	High	Fawn Creek	Moderate	Cooney Creek	Low		
Monture Creek below the Falls	High	Findell Creek	Moderate	Dobrota Creek	Low		
Morrell Creek	High	Finley Creek	Moderate	Drew Creek	Low		
N.F. Placid Creek	High	Fish Creek	Moderate	East Fork of North Fork	Low		
Nevada Spring Cr.	High	Hayden Creek	Moderate	Finn Creek	Low		
North Fork below the Falls	High	Hogum Creek	Moderate	First Creek	Low		
Owl Creek	High	Inez Creek	Moderate	Frazier Creek	Low		
Poorman Creek	High	Jacobsen Spring Creek	Moderate	Frazier Creek, NF	Low		
Rock Creek	High	Jefferson Creek	Moderate	Gallagher Creek	Low		
Salmon Creek	High	Johnson Creek	Moderate	Game Creek	Low		
Saurekraut Creek	High	Keep Cool Creek	Moderate	Gleason Creek	Low		
Shanley Creek	High	Little Fish Creek	Moderate	Grantier Spring Cr.	Low		
Snowbank Creek	High	Lodgepole Creek	Moderate	Grouse Creek	Low		
Spring Cr.(Cottonwood)	High	Lost Horse Creek	Moderate	Halfway Creek	Low		
Spring Creek (N.F.)	High	Moose Creek	Moderate	Horn Creek	Low		
Trail Creek	High	Mountain Creek	Moderate	Humbug Creek	Low		
W.F. Clearwater	High	Murphy Creek	Moderate	Indian Creek	Low		
Warren Creek	High	Murray Creek	Moderate	Little Moose Creek	Low		
Willow Cr. (lower)	High	Nevada Cr. (lower)	Moderate	Lost Pony Creek	Low		
Yourname Creek	High	Nevada Cr.(upper)	Moderate	Lost Prairie Creek	Low		

Table 3. Streams arranged alphabetically and sorted by biological (high, moderate and low) classification groupings.

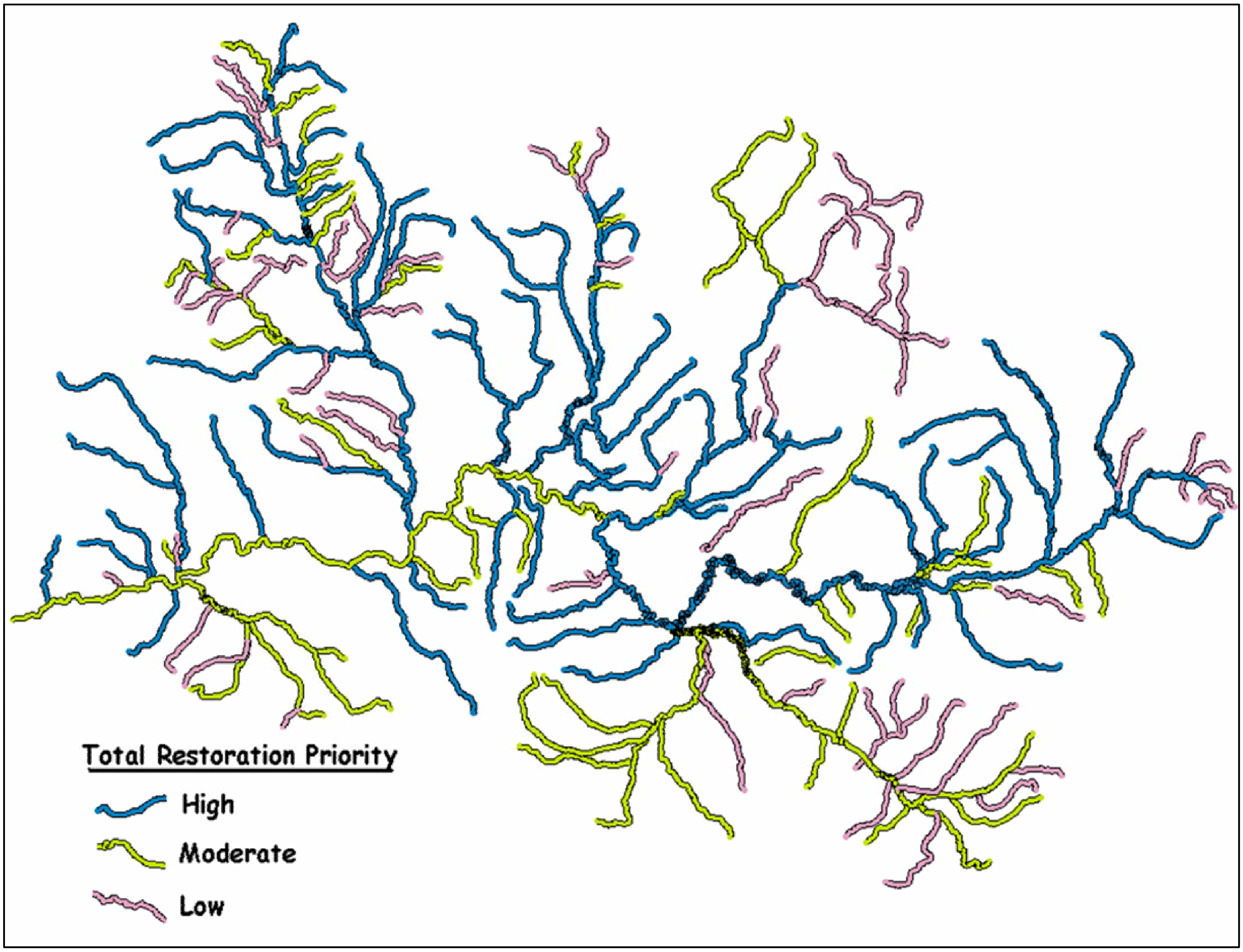

Figure 4. Total restoration priorities. This map is classified by high, moderate and low scores. In addition to the biological scores, the social scores influence this classification (Table 4).

STRATEGY FOR RECOVERY

A core area represents the closest approximation of a biologically functioning unit for bull trout. The combination of core habitat (*i.e.*, habitat that could supply all elements for the long-term security of bull trout, including for both spawning and rearing, as well as for foraging, migrating, and overwintering) and a core population (*i.e*., bull trout inhabiting a core habitat) constitutes the basic core area unit on which to gauge recovery within a recovery unit.

In the Clark Fork Recovery Unit (Table 2), core areas were most easily delineated for adfluvial populations (*e.g.*, typically the lake where adults reside and interconnected watershed upstream). For fluvial or anadromous populations, delineating core areas requires that some judgment calls be made in determining the extent of historical and current connectivity of migratory habitat, while considering natural and manmade barriers, survey and movement data, and genetic analysis. For resident populations, we must consider whether local populations are remnants from previously existing migratory bull trout and whether reconnecting fragmented habitat would restore a migratory core area. Overall, the hierarchy of population units was mutually exclusive both within a level (*e.g.*, core areas did not overlap) and among levels (*e.g.*, a core area did not occur within portions of more than one recovery unit or subunit).

Table 2. List of local populations (in bold) by core area, in the Clark Fork Recovery Unit. Streams designated by (mc) are migratory corridors only and are not considered to host their own local population.

RECOVERY UNIT AND SUBUNIT	CORE AREA	LOCAL POPULATION

Clark Fork RU
 	
Upper Clark Fork RSU
	Clark Fork River Section 1
	
	(Upstream of Milltown Dam)
		Clark Fork River
		    Warm Springs Creek
		    Racetrack Creek
		    Little Blackfoot River
		    Flint Creek
		        Boulder Creek
		    Harvey Creek

	Rock Creek	**Rock Creek**
		    Middle Fork Rock Creek
		        East Fork Rock Creek
		    West Fork Rock Creek
		        Ross Fork Rock Creek
		    Upper Willow Creek
		    Stony Creek
		    Wyman Creek
		    Hogback Creek
		    Cougar Creek
		    Wahlquist Creek
		    Butte Cabin Creek
		    Welcome Creek
		    Ranch Creek
		    Brewster Creek
		    Gilbert Creek

	Blackfoot River	**Blackfoot River**
		    Landers Fork
		    North Fork Blackfoot River
		    Monture Creek
		    Cottonwood Creek
		    Belmont Creek
		    Gold Creek

	Clearwater River and Clearwater lake chain	**Clearwater River** (upstream of Salmon Lake)
		    West Fork Clearwater River
		    Deer Creek
		    Morrell Creek
		    Owl Creek (mc)
		        Placid Creek

<table>
<tr><th>RECOVERY UNIT AND SUBUNIT</th><th>CORE AREA</th><th>LOCAL POPULATION</th></tr>
<tr><td></td><td>Clark Fork River Section 2

(Milltown Dam to Flathead River)</td><td>Clark Fork River (mc)
Rattlesnake Creek
Petty Creek
Fish Creek
Trout Creek
Cedar Creek
St. Regis River</td></tr>
<tr><td></td><td>West Fork Bitterroot River</td><td>**All tributaries** upstream of Painted Rocks Dam</td></tr>
<tr><td></td><td>Bitterroot River</td><td>**West Fork Bitterroot River**
(downstream of Painted Rocks)
East Fork Bitterroot River
Warm Springs Creek
Bitterroot River
Sleeping Child Creek
Skalkaho Creek
Blodgett Creek
Fred Burr Creek
Burnt Fork Creek</td></tr>
<tr><td>Clark Fork RU

Lower Clark Fork RSU</td><td>Lower Flathead River</td><td>Mission Creek (mc)
Post Creek (trib. to McDonald Lake)
Mission Creek (trib. to Mission Reservoir)
Dry Creek (trib. to Tabor (St. Marys) Res.)
Jocko River
South Fork Jocko River
Middle Fork Jocko River
North Fork Jocko River</td></tr>
<tr><td></td><td>Clark Fork River Section 3
(Flathead River to Thompson Falls Dam)</td><td>Clark Fork River (mc)
Thompson River (mc)
Fishtrap Creek
West Fork Thompson River</td></tr>
<tr><td></td><td>Noxon Rapids Reservoir</td><td>**Prospect Creek**
Graves Creek
Vermillion River</td></tr>
<tr><td></td><td>Cabinet Gorge Reservoir</td><td>**Rock Creek**
Bull River</td></tr>
</table>

RECOVERY UNIT AND SUBUNIT	CORE AREA	LOCAL POPULATION
	Lake Pend Oreille (LPO)	**Clark Fork River** **Twin Creek** **Lightning Creek** **Rattle Creek** **Wellington Creek** **Porcupine Creek** **East Fork Lightning Creek** **Johnson Creek** (trib. to LPO) **Gold Creek** (trib. to LPO) **North Gold Creek** (trib. to LPO) **Granite Creek** (trib. to LPO) **Trestle Creek** (trib. to LPO) **Pack River** (trib. to LPO) **Grouse Creek** **Priest River** East River (mc) Middle Fork East River (mc) Uleda Creek Tarlac Creek
Clark Fork RU Flathead RSU	Frozen Lake	**Unnamed headwater tributary** (and stream flowing out of Frozen Lake)
	Upper Kintla Lake	**Kintla Creek** (trib. to Upper Kintla Lake)
	Kintla Lake	**Kintla Creek** (trib. to Kintla Lake)
	Akokala Lake	**Akokala Creek** (trib. to Akokala Lake)
	Bowman Lake	**Bowman Creek** (trib. to Bowman Lake)
	Cerulean Lake Quartz Lake Middle Quartz Lake	**Quartz Creek** (trib. to Middle Quartz Lake)
	Lower Quartz Lake	**Quartz Creek** (trib. to Lower Quartz Lake)
	Cyclone Lake	**Cyclone Creek** (entire drainage)
	Logging Lake	**Logging Creek** (trib. to Logging Lake)
	Trout Lake	**Camas Creek** (trib. to Trout Lake)
	Arrow Lake	**Camas Creek** (trib. to Arrow Lake)
	Isabel Lake(s)	**Park Creek** (trib. to Lower Isabel Lake)
	Harrison Lake	**Harrison Creek** (trib. to Harrison Lake)
	Lincoln Lake	**Lincoln Creek** (trib. to Lincoln Lake)

RECOVERY UNIT AND SUBUNIT	CORE AREA	LOCAL POPULATION
	Lake McDonald	**McDonald Creek** (trib. to Lake McDonald)
	Doctor Lake	**Doctor Creek** (trib. to Doctor Lake)
	Big Salmon Lake	**Big Salmon Creek** (trib. to Big Salmon Lake)
	Hungry Horse Reservoir	South Fork Flathead River (mc) **Danaher Creek** **Youngs Creek** **Gordon Creek** **White River** **Little Salmon Creek** **Bunker Creek** **Spotted Bear River** **Sullivan Creek** (trib. Hungry Horse Res.) **Wheeler Creek** (trib. H. Horse Res.) **Wounded Buck Creek** (trib. H. Horse Res.)
	Upper Stillwater Lake	**Stillwater River** (trib. to Upper Stillwater Lake)
	Whitefish Lake	**Swift Creek** (trib. to Whitefish Lake)
	Upper Whitefish Lake	**East Fork Swift Creek** (trib. and downstream)
	Lindbergh Lake	**Swan River** (trib. to Lindbergh Lake)
	Holland Lake	**Holland Creek** (trib. to Holland Lake)
	Swan Lake	Swan River (mc) **Elk Creek** **Cold Creek** **Jim Creek** **Piper Creek** **Lion Creek** **Goat Creek** **Woodward Creek** **Soup Creek** **Lost Creek**

RECOVERY UNIT AND SUBUNIT	CORE AREA	LOCAL POPULATION
	Flathead Lake	Flathead River (mc) **North Fork Flathead River** (U.S. / B.C.) **Howell Creek** (B. C.) **Kishinehn Creek** (B. C.) **Trail Creek** **Whale Creek** **Red Meadow Creek** **Coal Creek** **Big Creek** Middle Fork Flathead River (mc) **Strawberry Creek** (includes Trail) **Bowl Creek** **Clack Creek** **Schafer Creek** (includes Dolly Varden) **Morrison Creek** (Includes Lodgepole) **Granite Creek** **Long Creek** **Bear Creek** **Ole Creek** **Park Creek** **Nyack Creek**
Clark Fork RU Priest RSU	Priest Lakes	**Upper Priest River** **Hughes Fork** **Gold Creek** **Trapper Creek** (trib. to Upper Priest Lake) **Lion Creek** (trib. to Priest Lake) **Two Mouth Creek** (trib. to Priest Lake) **Granite Creek** (trib. to Priest Lake) **North Fork Granite Creek** **South Fork Granite Creek** **Indian Creek** (trib. to Priest Lake) **Kalispell Creek** (trib. to Priest Lake) **Soldier Creek** (trib. to Priest Lake)

Recovery Goals and Objectives

The specific goal of the bull trout recovery plan is to **ensure the long-term persistence of self-sustaining, complex, interacting groups of bull trout distributed throughout the Clark Fork River basin so that the species can be delisted.** Specifically, the recovery subunit teams for the four Clark Fork River subunits (Upper Clark Fork, Lower Clark Fork, Flathead, and Priest) adopted the goal of **a sustained net increase in bull trout abundance, and increased distribution of some local populations, within existing core areas in this recovery unit (as measured by standards accepted by the recovery subunit teams, often referred to collectively as the Clark Fork Recovery Unit Teams).**

- Maintain current distribution of bull trout and restore distribution in previously occupied areas within the Clark Fork Recovery Unit.

- Maintain stable or increasing trends in abundance of bull trout in each subunit of the Clark Fork Recovery Unit.

- Restore and maintain suitable habitat conditions for all bull trout life history stages and strategies.

- Conserve genetic diversity and provide opportunity for genetic exchange.

Within that general guidance, the Clark Fork Recovery Unit Teams developed specific recovery criteria for the Clark Fork Recovery Unit. Bull trout are distributed among about 150 local populations within 38 core areas of the recovery unit (see Table 2). As more information on fish distribution and genetics is collected and analyzed, the number of local populations identified will probably increase. In this recovery unit, the historical distribution of bull trout is relatively intact, and no vacant core habitat is recommended at this time for reestablishment of extirpated local populations. Instead, emphasis is placed on securing the existing distribution within core areas and increasing the abundance and connectivity of local populations.

The Upper Clark Fork, Lower Clark Fork, Flathead, and Priest Subunit Recovery Teams adopted the following objective for the Clark Fork Recovery Unit:

> **A sustained net increase in bull trout abundance, and increased distribution of some local populations, within existing core areas in this recovery unit (as measured by standards that the Clark Fork Recovery Unit Teams develop).**

To assess progress toward this objective, each recovery subunit team adopted recovery criteria for its respective subunit. Relevant numerical standards are presented in Table 3. The standards for adult abundance, presented in Table 3, are based in part on recent historical information about the size of the adult population, as well as its potential, given the extent of the interconnected watershed.

Inherent stochastic, as well as genetic, risks are broadly acknowledged to be associated with low population levels of any species, but, to date, there has been a great deal of uncertainty about the proper application of theoretical population standards to bull trout. Rieman and Allendorf (2001) proposed that 1,000 spawning adults is a cautious management goal for long-term maintenance of genetic variation in a core area population of bull trout. The Clark Fork Recovery Unit Teams estimate that, of the 38 core areas identified in the Clark Fork Recovery Unit, only about 10 core areas have the potential to support 1,000 or more adult bull trout, even under recovered conditions.

Based in part on the analysis of Rieman and Allendorf (2001), the Clark Fork Recovery Unit Teams also assumed that a core area cannot maintain genetic viability for even the short term with spawning populations of fewer than roughly 100 adults. Rieman and Allendorf (2001) concluded that a cautious interpretation would be that approximately 100 adult bull trout, spawning each year, would be required to minimize the risk of inbreeding in a population. For some of the isolated core areas in the Clark Fork Recovery Unit, even this level of population abundance will be difficult to attain.

Table 3. Numeric standards necessary to achieve recovered abundance of bull trout in primary and secondary core areas of the Clark Fork Recovery Unit of the Columbia River drainage

CORE AREAS	**Existing Number (Estimated) Local Populations**	**Existing Number (Estimated) Local Populations with > 100**	**Recovered Minimum Number Local Populations with > 100**	**Recovered Minimum Number Core Area Total Adult Abundance**
<u>PRIMARY</u> **Upper Clark Fork River Complex** (Sections 1 and 2 combined)	13	0	5	1,000
Rock Creek	14	2	5	1,000
Blackfoot River	7	3	5	1,000
Bitterroot River	9	2	5	1,000
Lower Clark Fork River Complex (Clark Fork River Section 3, Lower Flathead River, Noxon Reservoir, and Cabinet Gorge Reservoir)	16	0	5	1,000
Lake Pend Oreille	14	3	6	2,500
Flathead Lake	19	9	10	2,500
Swan Lake	9	7	5	2,500
Hungry Horse Reservoir	10	5	5	1,000
Priest Lakes	12	0	5	1,000
TOTAL - PRIMARY CORES	**123**	**31**	**56**	**14,500**
<u>SECONDARY</u> - Clearwater River	5	0	1	Maximize with goal of > 100 in each
West Fork Bitterroot	1	1	1	
Flathead Disjuncts (22 separate adfluvial cores)	22 (1 each)	1	22 (1 each)	
TOTAL - SECONDARY CORES	**28**	**2**	**24**	**2,400**

The numerical criteria proposed by the Clark Fork Recovery Unit Teams to ensure replication of populations and to function as minimum recovery standards for adult abundance of bull trout in the Clark Fork Recovery Unit (Table 3) are based in part upon Rieman and Allendorf's (2001) estimates of the minimum population levels required for maintaining long-term genetic variability (1,000 adults) and genetic viability (100 adults). However, the Clark Fork Recovery Unit Teams also used the best professional scientific judgment of their members in setting those standards. At this time, the proposed recovery standards are based primarily on genetic concerns. Over time, protection of other ecological and biological attributes that contribute to population viability and long-term population stability will also need to be considered. Rieman and Allendorf (2001) cautioned that the guidelines they presented represent conservative minimum standards for the conservation of genetic variability and not "goals that will assure the viability of any population." They also noted that mitigation of extinction threats associated with demographic processes may require larger population sizes regardless of the genetic issues. They concluded that maintaining genetic diversity is essential, but not necessarily sufficient, for effective conservation.

It must be noted, however, that many of the small isolated populations in the Clark Fork Recovery Unit (defined below as secondary core areas) are essentially stranded local populations that have apparently persisted for a very long time, even thousands of years, at population levels very similar to current levels. Most such populations will continue to exist at a high degree of genetic risk and will be subject to high risk of extirpation from stochastic events. As more numerical data are collected and as trends are more clearly documented, the abundance standards should be further refined in their application as recovery criteria.

For purposes of recovery in this unit, the Clark Fork Recovery Unit Teams divided the entire unit into primary and secondary core areas, based mostly on the size, connectedness, and complexity of the watershed. The distinction between primary and secondary core areas indicates that a different set of standards are needed for recovery criteria, particularly for addressing abundance. The distinction does not infer a different level of importance for recovery purposes.

Primary Core Areas: Primary core areas in the Clark Fork Recovery Unit are typically located in watersheds of major river systems, often contain large lakes or reservoirs, and have migratory corridors that usually extend 50 to 100 kilometers (30 to 60 miles) or more. Each primary core area includes 7 to 19 identified local populations of bull trout. In recovered condition, a primary core area is expected to support at least 5 local populations with 100 or more adults each and to contain 1,000 or more adult bull trout in total.

The following areas have been designated as primary core areas in the Clark Fork Recovery Unit:

1. **Upper Clark Fork River** (includes two currently fragmented population segments, upstream and downstream of Milltown Dam, that are currently treated as separate core areas). Note that these core areas were historically connected and must be functionally rejoined under recovered conditions.

2. **Rock Creek**

3. **Blackfoot River**

4. **Bitterroot River**

5. **Lower Clark Fork River** (includes four currently fragmented population segments: Lower Flathead River, Thompson Falls Reservoir, Noxon Reservoir, and Cabinet Gorge Reservoir; these segments are currently treated as separate core areas). Note that these core areas were historically connected and must be functionally rejoined under recovered conditions.

6. **Lake Pend Oreille**

7. **Priest Lakes and Priest River**

8. **Flathead Lake**

9. **Swan Lake**

10. **Hungry Horse Reservoir**

Secondary Core Areas: Secondary core areas are based in smaller watersheds and typically contain adfluvial populations of bull trout that have become naturally isolated, with restricted upstream spawning and rearing habitat extending less than 50 kilometers (30 miles). Each secondary core areas includes one identified local population of bull trout (the Clearwater River is an exception, with as many as five local populations) and is not believed to contain sufficient size and complexity to accommodate 5 or more local populations with 100 or more adults to meet the abundance criteria defined above for primary core areas. Most secondary core areas have the potential to support fewer than a few hundred adult bull trout, even in a recovered condition. In extreme cases, secondary core areas may include small isolated lakes that occupy as little as 10 surface hectares (25 acres) and that are connected to 100 meters (about 100 yards) or less of accessible spawning and rearing habitat. In most cases, these conditions are natural, and, in some situations, these bull trout have probably existed for thousands of years with populations that seldom exceed 100 adults.

Collectively, the 24 secondary core areas may support a broad range of the genetic and phenotypic diversity that is representative of bull trout in the Clark Fork Recovery Unit.

The following areas have been designated as secondary core areas for the Clark Fork Recovery Unit:

1. **Clearwater River** and associated chain of lakes

2. **West Fork Bitterroot River** upstream of Painted Rocks Dam

3.–24. **22 lakes in the Flathead Recovery Subunit** (see Table 2)

It is noted that, for the portions of these watersheds in Montana, the primary core areas are functionally equivalent to the Restoration/Conservation Areas (also known as RCAs) designated by the Montana Bull Trout Restoration Team 2000. The secondary core areas generally represent the waters referred to as "disjunct" by the Montana Scientific Group.

Recovery Criteria

Listed below are the proposed recovery criteria for the Clark Fork Recovery Unit. As for the objectives identified in Chapter 1, the intent of recovery criteria within this recovery unit is to maximize the likelihood of persistence. Such persistence will be achieved, in part, by seeking to perpetuate the current distribution and by maintaining or increasing abundance of all local bull trout populations that are currently identified in the Clark Fork Recovery Unit (Table 2). Numerical summary of the recovery criteria is presented in Table 3.

Achieving the recovery criteria, including increasing monitoring and evaluation, will require the cooperative efforts of State, Federal, and Tribal resource management agencies; government and private landowners and water users; conservation organizations; and other interested parties. Criteria will only be achieved through reducing threats to bull trout, in part as a result of implementing tasks identified in the Recovery Measures Narrative section of this recovery plan, as well as by taking advantage of other new conservation and recovery opportunities as they arise.

1. **Distribution criteria will be met when the total number of identified local populations (currently numbering about 150) has been maintained or increased and when local populations remain broadly distributed in all existing core areas (Table 2).** This criteria must be applied with enough flexibility to allow for adaptive changes in the list of local populations (both additions and subtractions), based on best available science, as the body of knowledge concerning population and genetic inventory grows. It is also accepted that some secondary core areas may be at high risk of, or are currently undergoing, extirpation.

The distribution criteria cannot be met if major gaps develop in the current distribution of bull trout in the primary core areas of the Clark Fork Recovery Unit. Reconnecting fragmented habitat, as well as documenting new or previously undescribed local populations, should allow the documented distribution of bull trout to increase as recovery progresses. An exception to such an increase may occur in the Flathead Recovery Subunit where historical distribution is nearly intact.

The intention of the Clark Fork Recovery Unit Teams is also to maintain the existing bull trout distribution within all secondary core areas, but the teams recognize that stochastic events or deterministic processes already occurring are likely to cause a loss of distribution in some cases. The significance of such losses in the ultimate determination of whether or not distribution criteria have been met need to be judged on a case-by-case basis.

2. **Abundance criteria will be met when, in all 10 primary core areas, each of at least 5 local populations contain more than 100 adult bull trout. In the Lake Pend Oreille Core Area, each of at least 6 local populations must contain more than 100 adult bull trout. In the Flathead Lake Core Area, each of at least 10 local populations must contain more than 100 adult bull trout. In each of the 10 primary core areas, the total adult bull trout abundance, distributed among local populations, must exceed 1,000 fish; total abundance must exceed 2,500 adult bull trout in Lake Pend Oreille, Flathead Lake, and Swan Lake.**

<u>Lake Pend Oreille, Flathead Lake, Swan Lake</u>. These three core areas represent the largest natural adfluvial populations of bull trout in the Clark Fork Recovery Unit and perhaps the largest within the species' range in the United States. Each of these lakes has consistently supported spawning populations of adfluvial bull trout that produce over 500 redds annually in the currently connected portions of its watershed. Higher standards established for these three core areas reflect their higher biological potential, as well as their significance in maintaining high population levels, to conserve genetic variability within this recovery unit. These higher standards are based, in part, upon professional scientific judgment after evaluation of the existing 20 years of data for these waters.

In Lake Pend Oreille, 13 relatively complete basinwide redd counts were conducted between 1983 and 2000. These counts found an average of 657 redds in 18 streams (range 412 to 881). The 2000 redd count located 740 redds. Five drainages (Grouse, Gold, Granite, Trestle, and Lightning Creeks) consistently support over 25 redds, with the strongest (Gold and Trestle Creeks) normally exceeding 100 redds each. Johnson Creek also exceeded the 25 redd level in two of the 4 years between 1997 and 2000.

In Flathead Lake, 7 basinwide bull trout redd counts, conducted in 30 streams across 24 drainages between 1980 and 2000, found an average of 628 redds (range 236 to 1,156). The most recent basinwide count in 2000 found 555 bull trout redds, reflecting a rebounding trend from lows of the 1990's. Nine drainages (Big, Coal, Whale, Trail, and Howell [British Columbia] Creeks in the North Fork Flathead watershed and Ole, Morrison, Schafer, and Strawberry Creeks in the Middle Fork Flathead watershed) averaged 25 redds or more during the 21-year survey period, and several more drainages approached that level.

In the Swan Lake Core Area, basinwide redd counts were conducted annually between 1995 and 2000 and found an average of 752 bull trout redds in 10 streams across 8 drainages. Redd counts ranged from 703 to 861 during that period, and 717 redds were counted in 2000. Five drainages (Woodward, Goat, Lion, Jim, and Elk Creeks) consistently produced redd counts of 50 to 250 redds each, and 2 additional streams (Lost and Cold Creeks) produce about 20 to 30 redds.

Conversion of redd counts or other indices to adult numbers should be developed on a case-by-case basis, using the best available science and conversion factors that may be unique to each population. In many adfluvial populations, alternate-year spawning appears to be the norm. On the other hand, when Carnefix *et al.* (2001) used radio telemetry to track movements of 96 bull trout in the Rock Creek core area over a 3-year period, they concluded that nearly all of the fish they followed spawned annually.

<u>Remaining Seven Primary Core Areas</u>. In the other seven primary core areas, there are generally insufficient data over too short a period of record to provide a statistical analysis of abundance. Flathead, Pend Oreille, and Swan Lakes are thought to

represent unique situations because of the high number of extant local populations of adfluvial origin, and these lakes may not reflect the norm for the other seven primary core areas in the Clark Fork Recovery Unit. The standard criteria we have adopted for the remaining core areas are 5 local populations with 100 or more adults each and 1,000 or more adults in total.

The default abundance criteria for primary core areas—five local populations with 100 or more adults and 1,000 or more adult fish in total—is designed to protect genetic integrity and to reduce chances of stochastic extirpation by replicating local populations in these core areas. As more information becomes available, the default criteria for each primary core area should be evaluated and may be adjusted to reflect that new information. The recovery unit teams emphasize that these criteria must be adaptive if we are to fully protect and restore bull trout in this recovery unit.

> **The abundance criteria for 24 secondary core areas will be met when each of these core areas with the habitat capacity to do so supports at least 1 local population containing more than 100 adult bull trout and when total adult abundance in the secondary core areas collectively exceeds 2,400 fish.** Some of the weakest and smallest secondary core areas do not have sufficient habitat available to meet this criteria, even in a recovered condition, and these cases must be factored into the evaluation of whether or not these criteria have been attained.

Extirpation of bull trout in as many as one-fourth of the secondary core areas (6 or fewer) is expected to occur over the next 25 years, or is already in process, based upon the evaluation of existing trend and status information. This eventuality should not prevent overall abundance criteria from being attained if each of the primary core areas and the remaining secondary core areas (75 percent) meet their individual criteria. Reasonable recovery efforts must continue in all primary and secondary core areas to minimize the chance of local extirpations. Consideration must be given to using whatever means necessary to maintain or restore at-risk populations to protect the genetic and phenotypic diversity that these core areas represent in the Clark Fork Recovery Unit.

3. **Trend criteria will be met when the overall bull trout population in the Clark Fork Recovery Unit is accepted, under contemporary standards of the time, to be stable or increasing, based on at least 10 years of monitoring data.**

4. **Connectivity criteria will be met when functional fish passage is restored or determined to be unnecessary to support bull trout recovery at Milltown, Thompson Falls, Noxon Rapids, Cabinet Gorge, and Priest Lake Dams and when dam operational issues are satisfactorily addressed at Hungry Horse, Bigfork, Kerr, and Albeni Falls Dams (as identified through license conditions of the Federal Energy Regulatory Commission and the Biological Opinion of the U.S. Fish and Wildlife Service).** Restoring connectivity so that the abundance and distribution requirements above can be met will probably require remedying additional passage barriers identified as inhibiting bull trout migration on smaller streams within the Clark Fork Recovery Unit. Restored connectivity of the mainstem Clark Fork River will consolidate six existing core areas, a result of fragmentation caused by the dams, into two (recovered) core areas in the upper and lower Clark Fork River.

   a) In the Upper Clark Fork Recovery Subunit, fish passage must be provided at Milltown Dam, or the dam must be removed and the migratory corridor restored (Federal Energy Regulatory Commission relicensing process).

   b) In the Lower Clark Fork Recovery Subunit, fish passage needs must be fully evaluated at Thompson Falls, Noxon, and Cabinet Gorge Dams and be provided where determined biologically feasible and necessary (Federal Energy Regulatory Commission license conditions). Additional concerns relating to water level manipulation and flow regulation through the operations of Kerr Dam (Federal Energy Regulatory Commission license conditions) and Albeni Falls Dam (USFWS 2000) must also be evaluated and mitigative or restorative actions implemented.

   c) In the Flathead Recovery Subunit, no major barriers currently require passage. Concerns related to water level manipulation and flow regulation through the operations of Kerr (Federal Energy Regulatory Commission license conditions) and Hungry Horse (USFWS Biological Opinion) Dams must be resolved, and conditions established by Federal Energy Regulatory Commission relicensing of Bigfork Dam must be met.

d) In the Priest Recovery Subunit, fish passage needs must be fully evaluated at Priest Lake Dam (Federal Energy Regulatory Commission license), and year-round fish passage must be provided if determined biologically necessary.

In all recovery subunits, substantial gains in reconnecting fragmented habitat may be achieved by restoring passage over and around many of the barriers that are typically located on smaller streams, including water diversions, road crossings, and culverts. Such barriers on small streams are not listed individually in the recovery criteria. In fact, many have not been identified. But, they are collectively important to recovery, and some are highlighted in the recovery narrative portion of this plan. A list of all such barriers should be prepared in the first five years of implementation. Substantial progress must be made in providing passage over at least half of these sites, consistent with the protection of upstream populations of westslope cutthroat trout and other native fishes, to meet the bull trout recovery criteria for connectivity.

ACTIONS NEEDED

Recovery Measures Narrative

In this chapter and all other chapters of the bull trout recovery plan, the recovery measures narrative consists of a hierarchical listing of actions that follows a standard template. The first-tier entries are identical in all chapters and represent general recovery tasks under which specific (*e.g.*, third-tier) tasks appear when appropriate. Second-tier entries also represent general recovery tasks under which specific tasks appear. Second-tier tasks that do not include specific third-tier actions are usually programmatic activities that are applicable across the species' range; they appear in *italic type*. These tasks may or may not have third-tier tasks associated with them; see Chapter 1 for more explanation. Some second-tier tasks may not be sufficiently developed to apply to the recovery unit at this time; they appear in *a shaded italic type (as seen here)*. These tasks are included to preserve consistency in numbering tasks among recovery unit chapters and intended to assist in generating information during the comment period for the draft recovery plan, a period when additional tasks may be developed. Third-tier entries are tasks specific to the Clark Fork Recovery Unit. They appear in the Implementation Schedule that follows this section and are identified by three numerals separated by periods.

The Clark Fork Recovery Unit chapter should be updated as recovery tasks are accomplished or revised as environmental conditions change and as monitoring results or additional information become available. The Clark Fork Recovery Unit Teams should meet annually to review annual monitoring reports and summaries and to make recommendations to the U.S. Fish and Wildlife Service.

UPPER CLARK FORK RECOVERY SUBUNIT

1 Protect, restore, and maintain suitable habitat conditions for bull trout.

1.1 Maintain or improve water quality in bull trout core areas or potential core habitat.

1.1.1 Reduce general sediment sources. Stabilize roads, crossings, and other sources of sediment delivery. Implement Watershed Improvement Needs activities throughout the Bitterroot River watershed and sediment source reduction activities identified by comprehensive U.S. Forest Service survey(s) elsewhere. Priority watersheds include **Bitterroot River:** Cameron, Camper, Fred Burr, Lolo (Highway 12), Martin, Meadow, Moose, Overwhich, Piquett, and Warm Springs Creeks and the Nez Perce Fork, East Fork, and mainstem Bitterroot Rivers; **Blackfoot River:** Arrastra, Belmont, Dick, Elk, Hogum, McElwain. Moose, Murray, Nevada, Poorman, Rock, Sauerkraut, Seven Up Pete, Warm Springs, and Wilson Creeks; **Clark Fork River:** Boulder, Cedar, Dry, Fish, Flint, Racetrack, Rattlesnake, Tamarack, and Warm Springs Creeks and the St. Regis and mainstem Clark Fork Rivers; **Little Blackfoot River:** Dog, Ontario, and Telegraph Creeks and numerous sites identified in survey; **Rock Creek:** Stony and Upper Willow Creeks and Middle Fork, Ross Fork, West Fork, and mainstem Rock Creek.

1.1.2 Upgrade problem roads. Increase maintenance of extensive secondary road systems of the U.S. Forest Service, Plum Creek Timber Company, and State lands by increasing application of best management practices, with emphasis on remediation of sediment-producing hotspots and maintenance of bridges, culverts, and crossings in drainages supporting bull trout spawning and rearing. Decommission surplus forest roads, especially those that are chronic sources of sediment and/or those located in areas of highly erodible geological formations. Remove culverts and/or bridges on closed roads that are no longer maintained. Paving or graveling portions of major roads that encroach on riparian zones to reduce sediment delivery may be appropriate, but such resurfacing must be considered on a case-by-case basis along with other factors, such as the impacts of easier accessibility for anglers. Priority watersheds include

Bitterroot River: Nez Perce Fork Road (improve), Meadow and Moose Creek roads in the East Fork, roads along the mainstem and Slate Creek in the West Fork Bitterroot River, and Skalkaho Highway; **Blackfoot River:** Poorman Creek (pave portions of Stemple Pass Road to reduce sediment delivery to the creek) and South Fork Poorman Creek (reroute a portion of the county road up the creek to the hillside to eliminate one culvert and three fords within a 0.4-kilometer [0.25-mile] stream reach); **Clark Fork River:** Fish Creek Road, State Highway 1 along Flint Creek, I-90 corridor, Upper Warm Springs Creek Road, Foster Creek, Storm Lake Road, and South Boulder Creek Road; **Rock Creek:** Skalkaho Highway (State Highway 38) along the West Fork, mainstem Rock Creek Road (needs management plan), Copper Creek, and Upper Willow Creek.

1.1.3 Clean up mine waste. Control mining runoff by removing or stabilizing mine tailings and waste rock deposited in the stream channel and floodplains and by restoring stream channel function. Priority watersheds include **Bitterroot River:** Hughes Creek in the West Fork Bitterroot, Stansbury Vermiculite Mine; **Blackfoot River:** Beartrap, Day Gulch, Douglas, Elk, Jefferson, Poorman, Sandbar (tributary to Willow), Sauerkraut, Seven Up Pete, Washington, Washoe, West Fork Ashby, and Willow Creeks and the mainstem Blackfoot River (downstream of the Mike Horse Dam that partially washed out in 1975); **Clark Fork River:** Dunkleberg (Forest Rose), Douglas (Wasa), Boulder (Nonpariel site), Cedar, Ninemile, Quartz, and Trout Creeks and the St. Regis River; **Little Blackfoot River:** Charter Oak, Golden Anchor, Ontario, and numerous other mine sites; **Rock Creek:** Frog Pond basin and sites in Middle Fork Rock Creek and Stony Creek drainages.

1.1.4 Implement Atlantic Richfield Corporation mitigation. Implement mitigation activities resulting from the Atlantic Richfield

Corporation settlement for heavy metals contamination of at least 562 kilometers (349 miles) of streams and 5,000 hectares (13,000 acres) of the Clark Fork River floodplain between Warm Springs Creek and Milltown Reservoir from past mining and ore-processing activities in the Butte and Anaconda areas. Impacts to surface water, streambed sediments, benthic macroinvertebrates, trout populations, riparian wildlife, and vegetation have been documented in the Clark Fork and Blackfoot River watersheds, and a mitigation plan is being developed through an advisory board process.

1.1.5 Monitor McDonald Gold Mine. Monitor the application status of the former McDonald Gold Mine near Lincoln and, if mine operations move forward, implement mitigation actions to reduce the potential negative effects on water quality and quantity.

1.1.6 Restore fish passage at Milltown Dam. Monitor and participate (representing bull trout concerns) in Superfund processes designed to decide the fate of Milltown Dam and the heavy metal deposits stored behind it. Fully restoring fish passage and eliminating the threat of toxic sediment discharge during runoff events are important elements for reducing fragmentation and supporting bull trout recovery.

1.1.7 Assess and mitigate nonpoint thermal pollution. Assess and attempt to mitigate effects on bull trout from thermal increases (nonpoint sources) that negatively impact receiving waters and migratory corridors downstream. Priority watersheds include **Bitterroot River:** Blodgett, Fred Burr, Kootenai, Roaring Lion, Lolo, Sawtooth, Skalkaho, Sleeping Child, and Tin Cup Creeks and the mainstem and East Forks of the Bitterroot River; **Blackfoot River:** Cottonwood (near Helmville), Douglas, Elk, Nevada, Nevada Spring, Union, and Willow (near Sauerkraut) Creeks and the Clearwater River; **Clark Fork River:** Fish, Flint, Ninemile, Petty Creeks and the entire mainstem of the Clark Fork River; **Little Blackfoot River:** throughout the drainage; **Rock Creek:** Upper Willow Creek.

1.1.8 Reduce nutrient input. Reduce nutrient delivery throughout the Bitterroot and Clark Fork River watersheds by improving sewage disposal, agricultural practices, and silvicultural practices.

1.1.9 Implement water quality regulations. Enforce water quality standards and implement a total maximum daily load program.

1.1.10 Minimize recreational development in bull trout spawning and rearing habitat. Minimize impacts from expansion or development of new golf courses, ski areas, campgrounds, fishing access sites, and second home or other recreational developments in the corridors of bull trout spawning and rearing streams.

1.2 Identify barriers or sites of entrainment for bull trout and implement tasks to provide passage and eliminate entrainment.

1.2.1 Eliminate entrainment in diversions. Screen both water diversions and irrigation ditches to reduce entrainment losses or eliminate unneeded diversions. Priority watersheds include **Bitterroot River:** Bass, Blodgett, Burnt Fork, Chaffin, Fred Burr, Hughes, Kootenai, Lolo, Mill, Roaring Lion, Sawtooth, Skalkaho, Sleeping Child, Sweathouse, Tin Cup, and Tolan Creeks and the East Fork, Nez Perce Fork, and West Fork Bitterroot Rivers; **Blackfoot River:** Poorman Creek and mainstem Blackfoot River between Landers Fork and Poorman Creeks and between Lincoln and Nevada Creeks; **Clark Fork River:** Twin Lakes Creek in the Warm Springs Creek drainage, Flint Creek watershed, the mainstem Clark Fork River (five Missoula Valley diversions); **Little Blackfoot River:** Dog Creek and other creeks not yet evaluated; **Rock Creek:** East Fork Rock

Creek (Flint Creek Diversion), Ross Fork Rock Creek (diversions), and Upper Willow Creek (diverions).

1.2.2 Provide fish passage around diversions. Install appropriate fish passage structures around diversions and/or remove related migration barriers to facilitate bull trout movement. Priority watersheds include **Bitterroot River:** Burnt Fork, Fred Burr, Lolo, Skalkaho (Republican Ditch and others), Sleeping Child, and Warm Springs (Highway 93 crossing) Creeks; **Clark Fork River:** Dry and Lower Willow Creeks in Flint Creek drainage and Rattlesnake, Storm Lake, and Twin Lakes Creeks in Warm Springs Creek drainage; **Little Blackfoot River:** throughout drainage (survey is needed).

1.2.3 Eliminate culvert barriers. Monitor road crossings for blockages to upstream passage and, where beneficial to native fish, replace or improve existing culverts that impede passage. Priority watersheds include **Bitterroot River:** Bugle, Hughes, Lolo, Moose, Upper Mine, and Warm Springs Creeks and the upper West Fork and Nez Perce Fork of the Bitterroot River; **Blackfoot River:** Arrastra (Section 24), Cotter (tributary to Copper Creek), Cottonwood, Hogum, Moose, Poorman, Sauerkraut, and Spring Creeks; **Clark Fork River:** Fish Creek, Tamarack Creek, and St. Regis River; **Little Blackfoot River:** Hat Creek; **Rock Creek:** Skalkaho Highway crossings on West Fork Rock Creek (Duncie Creek, Fuse Creek, and others).

1.2.4 Restore connectivity over other manmade barriers. Investigate manmade barriers that were installed to eliminate upstream fish movement through Rainy, Alva, and Inez Lakes in the Clearwater River drainage, in Harvey Creek (Upper Clark Fork River), and in any other streams. Assess advisability and feasibility of restoring passage.

1.2.5 Improve instream flows. Restore connectivity and opportunities for migration by securing or improving instream flows and/or acquiring water rights. Priority streams identified to date (see also Montana Fish, Wildlife and Parks dewatered streams list) include **Bitterroot River:** Bass, Big, Blodgett, Chaffin, Fred Burr, Kootenai, Lolo, Lost Horse, Mill, North Bear, O'Brien, Roaring Lion, Rock, Sawtooth, Skalkaho, Sleeping Child, South Bear, South Fork Lolo, Sweathouse, Sweeney, Tin Cup, Tolan, and Warm Springs Creeks and the East Fork, Burnt Fork, and mainstem of the Bitterroot River from Corvallis to Stevensville; **Blackfoot River:** Cottonwood (stream miles 9 to 11) and Poorman Creeks and the mainstem Blackfoot River between Landers Fork and Poorman Creek; **Clark Fork River:** Cedar, Dry, Grant, Petty, and Twin Lakes Creeks and the Flint Creek drainage (including Douglas and Lower Willow Creeks); **Rock Creek:** Beaver Creek (tributary to Upper Willow).

1.2.6 Consider fish salvage, as needed. Consider implementing fish salvage programs, as needed, as an interim measure to address stranding while long-term solutions are developed (*e.g.,* Blackfoot River between Landers Fork and Poorman Creeks, East Fork Rock Creek at Flint Creek diversion).

1.2.7 Consider passage around natural barriers. Evaluate and make recommendations concerning potential benefits of fish passage around, or establishment of resident bull trout populations upstream of, natural barriers as a way to conserve genetic diversity in existing bull trout populations in the following areas: **Bitterroot River:** Bass, Daly, North Lost Horse, Overwhich, and Sweathouse Creeks upstream of falls; **Blackfoot River:** Arrastra Creek (section 24), Landers Fork (Silver King Falls), and North Fork Blackfoot River above North Fork Falls.

1.3 Identify impaired stream channel and riparian areas and implement tasks to restore their appropriate functions.

1.3.1 Conduct watershed problem assessments. Identify site-specific threats (problem assessment) that may be limiting bull trout in watersheds that have not already been evaluated, including the Bitterroot River, Little Blackfoot River, middle portions of the Clark Fork River, and Rock Creek drainages.

1.3.2 Prioritize actions on waters with restoration potential. As recovery progresses, identify highest-priority actions—ones that will contribute most to recovery—on streams in the Bitterroot River drainage where bull trout occurrence is incidental (or on contributing waters with no bull trout). Areas include Bass, Bear, Big, Cameron, Camp, Chaffin, Gird, Hayes, Lost Horse, Miller, One Horse, Patte, Rye, St. Clair, Sweeney, and Willow Creeks and the West Fork Bitterroot River downstream of Painted Rocks.

1.3.3 Revegetate denuded riparian areas. Revegetate to restore shade and canopy, riparian cover, and native vegetation. Priority watersheds include **Bitterroot River:** Blodgett, Fred Burr, Hughes, Meadow, Mill, Skalkaho, Sleeping Child, and Sweathouse Creeks and the East Fork, West Fork, Burnt Fork, and mainstem of the Bitterroot River; **Blackfoot River:** the mainstem Blackfoot River between the North Fork Blackfoot River and Arrastra Creek, Dunham Creek, Landers Fork, Nevada Creek, and other sites throughout the drainage; **Clark Fork:** Cedar, Dry, Fish, Ninemile, South Fork Lower Willow, **and** Petty Creeks and the St. Regis and mainstem Clark Fork Rivers; **Little Blackfoot River:** throughout the drainage; **Rock Creek:** the East Fork, Middle Fork, and Ross Fork of Rock Creek.

1.3.4 Improve grazing practices. Reduce negative effects of grazing by improving management practices and/or fencing riparian areas.

Priority watersheds include **Bitterroot River:** Bugle, Camp (west fork), Fred Burr, Gird, Lolo, Meadow, Mill, Skalkaho, Sleeping Child, and Tolan Creeks and the Burnt Fork, East Fork, and mainstem Bitterroot River; **Blackfoot River:** the mainstem Blackfoot River (from Lincoln to mouth) and Beaver, Blanchard, Belmont, Cottonwood, Dick, Douglas, Elk, Frazier, Hogum, Humbug, Keep Cool, Kleinschmidt, McElwain, Monture, Murray, Nevada, Nevada Spring, Poorman, Rock, Sauerkraut, Shanley, Warren, Wasson, Willow, and Yourname Creeks; **Clark Fork River:** Cedar, Petty, Racetrack, Tamarack, and Twin (St. Regis River drainage) Creeks and other sites (largely private lands) throughout the upper Clark Fork River drainage; **Little Blackfoot River:** Dog, Elliston, and Hat Creeks and the mainstem Little Blackfoot River; **Rock Creek:** the entire upper drainage, especially the upper mainstem Rock Creek, Middle Fork Rock Creek, Meadow Creek, Beaver Creek, Ross Fork, Sand Basin, Stoney Creek, and U.S. Forest Service allotments on Upper Willow Creek.

1.3.5 <u>Restore stream channels</u>. Conduct stream channel restoration activities where such activities are likely to benefit native fish and only where similar results cannot be achieved by other, less costly and less intrusive means. Priority watersheds include **Bitterroot River:** Blodgett, Burnt Fork, Fred Burr, Hughes, Lolo, Mill, O'Brien, Overwhich, Skalkaho, Sleeping Child, and Sweathouse Creeks and the East Fork (Highway 93 reconstruction) and Nez Perce Fork Bitterroot Rivers; **Blackfoot River:** Cottonwood, Dunham, Kleinschmidt, Landers Fork, Moose, Rock, Sauerkraut, and Warren Creeks; **Clark Fork River:** South Fork Lower Willow Creek in the Flint Creek drainage; **Rock Creek:** Stony Creek (Moose Gulch, Shively Gulch), Upper Willow Creek (Shylo Gulch, Miners Gulch), and the East Fork and West Fork of Rock Creek (Coal Gulch).

1.3.6 Improve instream habitat. Increase or improve instream habitat by restoring recruitment of large woody debris, restoring pool development, or by initiating other appropriate activities, wherever the need is identified. Priority watersheds include **Blackfoot River:** Chamberlain and Gold Creeks, the mainstem Blackfoot River upstream of Lincoln, and the Landers Fork; **Bitterroot River:** Burnt Fork, Lolo, and Moose Creeks and the East Fork Bitterroot River downstream of Camp Creek; **Clark Fork River:** Ninemile Creek; **Little Blackfoot River:** portions of the Little Blackfoot River that have been channelized by railroad and highway development.

1.3.7 Minimize potential stream channel degradation. Ensure that negative effects on bull trout of ongoing flood control activities are minimized (*e.g.*, dredging, channel clearing, and bank stabilization on the Clark Fork, Blackfoot, and Bitterroot Rivers).

1.3.8 Manage beaver to function naturally in maintaining wetlands. Manage beaver populations to maintain wetland complexes that provide important biological filters (*e.g.*, Mike Renig Gulch in the Little Blackfoot River drainage).

1.3.9 Reduce riparian firewood harvest. Implement campaigns, such as with signs, to improve public awareness or implement regulatory actions to eliminate firewood cutting in riparian areas, especially in the Rock Creek and Skalkaho Creek drainages.

1.3.10 Reduce impacts from campsite use. Identify and mitigate impacts from concentrated use of campsites on the Burnt Fork and Skalkaho Creeks in the Bitterroot River drainage; on the North Fork and mainstem Blackfoot Rivers and Monture, Copper, and Gold Creeks; on Middle Fork and mainstem Rock Creeks; and on Racetrack Creek in the upper Clark Fork River drainage.

1.3.11 Mitigate for transportation corridor encroachment on streams. Mitigate for impacts from the legacy effects of highway and railroad encroachment, channel straightening, channel relocation, and undersized bridges on the Bitterroot River (U.S. 93), Blackfoot River (Montana 200), Clark Fork River (I-90), Lolo Creek (U.S. 12), and St. Regis River (I-90).

1.3.12 Reduce impacts to Foster Creek. Identify and mitigate potential impacts (from sediment, water use, use of riparian areas) of the Anaconda Job Corps Center development on Foster Creek in the Warm Springs Creek drainage of the upper Clark Fork River drainage.

1.4 Operate dams to minimize negative effects on bull trout.

1.4.1 Reduce reservoir operational impacts. Review reservoir operational concerns (*e.g.*, water level manipulation, minimum pool elevation) and provide operating recommendations for East Fork Reservoir (East Fork Rock Creek), Georgetown Lake (Flint Creek), Nevada Reservoir (Nevada Creek in Blackfoot River drainage), and Painted Rocks Reservoir (West Fork Bitterroot River).

1.4.2 Provide instream flow downstream of dams. Maintain or exceed established instream flows downstream of Painted Rocks Reservoir (West Fork Bitterroot River), East Fork Reservoir (East Fork Rock Creek), and Georgetown Lake (Flint Creek). Establish instream flows from high-elevation reservoirs in the Bitterroot National Forest on Bass, Big, Blodgett, Burnt Fork, Fred Burr, and Tin Cup Creeks.

1.4.3 Operate Milltown Dam to minimize impact on native fish. If the dam is not removed, operate to minimize potential for downstream discharge of heavy metal deposits in Milltown

Reservoir. Operate the dam to minimize northern pike reproduction and maximize survival and downstream passage of bull trout juveniles and adults. Restore upstream fish passage.

1.4.4 Evaluate fish passage at Painted Rocks Dam. Evaluate advisability and need for upstream fish passage at Painted Rocks Dam (West Fork Bitterroot River).

1.5 Identify upland conditions that negatively affect bull trout habitats and implement tasks to restore appropriate functions.

1.5.1 Mitigate for legacy effects of mining-related timber management practices. Continue to mitigate for legacy effects of mining-related timber harvest and for other impairment from poor silvicultural practices in the last century in the following areas: **Blackfoot River:** Bear, Belmont, Chamberlain, Deer, Keno, Marcum, McElwain, and Richmond Creeks and the North Fork Blackfoot and West Fork Clearwater Rivers; **Clark Fork River:** Fish, Rattlesnake, and Trout Creeks and the St. Regis River.

1.5.2 Monitor fire effects and mitigate effects where necessary. Monitor effects from wild fires and pursue habitat restoration actions where warranted, especially in the upper portions of the Bitterroot River drainage (where there were fires in 2000).

2 Prevent and reduce negative effects of nonnative fishes and other nonnative taxa on bull trout.

2.1 Develop, implement, and evaluate enforcement of public and private fish stocking policies to reduce stocking of nonnative fishes that affect bull trout.

2.1.1 Review fish stocking programs. Review annual fish stocking programs to minimize potential conflict with this bull trout recovery plan.

2.1.2 Regulate private fish ponds. Reduce the risk of inadvertent introduction of nonnative fish from private fish ponds by closely regulating existing permits to ensure that only permitted species are stocked and that fish barriers are maintained and by attaching conditions to future permits.

2.1.3 Encourage development of commercial sources of westslope cutthroat trout. Develop and maintain an approved and available source of genetically diverse native westslope cutthroat trout for private pond stocking. Follow stocking guidelines developed by the Montana Westslope Cutthroat Trout Technical Committee.

2.2 Evaluate policies for preventing illegal transport and introduction of nonnative fishes.

2.3 Inform the public about ecosystem concerns of illegal introductions of nonnative fishes.

2.3.1 Discourage unauthorized fish introductions. Implement educational efforts about the problems and consequences of unauthorized fish introductions.

2.3.2 Develop bull trout education program. Develop a public information program with a broad emphasis on bull trout ecology and life history requirements and with a more specific focus on regionally or locally important recovery issues.

2.4 Evaluate biological, economic, and social effects of control of nonnative fishes.

2.5 Implement control of nonnative fishes where found to be feasible and appropriate.

2.5.1 Experimentally remove established brook trout populations. Evaluate opportunities for experimentally removing brook trout from selected streams and lakes. Priority watersheds include **Bitterroot River:** Blodgett, Boulder, Fred Burr, Hughes, Kootenai, Lolo, Martin, Meadow, Mill, O'Brien, Overwhich, Piquett, Roaring Lion, Sawtooth, Skalkaho, Slate, Sleeping Child, Springer, Tin Cup, Trapper, and Warm Springs Creeks and the East Fork, Burnt Fork, and Nez Perce Fork Bitterroot Rivers; **Blackfoot River:** Cottonwood, Hogum, Nevada (upstream of Shingle Mill), Poorman, Sauerkraut, and South Fork Poorman Creeks and the North Fork Blackfoot River upstream of the falls; **Clark Fork River:** Lower Twin Lake and Storm Lake Creek in the Warm Springs Creek drainage; **Little Blackfoot River:** Bison, Hat, Elliston, and Ontario Creeks; **Rock Creek:** East Fork Reservoir and upstream waters.

2.5.2 Suppress northern pike in Clearwater Lakes chain. Continue assessment of predator–prey interactions in Clearwater Chain of Lakes, with emphasis on the northern pike threat and suppression of those populations.

2.5.3 Reduce brown trout numbers in portions of mainstem rivers. Continue to encourage harvest of brown trout in the mainstem Blackfoot, Clark Fork, and Bitterroot Rivers and in Rock Creek by maintaining liberal angling regulations.

2.6 Develop tasks to reduce negative effects of nonnative taxa on bull trout.

2.6.1 Evaluate bull trout–brown trout interaction. Evaluate the interaction between bull trout and brown trout populations in the

Blackfoot River drainage, including the potential threat of brown trout redds superimposed on bull trout redds.

3 Establish fisheries management goals and objectives compatible with bull trout recovery and implement practices to achieve goals.

3.1 Develop and implement State and Tribal native fish management plans integrating adaptive research.

3.1.1 Implement adaptive management of native fish management plans. Develop and implement native fish management plans that emphasize integration of research results into management programs.

3.1.2 Aggressively protect remaining native species complexes. Protect integrity of all intact native species assemblages, such as in Harvey Creek (upper Clark Fork River), Belmont and Copper Creeks, and the Landers Fork of the Blackfoot River, by aggressively removing any nonnative invaders.

3.2 Evaluate and prevent overharvest and incidental angling mortality of bull trout.

3.2.1 Minimize unintentional mortality of bull trout. Continue to develop and implement sport angling regulations and fisheries management plans, guidelines, and policies that minimize incidental mortality of bull trout in all waters, especially the most heavily fished reaches of Rock Creek and the Bitterroot, Blackfoot, upper Clark Fork, and Clearwater Rivers.

3.2.2 Evaluate enforcement of angling regulations and oversee scientific research. Ensure compliance with angling regulations and scientific collection policies and target bull trout spawning and staging areas for enforcement.

3.2.3 Implement angler education efforts. Inform anglers about special regulations and about how to identify bull trout and reduce hooking mortality of bull trout caught incidentally, especially in the most heavily fished migratory habitat of mainstem rivers.

3.2.4 Solicit information from commercial guides. Develop a reporting system to collect information on bull trout caught and released by commercial fishing guides on the Bitterroot River, Blackfoot River, and Rock Creek.

3.3 Evaluate potential effects of introduced fishes and associated sport fisheries on bull trout recovery and implement tasks to minimize negative effects on bull trout.

3.3.1 Evaluate site-specific conflicts with introduced sport fish. Determine site-specific level of predation, competition, and hybridization of bull trout with introduced sport fish and assess effects of those interactions, especially with brook trout, brown trout, and northern pike in the Blackfoot, Bitterroot, and Clark Fork Rivers.

3.4 Evaluate effects of existing and proposed sport fishing regulations on bull trout.

3.4.1 Evaluate effects of existing and proposed angling regulations on bull trout in heavily fished waters. Rapidly increasing angler pressure has led to increasing concerns about angling regulations, species complexes, unintentional mortality, and other angler-related issues affecting bull trout on the most heavily fished waters of Rock Creek and the Blackfoot, Bitterroot, and Clark Fork Rivers. An investigation of these issues should be made, and recommendations on how to reduce impacts to bull trout recovery should be developed and adaptively implemented.

4 Characterize, conserve, and monitor genetic diversity and gene flow among local populations of bull trout.

4.1 Incorporate conservation of genetic and phenotypic attributes of bull trout into recovery and management plans.

4.1.1 Conduct genetic inventory. Continue coordinated genetic inventory throughout recovery subunit, with emphasis on upper Clark Fork and Clearwater River drainages, to contribute to establishing a program to understand the genetic baseline and to monitor genetic changes throughout the range of bull trout (see Chapter 1 narrative).

4.2 Maintain existing opportunities for gene flow among bull trout populations.

4. 3 Develop genetic management plans and guidelines for appropriate use of transplantation and artificial propagation.

5 Conduct research and monitoring to implement and evaluate bull trout recovery activities, consistent with an adaptive management approach using feedback from implemented, site-specific recovery tasks.

5.1 Design and implement a standardized monitoring program to assess the effectiveness of recovery efforts affecting bull trout and their habitats.

5.2 Conduct research evaluating relationships among bull trout distribution and abundance, bull trout habitat, and recovery tasks.

5.2.1 Identify suitable unoccupied habitat. Identify suitable bull trout habitat that is unoccupied, if any. Within five years, complete a comprehensive list of all known passage barriers that prevent upstream-migrating bull trout from accessing suitable habitat.

5.2.2 Investigate bull trout movement and distribution. Investigate movement, distribution, and status of bull trout in the Bitterroot, middle Clark Fork, Clearwater, Little Blackfoot, and St. Regis River drainages and make recovery recommendations.

5.2.3 Evaluate importance of contributing waters. Evaluate the importance and contribution to bull trout recovery of streams with only incidental bull trout presence.

5.2.4 Map spawning habitat. Develop a comprehensive map of primary bull trout spawning reaches in tributaries for the purpose of focusing protection and recovery efforts.

5.2.5 Coordinate monitoring of fish movement. Develop a coordinated fish marking and tracking strategy (*e.g.*, standardized PIT tags and radio implant frequencies) throughout the Clark Fork River basin so that marked fish are recognized and reported when captured in other States or different project jurisdictions (*e.g.*, Lake Pend Oreille, Avista, Milltown).

5.2.6 Evaluate water temperature as a limiting factor. Evaluate water temperature as a limiting factor and/or migration barrier in the mainstem of the Bitterroot, Blackfoot, Clearwater, and Clark Fork Rivers.

5.3 Evaluate the adequacy and effectiveness of current and past best management practices in maintaining or achieving habitat conditions conducive to bull trout recovery.

5.3.1 Develop and implement best management practices for managing water diversions. Establish best management practices for constructing, maintaining, and operating water diversion structures.

5.3.2 Implement best management practices for grazing in riparian zones. Establish best management practices for grazing management and establish a monitoring program in riparian zones.

5.3.3 Expand monitoring of forestry best management practices. Continue and expand monitoring of compliance and effectiveness of Montana Forestry best management practices and recommend adjustments to best management practices to correct any documented deficiencies.

5.3.4 Protect groundwater inflow sources. Inventory and protect important stream reaches with groundwater inflow.

5.4 Evaluate effects of diseases and parasites on bull trout and develop and implement strategies to minimize negative effects.

5.4.1 Monitor fish health in private hatcheries. Closely regulate fish health in private hatcheries that supply fish for private ponds (State and Federal hatcheries are already closely monitored).

5.4.2 Prevent spread of fish pathogens. Survey and evaluate fish health before implementing major fish passage projects.

5.4.3 Evaluate effects of whirling disease on bull trout. Continue experimental evaluation (and limited field survey) of the potential effects of whirling disease on bull trout.

5.5 Develop and conduct research and monitoring studies to improve information concerning the distribution and status of bull trout.

5.6 Identify evaluations needed to improve understanding of relationships among genetic characteristics, phenotypic traits, and local populations of bull trout.

5.6.1 Investigate status of migratory and resident life history forms. Investigate the genetic and/or behavioral basis of resident and migratory bull trout in the Bitterroot River basin.

5.6.2 Research origin of migratory bull trout at Milltown Dam. Continue to investigate life history and spawning habitat of bull trout congregating below Milltown Dam.

6 Use all available conservation programs and regulations to protect and conserve bull trout and bull trout habitats.

6.1 Use partnerships and collaborative processes to protect, maintain, and restore functioning core areas for bull trout.

6.1.1 Support watershed group restoration efforts. Support collaborative efforts by local watershed groups already established in Montana, such as the Bitterroot Water Forum, Blackfoot Challenge, Trout Unlimited Chapters, and Clark Fork Coalition, to accomplish site-specific protection and restoration activities consistent with this recovery plan.

6.1.2 Protect habitat. Provide long-term habitat protection through purchase, conservation easements, watershed restoration, management plans, land exchanges, and other methods. Opportunities have been identified on the Blackfoot River and the Little Blackfoot River upstream of Hwy. 12 crossing; Hughes Creek in the West Fork Bitterroot River drainage; and Fish Creek, the mainstem Clark Fork River, and Rock Creek.

6.1.3 Integrate watershed restoration efforts on public and private lands. Integrate watershed analyses and restoration activities on public lands in the headwaters and on private lands lower in the watersheds to ensure activities are complementary for bull trout restoration (*e.g.*, Bitterroot River, Dunham Creek, Fish Creek, Landers Fork of the Blackfoot River, Rattlesnake Creek, Rock Creek, and Warm Springs Creek).

6.1.4 Develop strategy for implementation participation. Develop participation plans to support implementation or recovery actions in the Upper Clark Fork Recovery Subunit.

6.2 Use existing Federal authorities to conserve and restore bull trout.

6.2.3 Complete Federal Energy Regulatory Commission licensing of Milltown Dam. Complete Federal Energy Regulatory Commission licensing or decommissioning of Milltown Dam (beyond current license expiration date of December 31, 2006) and implement mitigation plan and/or dam removal.

6.2.4 Implement Plum Creek Habitat Conservation Plan. Carry out compliance monitoring and U.S. Fish and Wildlife Service commitment to adaptive management planning under the Plum Creek Native Fish Habitat Conservation Plan, primarily applicable to waters of the Blackfoot River and upper Clark Fork River watersheds.

6.3 Evaluate enforcement of existing Federal and State habitat protection standards and regulations and evaluate their effectiveness for bull trout conservation.

6.3.1 Fully implement State habitat protection laws. Fully implement the Montana Streamside Management Zone Law (1993), Montana Stream Protection Act (1965), and Montana Natural Streambed and Land Preservation Act (1975) to maximize legal protection of bull trout habitat under State law and evaluate the effectiveness of these laws in conserving bull trout habitat.

6.3.2 Encouragefloodplain protection. Encourage local governments to develop, implement, and promote restrictive regulations for floodplains to mitigate extensive habitat loss and stream encroachment from rural residential development throughout the Bitterroot, Blackfoot, and upper Clark Fork River drainages because these and other effects of development exacerbate temperature problems, increase nutrient loads, decrease bank stability, alter instream and riparian habitat, and change hydrologic response of affected watersheds.

7 Assess the implementation of bull trout recovery by recovery units and revise recovery unit plans based on evaluations.

LOWER CLARK FORK RECOVERY SUBUNIT

1 Protect, restore, and maintain suitable habitat conditions for bull trout.

1.1 Maintain or improve water quality in bull trout core areas or potential core habitat.

1.1.1 Reduce general sediment sources. Stabilize roads, crossings, and other sources of sediment delivery. Priority watersheds include **Idaho:** Gold, Granite, Grouse, Lightning, North Gold, and Trestle Creeks and the Middle Fork East River and Pack River; **Montana:** Elk, Fish Trap (Thompson River tributary), Marten, Pilgrim, Prospect, Rock, Snake Swamp, West Fork Elk (Bull River tributary) Creeks and the Bull, South Fork Bull, South Fork Jocko, Thompson, Vermilion, and West Fork Thompson Rivers.

1.1.2 Upgrade problem roads. Increase maintenance of extensive secondary road systems—U.S. Forest Service, Plum Creek Timber Company, and State lands—by increased application of best management practices, with emphasis on remediating sediment-producing hotspots and on maintaining bridges,

APPENDIX L

RESTORATION EFFECTIVENESS MONITORING PROTOCOL FOR THE BLACKFOOT WATERSHED

RESTORATION EFFECTIVENESS MONITORING PROTOCOL FOR THE BLACKFOOT WATERSHED

1.0 INTRODUCTION

The Blackfoot River watershed has been the focus of extensive stream restoration activities over the past several years, with the scope of restoration activities increasing in recent years. Restoration activities undertaken by various entities, including but not limited to, Montana Department of Fish Wildlife and Parks (FWP), the Blackfoot Challenge, and the Big Blackfoot Chapter of Trout Unlimited (BBCTU) have focused on fisheries restoration, water conservation, and mitigation of impaired streams as identified on the State of Montana 303(d) list. Due to the increasing scope of restoration activities in the watershed, and specific needs tied to certain restoration project funding sources, the restoration partners have identified a growing need for an established restoration monitoring program and protocol designed to document the effectiveness of restoration activities in the watershed in terms of immediate and long-term attainment of restoration goals.

This document presents a conceptual plan for restoration effectiveness monitoring in the Blackfoot Watershed. The purpose of this Restoration Effectiveness Monitoring Plan is to provide a common reference for restoration planners to determine appropriate monitoring parameters/activities and protocol to utilize on a given restoration project. Specific objectives of this document include:

- Promoting inclusion of appropriate pre- and post-restoration monitoring in ALL stream and riparian area restoration projects within the watershed;
- Establishing monitoring protocol and procedures to be employed for restoration monitoring to ensure consistency in data collection efforts between projects and between various organizations/agencies involved with stream and riparian area restoration; and
- Providing a tool for use in the planning and design phase of restoration projects throughout the watershed.

Attainment of these objectives will not only assist project planners in the design and implementation of appropriate restoration effectiveness monitoring on their projects, but should also result in a greater degree of consistency in the scope of monitoring, and monitoring methodologies employed, both from project to project and through time. This in turn will lead to development of a comprehensive database of restoration-related data and information collected under consistent methods, thus facilitating informational sharing among projects and, potentially, reduced monitoring costs in the long-term.

This Restoration Effectiveness Monitoring Plan is intended to serve as a guide to restoration project monitoring. The plan outlines various monitoring activities that should be considered for inclusion on restoration projects, depending on the restoration project objectives and/or impairment conditions associated with the project. The specific scope of monitoring to be applied for a given project should be determined by the individuals and agencies involved in the project, with the scope of monitoring dependent on specific project needs as well as possible budget constraints. However, it is hoped that through consultation of this plan, all restoration projects will be monitored to the extent necessary to allow determination of the effectiveness of the restoration action, with a level of consistency in monitoring methodology so that data may be used by other restoration and land use planners in the watershed.

This document is designed to be a quick reference for restoration planners evaluating potential monitoring needs for their projects. Section 2 outlines monitoring parameters/activities, such as stream substrate characterization or water temperature monitoring, that may be applicable to restoration projects based on project objectives and goals, and stream impairment conditions. Section 3 summarizes actual protocol, or methodologies, to be employed for specific parameter measurement (i.e., streamflow measurement by USGS protocol).

2.0 RESTORATION EFFECTIVENESS MONITORING METRICS

Appropriate measures of restoration effectiveness will vary depending on the particular goals and objectives of the restoration project, be they restoration of aquatic habitat, maintenance of in-stream flow, or irrigation efficiency improvements. The various types of metrics used to assess the status of a water body generally include biological, physical, and chemical measurements. Table 2-1 shows suggested metrics to be used for restoration projects depending on the restoration goals and/or the particular water body impairment.

Biological metrics are particularly appropriate for many types of restoration effectiveness monitoring, due to their capacity to provide information on overall stream health by integrating the effects of many potential sources of impairment. For example, fish populations and macroinvertebrate community structure and abundance both will respond favorably to improvements in aquatic habitat and riparian conditions, as well as reductions in loads of specific pollutants such as nutrients or metals. Measurements of pollutant concentrations through water quality sampling should, if possible, be supplemented by one or more biological metrics to provide a more comprehensive representation of stream status and response to restoration activities. Note that biological metrics are typically more labor-intensive and expensive to conduct than water quality sampling; therefore, careful planning is important for conducting biological surveys.

As shown in Table 2-1, each restoration project category has multiple monitoring metrics identified as potentially applicable with some categories, such as "Excess Siltation in Stream Substrate", showing the majority of metrics as applicable. This does not mean that all of the identified monitoring metrics need be, or should be, included. Instead, a suitable suite of parameters should be selected by project planners based on the specific project scope and needs, as well as availability of funding. It should also be noted that the list of monitoring metrics in Table 2-1 is by no means exhaustive. For instance, the methods included for quantifying stream substrate composition (percent fine content measurements and McNeil core sampling), represent only two of numerous methods available for stream substrate characterization. Other common methods, such as Wohlman Pebble Counts and Riffle Stability Index, may be equally as applicable. However, the list of metrics included in this document are intended to provide a reasonable spectrum of measurement options, from relatively simple semi-qualitative methods to more intensive methods, to fit most project needs and budgets. The number of methods has intentionally been kept short in order to promote consistency in the data collection methodology throughout the watershed. Specific monitoring protocols are summarized in Section 3.

TABLE 2-1. RESTORATION EFFECTIVENESS MONITORING METRICS APPLICABLE TO VARIOUS RESTORATION OBJECTIVES/IMPAIRMENT SOURCES

METRICS	RESTORATION PROJECT OBJECTIVES/IMPAIRMENT CAUSES							
	In-Stream Flow Maintenance	Habitat Restoration	Reduce Substrate Siltation	Reduce Thermal Modification	Reduce Ag Runoff	Riparian Area Restoration	Reduce Elevated Metals	Reduce Elevated Nutrients
BIOLOGICAL METRICS								
Fish Population Surveys	X	**X**	X	X	X	X		
Redd Counts	X	**X**	X	X	X	X		
Macroinvertebrate Sampling	X	X	X	X	X	X	X	X
Periphyton Sampling	X	X	X	X	**X**			X
Chlorophyll-a					**X**			X
PHYSICAL PARAMETERS								
Habitat Assessments	X	**X**				**X**		
Riparian Assessment		X	X	X	X	**X**		
Water Temperature	X	X	X	**X**	X	**X**		
Flow Monitoring	**X**			X			**X**	**X**
Photo Points	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
WATER CHEMISTRY								
TSS Samples			**X**		**X**		X	X
Nutrient Sampling					**X**			**X**
Metals Sampling							**X**	
STREAM SUBSTRATE COMPOSITION								
McNeil Core Samples		X	**X**			X		
Percent Fine Sediment Content		X	**X**			X		

X – Metrics marked in bold should be given primary consideration for monitoring
TSS- Total Suspended Sediment

3.0 RESTORATION MONITORING PROTOCOL

The following monitoring protocols represent methodologies and practices generally accepted and commonly used for biological, physical and chemical characterization of aquatic and riparian systems. These protocols have been compiled by the Blackfoot Challenge, with input from various restoration partners. For instance, the Department of Fish, Wildlife and Parks provided methodologies for fish population surveys, redd counts, habitat assessments, and water temperature monitoring. FWP has been the primary entity performing these monitoring activities in the past, and should be consulted when these monitoring activities are being considered for restoration projects.

3.1 BIOLOGICAL MONITORING

3.1.1 Fish Population Surveys

Depending on the survey objectives, fish population surveys take many different forms. Methods generally involve fish collections using traps, seines, electrofishing or other methods. In some cases, population surveys may involve direct observations of fish (eg. Snorkeling) or of spawning activity (redds). Restoration-related fish population surveys often involve electrofishing means. These methods usually involve some quantification of densities or biomass using single-pass, mark-recapture, or multiple pass-depletion methods. Other information typically collected includes age/length structure, species identification

3.1.2 Redd Counts

Counting spawning sites (redds) is a standard method of assessing the numbers of adult spawning fish within a spawning area or for a given population. Redd counts are not considered a usefull method for certain spring spawning fish in environments where to high water and turbidity confounds the identification of redds. Redd counts work best for fall spawning fish (brown trout and bull trout) or in spring creeks. Counts were made by walking the spawning areas shortly after the spawning period. Redd areas were identified by a cleaned, oval shape (pit), and a mound of unconsolidated gravel (tailspill) left by the females digging activities. Only redds where a definite pit and tailspill were discernable are counted. Redd counts are often made in index reaches where surveys are completed annually in order to assess population trends.

3.1.3 Macroinvertebrate Sampling

In instances where restoration project objectives include fisheries restoration, pre- and post-restoration macroinvertebrate sampling should be considered. Besides serving as an indicator for general water quality and substrate conditions, macroinvertebrate populations represent an integral component of a functioning biological system and will therefore help in determining restoration project success and/or beneficial use support associated with aquatic life. Careful consideration should be given to the need for and utility of macroinvertebrate sampling due to the considerable expense.

Procedure:

When conducting macroinvertebrate sampling, two general methods can be used; the quantitative and qualitative methods. The quantitative sampling method uses a Hess or Surber sampler, and is the preferred sampling method. When sampling by the quantitative method, sampling should include collection of multiple samples (replicates) at each site to allow for statistical analysis of the data. Typically, between 3 and 8 replicate samples are recommended depending on the suspected site variability, level of analysis required, and budgetary constraints. In most cases, 4 replicate samples per site should suffice for evaluating restoration effectiveness. The qualitative method uses a kick net for sample collection. The qualitative method is quicker and generally less expensive than the quantitative method, but yields less reliable results.

Macroinvertebrate sampling should be performed by experienced personnel following MDEQ's Rapid Bioassessment Protocols, Standard Operating Procedures 12.1.3.1 (Quantitative Method) or 12.3.1.2 (Qualitative Method). The MDEQ protocols are available upon request from the Blackfoot Challenge, or at:

http://www.deq.state.mt.us/wqinfo/monitoring/SOP/pdf/12-1-3.pdf

If preferred, comparable procedures, such as the EPA Rapid Bioassessment Protocol, can be used provided they are consistent with substantive portions of the MDEQ protocol. When quantitative macroinvertebrate sampling is performed, it should also be performed in a manner consistent with the Status and Trends macroinvertebrate sampling to allow for comparison to the basin-wide Status and Trends data.

Monitoring Sites/Schedule:

Due to the considerable cost associated with macroinvertebrate sample analyses, careful consideration should be afforded to selection of sampling locations and schedules. Ideally, a minimum of two sampling sites should be established within and/or downstream of the restored stream segment. However, if budget constraints dictate, one sampling site properly located within the restored segment may suffice (see MDEQ SOPs for sample site selection). Once established, sampling sites should be photographed, and described using the Rapid Bioassessment Protocol Physical Evaluation Form and Contractor Evaluation Form provided with the MDEQ SOPs.

Macroinvertebrate sampling should occur at least once prior to and once after restoration. Sampling should occur after runoff, preferably in August/September, although samples can be collected later in the year if necessary. Sampling should not be conducted immediately after large storm-related runoff events.

3.1.4 Periphyton/Chlorophyll a Sampling

Periphyton refers to the assemblage of algae living attached to or in close proximity to the stream substrate. These assemblages represent the principle source of primary productivity in most Montana streams. In general, excessive crops of periphyton are indicators of poor water quality, particularly elevated nutrient concentrations. In addition, species composition, diversity and abundance can be used as a measure of overall stream ecological health, since different species show variable sensitivity to potential impairment causes such as temperature, nutrients, and toxic constituents. Periphyton analyses may include quantification of chlorophyll a, and/or taxonomic identification to varying levels of precision. The methods chosen will depend on the specific project objectives.

Procedure:

MDEQ protocol divides periphyton sampling into three tasks of increasing complexity:

- Field observations;
- Standing crop/chlorophyll a sampling; and
- Community composition and structure sampling.

Field observations include completion of an Aquatic Plant Field Sheet, which records information on general composition, amount, color, and condition of aquatic plants and is equivalent to a Level I Rapid Bioassessment Protocol for plants (similar to the RBP for macroinvertebrates). Semi-quantitative assessments of biomass and taxonomy may also be conducted using a field-based rapid periphyton survey technique, which involves use of a gridded viewing bucket and a biomass scoring system.

Collection of samples for chlorophyll a analysis can include targeted sampling (sampling of heaviest accumulations of attached algae in a sampling transect), or more random sampling and direct extraction of chlorophyll a from streambed rocks. In both cases an estimate of amount of chlorophyll a per unit area of streambed is generated. Finally, collection of samples for laboratory identification of community composition and structure basically involves scraping rock surfaces, lifting algal film from nearshore sediments, and scraping several submerged branches.

Standard Operating Procedures for periphyton and chlorophyll a sampling have been developed by MDEQ, and are available at the following web address (comparable procedures may also be used):

http://www.deq.state.mt.us/wqinfo/monitoring/SOP/pdf/12-1-2-0.pdf

Monitoring Sites/Schedule:

Similar to macroinvertebrate analysis, periphyton analysis (identification of community structure and composition) is a time-consuming, labor-intensive, and thus relatively expensive endeavor. Thus, the objectives of sampling and the potential data uses should be thoroughly assessed prior to collecting samples for periphyton. Ideally, a reference site should be established to evaluate baseline conditions, in addition to 1 or 2 monitoring locations within and/or downstream of the restored stream section. For high-gradient streams, one periphyton sampling site should cover a single riffle, while in low-gradient streams, the sampling site should consist of at least one meander length (about 20 bankful channel widths).

The recommended time for periphyton sampling is summer (late June through September). During this period, stream flow is relatively stable, and most streams exhibit peaks of both periphyton standing crop (biomass) and community diversity. If temporal trends are to be assessed by repeated sampling over a number of years, the time of sampling should remain consistent from year to year to minimize seasonal variance.

3.2 PHYSICAL PARAMETERS

3.2.1 Habitat Assessments

Methods of assessing aquatic habitat vary greatly depending on the scale of the project and the specific survey objectives. An excellent reference for determining scale and objectives is found in Aquatic Habitat Assessment: common methods (Bain and Stevenson, 1999). At a restoration project level, habitat survey methods should focus on survey precision and repeatability necessary for post-project evaluation. Habitat surveys almost always involve a longitudinal and areal description of channel bed forms including pools, riffles and channel complexity. Habitat survey methods often involve geomorphic assessments, stream bank condition and riparian health, measurements of flow, water temperature and water quality, substrate compositions and instream wood counts.

3.2.2 Riparian Assessment

Assessment and monitoring of riparian areas is a critical step in assessing riparian system health. Initial stream reach inventories can be used as indicators of problem areas and identification of potential solutions to unstable stream situations. These same assessment techniques can also be used to observe changes over time, especially to gauge progress in restoring health and vigor to riparian systems functioning at levels below their potential.

Vegetation in stream zones is the best terrestrial indicator of stream health and function. Healthy vegetation within the watershed, especially within the riparian corridor, is the best indicator of a proper functioning stream system from a biological and hydrological perspective. Vegetation is also the component of a watershed over which a land manager has the most influence.

Consequently, when riparian vegetation is not in a healthy state, management changes may be warranted. Riparian areas are complex systems and thus present numerous options to the land manager to make positive changes in management, especially when dealing with grazing animals. If management of these areas is part of an unhealthy stream system, management changes must then be part of any solution to enhance riparian health. Downward trends in vegetation health can be reserved relatively quickly with positive changes in management of grazing animals.

Physical and biological processes occurring in riparian areas are sustainable in a healthy stream system. These processes are complex but need to be in balance to maintain a proper functioning, stable system. Inventory, assessment techniques used to gauge the health of these systems therefore need to account for this complexity.

Two riparian assessment techniques are recommended for use in the Blackfoot Watershed, as described below. Both techniques account for the complexity of riparian systems, yet are relatively user friendly to those familiar with inventory techniques, and also provide repeatable, quantifiable data. Whatever process is used for an initial inventory of the riparian system, it should quantify current condition, assess problems, and be repeatable. The first method was developed by the NRCS and is a relatively quick means of assessing riparian conditions. The second method is the USFS Green Line method, which is slightly more complex, yet should be readily implementable on most restoration projects. The appropriate method to use for specific restoration projects should be based on the project scope and budget, and importance of riparian conditions to the project goals and objectives.

The first riparian evaluation recommended for use in the Blackfoot Watershed is the Riparian Assessment procedure and field form developed by the USDA NRCS (USDA, 2004). This evaluation gives the user a good overview of a particular stream reaches status of the ecological and physical processes interacting at a site. This assessment will indicate problem areas within a stream system and yields a numeric rating which can be used to indicate trends through time. This evaluation technique is a relatively quick method for trained observers to utilize and will indicate specific physical or biological problems for more detailed inventory/analysis. The NRCS protocol document and filed forms are available at the following website, or from the Blackfoot Challenge upon request:

http://www.mt.nrcs.usda.gov/technical/

The stream reach evaluated should be well identified and documented (e.g. gps points, aerial photography, photo points) so that future evaluators can locate the same site. All pertinent observations should be recorded on the enclosed forms to enable future reference. The more notes/observations recorded during an assessment, the easier it will be for future evaluators to visualize the current conditions.

The second riparian evaluation method recommended for use is Monitoring the Vegetation Resources in Riparian Areas, USDA Forest Service, Technical Report RMRS-GTR-47 (USDA, 2000). Since vegetation is a key component in evaluating riparian health, this method zeroes in on one of the key monitoring tools for streams. This monitoring technique does require some technical knowledge of riparian vegetation, and thus should only be used when a more quantitative analysis of the riparian situation is desired. For example, when a grazing management problem is identified, a more detailed evaluation of the current vegetation condition may be warranted to enhance management changes. This monitoring technique also provides a more quantitative measure of vegetation trends through time. Sites where this technique is employed should again be accurately documented to ensure that assessment reaches can be relocated in the future.

The publication RMRS-GTR-47 is available form the Blackfoot Challenge upon request. The document can also be ordered from the USDA Forest Service Rocky Mountain Research Station at phone number (970) 498-1392, or downloaded from:

http://www.fs.fed.us/rm

3.2.3 Water Temperature

Water temperature measures now include programmable miniature temperature loggers. These loggers collect time and temperatures at user-defined intervals. Loggers can be record for several years if needed. Loggers can be downloaded in a manner that provide maximum, min and mean temperature values or as continuous data. Data can be easily manipulated in computer programs like EXCEL or can be statistically manipulated.

3.2.4 Flow Monitoring

Streamflow measurements should be recorded anywhere that restoration goals include maintenance of in-stream flow. In addition, accurate flow measurements are necessary for calculating loads of chemical constituents (e.g., nutrients, metals) within a water body. Streamflow measurements should be collected using one of three general methods, depending on the channel geometry and stream or seep discharge rate:

- Velocity-area method;
- Portable trapezoidal flume; or
- Volumetric method.

The velocity-area method is used to measure streamflow in larger, wadeable streams. Measurement of streamflow is performed in accordance with the area-velocity method developed by the USGS (USGS, 1977). In general, the entire stream width is divided into subsections and the stream velocity measured at the midpoint of each subsection and at a depth equivalent to six-tenths of the total subsection depth. The velocity in each subsection is then multiplied by the cross-sectional area to obtain the flow volume through each subsection. The subsection flows are then summed to obtain the total streamflow rate. Streamflow measurements are typically collected in a stream reach as straight and free of obstructions as possible, to minimize potential measurement error introduced by converging or turbulent flow paths. Streamflow measurement data should be recorded on specially prepared forms available from the Blackfoot Challenge.

Streamflow measurements on smaller streams or seeps are obtained using a portable flume such as a 90° v-notch cutthroat flume. This flow measurement method is based on equations developed by Skogerboe et al (1967). To measure streamflow, the flume is placed and leveled in the streambed, and the full streamflow directed through the flume throat. Water depth or head measurements are then collected at specified locations in the upstream (H_a) and downstream (H_b) sections of the flume. The head measurements are used to verify proper functioning of the flume and to calculate streamflow based on the water depth.

Collection of volumetric flow measurements consists of directing the flow into a container of known volume (such as a five-gallon bucket), and recording the time required to fill the known volume. Volumetric flow measurements are typically limited to monitoring points with small seepage flows (which can be diverted into a container) and discrete discharge points such as culverts and pipes.

3.2.5 Photo Point Monitoring

Photo points should be established for all restoration projects to assure collection of adequate pre- and post-restoration photographs. Pre- and post-restoration photos are invaluable for visually portraying large scale changes in response to restoration activities and in presenting such information to the general public. Following are a few simple rules that should be applied when establishing photo points to ensure that Pre- and post- project photos capture the level of information desired.

- Photo points should be selected and established in the earliest stages of the project. This will allow pre-restoration photos to be taken for all seasons.

- Photo points should be permanently marked to facilitate future relocation and identification. Once selected, photo points should be marked in the field with a steel or wood stake and GPS coordinates recorded. Photo points should be assigned a unique site code name and the marker stake inscribed with the site code.

- Long view photos representative of the entire or large portion of the project area should have a distinct permanent landmark in the background such as a mountain peak, rock outcrop, etc. Other considerations when choosing photo point locations include:

    - Locations should be easily relocatable and accessible;
    - Make sure that future plant growth will not obscure view; and
    - Select sites that will portray the level and depth of information applicable to the project.

- Information on project photos should be recorded on special project photo forms for systematic documentation into a project photolog. Forms should include information such as: Project name and location; Photo point number and location; Direction of photo; Photograph date, time, and weather conditions; Photographers name; Dates of previous photos, if known; and any comments/notes by the photographer.

3.3 WATER QUALITY MONITORING

Water quality monitoring needs for specific projects will depend on the restoration project objectives and the specific causes of impairment. In most cases, water quality monitoring needs will include nutrients, sediment, and/or metals. Monitoring for each of these general parameter groups is described below.

3.3.1 General Water Sampling Procedures

Procedure

The USGS has published water quality monitoring protocol for sampling of metals, nutrient, and suspended sediment concentrations. These methods are widely accepted and used for water quality monitoring across Montana. Restoration effectiveness water quality monitoring conducted within the Blackfoot River drainage should be completed in accordance with USGS protocol, or in accordance with comparable methods such as MDEQ protocol. USGS procedures are available at the following web address:

http://water.usgs.gov/owq/FieldManual/

Current MDEQ procedures are available at:

http://www.deq.state.mt.us/wqinfo/monitoring/SOP/sop.asp

Streamflow rates should be measured in conjunction with all water quality monitoring events to allow parameter loads (mass/time) to be calculated from parameter concentrations (mass/volume) determined through sampling. Comparison of parameter loads at multiple locations along a stream can be used to determine where load increases occur, and thus where sources of contaminant loading are located. Streamflow measurement should be performed as described in Section 3.2.

Monitoring Sites and Schedule

When water quality sampling is performed to assess restoration effectiveness, samples should be collected upstream of the restoration area in addition to sampling within and downstream of the restored stream reach. Sampling upstream of the restoration project will document the quality of surface water entering the restoration stream reach, allowing variations in upstream water quality to be taken into account when evaluating restoration project effectiveness. For restoration projects encompassing relatively short segments of stream (1,000 feet or less), one monitoring site near the upstream boundary and a second site near the downstream boundary will generally be sufficient. For stream restoration projects encompassing longer stream segments, one or more internal monitoring sites should be added to document water quality trends through the project area.

A minimum of one pre-restoration and one post-restoration monitoring event is required to assess restoration effectiveness from a water quality improvement perspective. However, due to intrinsic variability in surface water quality due to streamflow and climatic conditions, multiple pre- and post-restoration monitoring events should be conducted over a number of years. Ideally, water quality data should be collected from various portions of the streamflow hydrograph, with the specific sampling schedule dependent on the water quality parameters of interest. For instance, sampling for metals concentrations should be performed during the rising limb and falling limb of the spring runoff peak and during baseflow conditions since different metals loading sources will predominate under differing flow conditions (see discussion below). Conversely, nutrient sampling should focus on summer and early fall baseflow conditions when nutrient-related water quality problems are generally most severe. Pre- and post-restoration data used for evaluating restoration effectiveness should be collected under similar climatic conditions since runoff from heavy precipitation events can greatly affect short-term water quality. In general, a minimum of three pre- and post-restoration monitoring events should be preformed under appropriate flow and climatic conditions to allow restoration effectiveness to be evaluated with a reasonable level of confidence. Following is additional detail on monitoring protocol for specific water quality parameters.

3.3.2 Nutrient Sampling

Although nutrient pollution can result from a wide variety of sources, nutrient-related impacts to streams in the Blackfoot watershed will most likely be associated with agricultural runoff. Therefore, water quality monitoring for nutrients should be conducted for restoration projects associated with agricultural sources, and/or where the stream has been identified as impaired due to nutrients. In these cases, pre- and post-restoration water samples should be collected at the upstream and the downstream ends of the restoration project.

Table 3-1 includes a list of typical nutrient parameters for restoration projects, including total phosphorus, orthophosphate, nitrate plus nitrite (as nitrogen), ammonia (as nitrogen) and total kjeldahl nitrogen. This list will allow discrimination of the primary organic and inorganic forms of nitrogen and phosphorus. Samples for all parameters (except total phosphorus) should be filtered through a 0.45-micrometer filter in the field prior to placement in the sample container to remove particulate matter from the water sample that could affect analytical results.

When conducting nutrient sampling, the pre- and post-restoration sampling should be conducted during the same time of the year to prevent seasonal variations in nutrient concentrations from affecting the pre- and post-restoration comparison. Nutrient sampling should be performed during the summer months when water quality impacts from nutrients are expected to be greatest. Precipitation trends during and prior to sampling should be noted since runoff from intense precipitation events can greatly affect nutrient concentrations in streams through agricultural runoff.

TABLE 3-1. ANALYTICAL PARAMETERS, SAMPLE REQUIREMENTS FOR NUTRIENT SAMPLING

Parameter	Detection Limit	Container	Preservation	Holding Time
Total Phosphorus	0.01 mg/l	250 ml polyethylene	Add H_2SO_4 to pH<2, cool to 4°C	28 days
Orthophosphate	0.01 mg/L	250 ml polyethylene	Filter to 0.45 micron, add H_2SO_4 to pH<2, cool to 4°C	28 days
Nitrate+Nitrite as N	0.05 mg/L	50 ml polyethylene	Filter to 0.45 micron, add H_2SO_4 to pH<2, cool to 4°C	28 days
Ammonia as N	0.1 mg/L	50 ml polyethylene	Filter to 0.45 micron, add H_2SO_4 to pH<2, cool to 4°C	28 days
Total Kjeldahl Nitrogen (TKN)	0.5 mg/L	500 ml polyethylene	Filter to 0.45 micron, add H_2SO_4 to pH<2, cool to 4°C	28 days

3.3.3 Suspended Sediment Sampling

Total suspended sediment (TSS) monitoring will serve as the primary indicator of the effectiveness of restoration projects on water column sediment concentrations. Although other measures of water column sediment conditions (such as turbidity) are available, TSS monitoring represents the most direct measure of sediment levels within the water column available. Table 3-2 includes details on sample collection and handling for TSS.

Suspended sediment (or water column sediment) sampling will be applicable to many projects in the Blackfoot watershed due to the widespread nature of sediment-related impairment in the drainage. Excessive suspended sediment is not only detrimental to fish and other aquatic life, but also interferes with other beneficial uses such as irrigation water and drinking water supplies. Elevated suspended sediment concentrations also are indicative of or related to a myriad of other water quality problems and impairment causes, such as riparian degradation, agricultural runoff, substrate siltation, and elevated metals and nutrient concentrations. Therefore, documenting changes in suspended sediment concentrations through proper monitoring will be applicable to the majority of restoration projects in the Blackfoot watershed.

Pre- and post-restoration sampling for TSS must be performed under similar conditions to reduce the effects of natural variability in TSS concentrations. For instance, pre- and post-restoration samples should be collected from similar points on the annual hydrograph (rising limb, falling limb, baseflow) and during similar climatic conditions (extended dry periods, during or shortly after significant precipitation events), to exclude flow and weather-induced variations in TSS concentrations from the restoration effectiveness assessment. A minimum of three pre- and post-restoration TSS monitoring events should be performed under various hydrologic and climatic conditions to adequately document restoration success. Monitoring should occur at the upstream and downstream boundary for smaller restoration projects (on the order of 1,000 feet in length), with one or more internal sites added for longer restoration projects.

TABLE 3-2. ANALYTICAL PARAMETERS AND SAMPLE REQUIREMENTS FOR TOTAL SUSPENDED SOLIDS SAMPLING

Parameter	Detection Limit	Container	Preservation	Holding Time
Total Suspended Solids	10 mg/L	1000 ml glass or plastic	Cool to 4°C	7 days

3.3.4 Metals Sampling

Monitoring of metals concentrations in surface water should be performed on all restoration/reclamation projects designed to reduce metals loading to surface waters. This may include abandoned mine reclamation projects or mitigation of other metals loading sources. When monitoring metals concentrations in stream restoration projects, the objectives are to determine how restoration activities affect in-stream metals concentrations, and to determine how post-restoration concentrations compare to applicable water quality standards presented in Circular WQB-7, the official list of Montana Numeric Water Quality Standards published by MDEQ.

Table 3-3 includes sample collection and handling requirements for metals analyses. Typically, metals of interest in assessing surface water quality may include aluminum, arsenic, cadmium, copper, iron, lead, manganese, zinc, or numerous other metals. Actual metals to be analyzed for a project should be based on specific metals impairments or loading sources. On projects where information on specific metals of concern is lacking, the above list of metals should be sufficient for documentation of metals impairment and restoration effectiveness.

With the exception of aluminum, all metals should be analyzed for total recoverable concentrations for comparability to the water quality standards. If applicable, aluminum should be tested for dissolved concentrations (sample should be filtered through 0.45 micron filter prior to acidification) since the aluminum standard is based on the dissolve concentration. Although not typically considered a pollutant, the metals calcium and magnesium should be included in metals sample analyses to determine the water hardness. Because water quality standards for certain metals are dependent on the water hardness, calcium and magnesium concentrations should be used to determine the water hardness by the following equation:

$$H = [Ca^{2+} \times 2.497] + [Mg^{2+} \times 4.117]$$

Where: H= water hardness (as $CaCO_3$) in mg/L

Ca^{2+} = dissolved calcium concentration

Mg^{2+}=dissolved magnesium concentration.

Similar to other water sampling protocol, pre- and post-restoration sampling for metals should be performed during similar hydrologic and climatic conditions to reduce the effects of natural variability in metals concentrations. A minimum of two pre- and post-restoration metals monitoring events should be performed under various hydrologic and climatic conditions to adequately document restoration success. Monitoring should occur at the upstream and downstream boundary for smaller restoration projects (on the order of 1,000 feet in length), with one or more internal sites added for longer restoration projects.

TABLE 3-3. ANALYTICAL PARAMETERS AND SAMPLE REQUIREMENTS FOR METALS SAMPLING

Parameter	Detection Limit	Container	Preservation	Holding Time
TRC Metals	*	250 ml polyethylene	Add HNO_3 to pH<2, cool to 4°C	6 mos
Dissolved Calcium, Magnesium	1.0 mg/L	50 ml polyethylene	Filter to 0.45 micron, add HNO_3 to pH<2, cool to 4°C	6 mos
Dissolved Aluminum (if applicable)	0.05 mg/L	50 ml polyethylene	Filter to 0.45 micron, add HNO_3 to pH<2, cool to 4°C	6 mos

TRC-total recoverable. Specific list of metals to be analyzed dependent on project needs but may include arsenic, copper, cadmium, iron, lead, manganese, zinc, or other metals of interest.

*Varies with metal. Detection limits for individual metals should be less than applicable water quality standard in WQB-7.

3.4 STREAM SUBSTRATE COMPOSITION

Stream substrate composition, or the distribution of sediment particle sizes in streambed sediments, can be an important measure of success and effectiveness for many stream restoration projects. Excessive fine sediment content, typically taken to be any sediment particles less than approximately 6 mm in size, can be detrimental to aquatic life and other beneficial uses. Changes in the fine sediment content of the stream substrate are also a useful measure of the effectiveness of specific restoration measures and objectives, such as reducing sediment runoff from roads or unstable streambanks. Following are two methods for documenting stream substrate composition before and after restoration actions. The Percent Fines Content method is a relatively simple measurement yielding semi-quantitative information on substrate composition, while the McNeil Core Sampling method provides more quantitative information. The specific method used on a project should depend on the scope of the project, importance of streambed siltation to the stream health and project objectives, and available funding. Other methods, such as Wohlman pebble counts, riffle stability index, etc., may also be considered as long as standard methodologies are employed. Whichever method is chosen, the same method must be applied for the pre- and post-restoration monitoring to allow for direct comparison of the results.

3.4.1 Percent Fine Content

Procedure

Percent fines content is calculated using a five-gallon bucket fitted with a clear plastic bottom. The bottom is marked with a grid of one-inch spaced lines, with a 6 mm wide space demarcated at each intersection. The bucket is then placed in the water, and the streambed viewed through the bucket. At each grid intersection (a total of 45), the size of the sediment particle below the intersection (greater than or less than 6 mm), is recorded. The percent fines content is than calculated from the percentage of intersection points with sediment particles less than 6mm. The procedure is described in MDEQ Standard Operating Procedure 11.8.6, Percent Fines Calculation at the following website:

http://www.deq.state.mt.us/wqinfo/monitoring/SOP/pdf/11-8-6.pdf

Monitoring Sites/Schedule

Percent fine sediment measurements should be taken in pool tails and riffles, with the distribution of measurements dependent on the relative abundance of each. For instance, if the reach contains 70% riffles and 30% pools, 70% of the measurements should be taken from riffles and 30% from pools. The total number of measurements to be taken depends of the size and variability of the stream in the restoration area, and importance of stream substrate composition to the project. A sufficient number of measurements should be made to adequately characterize the percent fines content of the stream substrate for the project purposes.

3.4.2 McNeil Core Samples

McNeil core sampling provides more quantitative information on stream substrate composition than does the Percent Fine Content method, but is also more labor and equipment intensive. McNeil core sampling also requires that sediment samples be analyzed for grain size distribution, adding additional costs. However, collection of McNeil core samples should be considered where documentation of the percent fine sediment content in stream substrate before and after restoration is critical to project objectives.

The Helena National Forest has been conducting McNeil core sampling in the Blackfoot watershed for the past several years, resulting in an existing database of McNeil core data from the drainage. In order to ensure comparability of future restoration project sampling results with the existing database, McNeil core sampling performed for restoration projects should be conducted in a manner consistent with the HNF methodology. The following protocol was provided by the Helena National Forest. The general procedure is as follows:

Required Equipment:

- GPS Unit
- McNeil core sampler
- 1000 ml Imhoff cone
- 500 ml plastic bottle
- 5 gallon bucket with plastic bag liner

Field Data to be Recorded:

- Stream Name /Date /Location
- Observer Name
- Depth of core (6" for bull trout spawning gravel and 4" for cutthroat spawning areas)
- Site # and Core # with a description of the start point and the distance between points.
- Number of redds located at the site.
- GPS location
- Suspended sediment measure (ss) – The measurement of the depth of the water taken within the core sampler after the sample has been pulled into the reservoir, but the sampler is still in the stream.
- Imholf cone measure (Imh) – Let the sample settle for approximately 20 minutes. If using a 500 ml bottle – double the total sediment reading in the cone (1000 ml) and multiply by 0.4. This will account for how much it would actually settle overnight.

Field Procedure:

- Locate a spawning site or a potential spawning site. (All successive sites will be located upstream from the first site.)
- Set up 5-gallon bucket with a plastic bag inside.
- Set up Imhoff cone.
- Write two identification tags on the flagging for each sample using a waterproof marker. One tag is short and will be placed inside the plastic bag with the sample and the other is long and will be used to tie the sample bag when finished. The tags contain the following information: Stream Name, Site #, and Core #.
- Place core sampler next to the existing redd, but not where it would be affected in any way by the coring (remember your feet). If the site is a potential site, place the core sampler where you would expect a redd.
- In a bull trout stream, take 6" of core, or 4" from the top of the inner rim on the McNeil sampler. (The inner cylinder is 10".)
- In a cutthroat stream take 4" of core, or 6" from the top of the inner rim on the McNeil sampler.
- When drilling the core into streambed, try not to let it walk over the stream bottom. If it hangs up on a large rock go ahead and re-core. If a piece of rubble is too big to fit through the 10" cylinder leave it out of the sample.
- Once the core sampler is down to the appropriate depth, remove the material from the inner 10" cylinder and place into the inner reservoir. You are finished when you feel the top of the teeth at the bottom of the sampler.
- Use the ruler to measure the depth of the water from the bottom of the core sampler.

- Quickly fill the 500 ml bottle to capture the suspended sediments and pour it into the Imholf cone.
- Slowly pull up the core sampler and place it on the 5 gallon bucket with the bag around the 10" cylinder.
- Empty the sample from the reservoir into the plastic bag through the 10" cylinder. Use extra wash water to carefully wash the extra sediment from inside the core sampler. Pick up the sampler and drain the rest of the water into the bag.
- Remove the bag from the plastic bucket and pour any remaining sediment and water into the bag.
- Place the short tag inside the bag.
- Twist the bag and tie it with many wraps of the long flagging.
- Record the GPS reading, the ss depth in inches and the Imholf cone reading. Empty the water from the cone using the cap at the bottom and then replace it tightly! (Easy to lose.)

Sample Analysis:

- Samples are processed by passing the sample through a set of soil sieves and recording the weight of soil passing through each sieve. The percent passing each sieve is then plotted against the sieve sizes on a semi-log plot to provide the grain size distribution of the sample. Samples should be passed through a stack of sieves consisting of the following sieve sizes:

Sieve Number	Opening Size (mm)
200	0.074
20	0.85
8	2.38
4	4.76
3	6.3
0.5"	12.7
1.0"	25.4
2.0"	50.8
3.0"	76.1

From the resulting data, the percent fine sediment can be determined. Other useful metrics, such as the Fredel Index and sorting coefficient, can also be calculated.

4.0 REFERENCES

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APPENDIX M

Table of Potential Restoration Projects

Blackfoot River Basin												
Stream Name	Road Crossings	Irrigation Impacts	Channel Alterations	Lacks Complexity	Riparian Vegetation	Instream Flow	Road Drainage	Feedlots, Grazing	Recreation Impacts	Whirling Disease	Mining	Residential
Alice Creek				X	X				X			
Arkansas Creek							X	X				
Arrastra Creek	X						X		X	X		
Ashby Creek	X	X	X	X	X	X	X	X				
Bartlett Creek					X				X			
Basin Spring Creek												
Bear Creek (Blackfoot trib. at R.M. 12.2)					X		X					
Bear Creek (Blackfoot trib. at R.M. 37.5)	X											
Bear Creek (North Fork drainage)		X				X						
Bear Gulch	X	X	X	X	X	X	X	X				
Beaver Creek		X			X	X		X		X		
Belmont Creek							X		X	X		
Black Bear Creek	X					X		X				
Blackfoot River (mouth to Clearwater)			X	X			X	X	X	X		
Blackfoot River (Clearwater to N.F)			X		X			X	X	X		
Blackfoot River (N.F. to Nevada Creek)						X		X		X		
Blackfoot River (Nevada Cr. to Arrastra Cr.)		X		X	X	X		X		X		
Blackfoot River (Arrastra Cr. to Lincoln, MT)		X	X	X	X	X		X	X	X		
Blackfoot River (Lincoln to Headwaters)		X	X	X		X			X	X	X	
Braziel Creek	X		X	X	X	X	X	X				
Buffalo Gulch	X			X	X			X			X	
Burnt Bridge Creek	X	X	X		X	X	X					
California Gulch	X			X	X			X				
Camas Creek			X	X				X				
Chamberlain Creek				X	X		X			X		
Chamberlain Creek, East Fork							X					
Chamberlain Creek, West Fork							X					
Chicken Creek	X		X	X	X			X				
Chimney Creek (Douglas Cr tributary)		X	X	X	X			X				
Chimney Creek (Nevada Cr tributary)	X	X	X			X		X				
Clear Creek	X		X		X			X				X
Copper Creek	X								X			
Cottonwood Creek (Blackfoot trib. at R.M. 43)	X		X	X	X	X	X	X		X		
Cottonwood Creek (Nevada Cr tributary)	X	X	X	X	X	X		X				X

Table of Potential Restoration Projects (cont'd).

Blackfoot River Basin (cont'd)												
Stream Name	Road Crossings	Irrigation Impacts	Channel Alterations	Lacks Complexity	Riparian Vegetation	Instream Flow	Road Drainage	Feedlots, Grazing	Recreation Impacts	Whirling Disease	Mining	Residential
Dick Creek	X	X	X	X	X	X		X				
Douglas Creek		X	X	X	X	X	X	X				
Dry Creek				X	X			X				
Dunham Creek					X	X						
East Twin Creek												
Elk Creek	X	X	X	X	X	X	X	X		X	X	
Enders Spring Creek				X	X							
Finn Creek		X		X		X		X				
Fish Creek		X	X									
Frazier Creek	X	X	X	X	X	X	X	X				
Frazier Creek, North fork		X	X		X	X		X				
Gallagher Creek	X							X				
Game Creek	X							X				
Gleason Creek	X										X	
Gold Creek									X	X		
Gold Creek, West Fork												
Grantier Spring Creek												
Halfway Creek				X	X			X				
Hogum Creek	X				X			X				
Hoyt Creek		X	X	X	X	X		X		X		
Humbug Creek		X	X		X	X		X			X	
Indian Creek				X								
Jacobsen Spring Creek										X		
Jefferson Creek	X		X	X		X					X	
Johnson Creek												
Keep Cool Creek	X	X	X		X	X		X			X	
Kleinschmidt Creek								X		X		
Landers Fork			X	X	X	X			X			
Lincoln Spring Creek	X	X	X	X	X			X		X		X
Little Fish Creek	X				X		X	X				
Little Moose Creek												
Lodgepole Creek												
McCabe Creek	X				X							

Table of Potential Restoration Projects (cont'd).

Blackfoot River Basin (cont'd)												
Stream Name	Road Crossings	Irrigation Impacts	Channel Alterations	Lacks Complexity	Riparian Vegetation	Instream Flow	Road Drainage	Feedlots, Grazing	Recreation Impacts	Whirling Disease	Mining	Residential
McDermott Creek												
McElwain Creek	X	X			X	X	X	X				
Mitchell Creek	X			X				X				
Monture Creek	X		X	X	X			X	X	X		X
Moose Creek	X										X	
Murphys Spring Creek		X				X						
Murray Creek	X	X		X	X	X	X	X				
Nevada Creek (lower)		X	X	X	X	X		X				
Nevada Creek (upper)	X	X			X		X	X			X	
Nevada Spring Creek			X							X		
North Fork Blackfoot River			X	X	X	X			X	X		
Pearson Creek					X		X					
Poorman Creek	X		X	X	X		X	X			X	
Rock Creek	X	X		X	X	X				X		X
Salmon Creek		X		X		X						
Sauerkraut Creek	X		X	X	X	X	X	X			X	
Seven up Pete Creek	X								X		X	
Shanley Creek		X		X	X	X		X		X		
Sheep Creek						X		X				
Shingle Mill Creek		X						X				
Smith Creek	X				X			X				
Snowbank Creek	X	X	X									
Spring Creek (Cottonwood Cr tributary)		X	X		X	X						
Stonewall Creek	X	X	X			X		X			X	
Strickland Creek				X	X			X				
Sturgeon Creek			X		X	X		X				
Sucker Creek	X	X	X	X	X	X		X				
Tamarack Creek	X	X	X	X	X	X	X					X
Union Creek	X	X		X	X	X		X				
Wales Creek		X	X		X	X		X				
Wales Spring Creek			X		X			X				
Ward Creek	X	X	X	X	X	X		X				
Warm Springs Creek	X	X				X	X					

Table of Potential Restoration Projects (cont'd).

Stream Name	Road Crossings	Irrigation Impacts	Channel Alterations	Lacks Complexity	Riparian Vegetation	Instream Flow	Road Drainage	Feedlots, Grazing	Recreation Impacts	Whirling Disease	Mining	Residential
Blackfoot River Basin (cont'd)												
Warren Creek	X	X	X	X	X	X		X		X		
Warren Creek (Doney Lake trib.)												
Washington Creek	X	X	X	X				X			X	
Washoe Creek				X				X				
Wasson Creek					X	X		X				
West Twin Creek												
Willow Creek (above Lincoln)					X			X				
Willow Creek (below Lincoln)	X	X	X	X	X	X	X	X			X	
Wilson Creek	X	X				X						
Yourname Creek		X	X	X	X	X		X				
Clearwater River Basin												
Stream Name	**Road Crossings**	**Irrigation Impacts**	**Channel Alterations**	**Lacks Complexity**	**Riparian Vegetation**	**Instream Flow**	**Road Drainage**	**Feedlots, Grazing**	**Recreation Impacts**	**Whirling Disease**	**Mining**	**Residential**
Auggie Creek	X					X	X					
Benedict Creek	X				X							
Bertha Creek												
Blanchard Creek	X	X	X	X	X	X	X	X				
Blanchard Creek, North Fork												
Blind Canyon Creek							X					
Boles Creek					X		X					
Buck Creek	X				X	X						
Camp Creek	X				X	X	X					
Clearwater River Section 1		X	X		X	X			X			X
Clearwater River Section 2			X		X	X			X			X
Clearwater River Section 3					X	X		X				
Clearwater River Section 4			X			X			X			
Clearwater RiverSection 5	X											
Clearwater River, East Fork							X					
Clearwater River, West Fork					X	X	X					
Cold Brook Creek												
Colt Creek	X		X		X	X	X					
Deer Creek	X				X		X					
Drew Creek	X	X	X	X	X		X					X

Table of Potential Restoration Projects (cont'd).

Clearwater River Basin (cont'd)												
Stream Name	Road Crossings	Irrigation Impacts	Channel Alterations	Lacks Complexity	Riparian Vegetation	Instream Flow	Road Drainage	Feedlots, Grazing	Recreation Impacts	Whirling Disease	Mining	Residential
Fawn Creek	X					X	X					
Findell Creek	X				X		X					
Finley Creek	X				X		X					
First Creek	X				X		X					
Grouse Creek	X						X					
Horn Creek						X	X					
Inez Creek	X				X		X					
Lost Horse Creek	X			X	X		X					
Lost Prairie Creek						X	X					
Marshall Creek					X		X					
Morrell Creek		X	X	X	X	X	X		X			X
Mountain Creek	X	X			X	X	X					X
Murphy Creek	X				X		X					
Owl Creek				X	X	X	X		X			
Placid Creek	X			X			X					
Placid Creek, North Fork	X	X					X					
Rice Creek		X					X					
Richmond Creek	X				X		X					
Sawyer Creek	X						X					
Second Creek							X					
Seeley Creek		X					X					X
Sheep Creek	X					X	X					
Slippery John Creek	X					X						
Swamp Creek	X		X	X	X	X	X					X
Trail Creek	X	X	X	X	X		X					X
Uhler Creek	X				X	X	X					
Vaughn Creek							X					