Appendix C

Restoration Plan
&
Monitoring Plan

Emerald Creek Garnet Area
Final Environmental Impact Statement

Final Design Submittal

St. Joe Garnet Workings Restoration
Idaho Panhandle National Forests
Latah County, Idaho
September 2006

DESIGN CONCEPTS MEMORANDUM

St. Joe Garnet Workings Restoration Final Design
Idaho Panhandle National Forests

St. Joe Garnet Workings Restoration
Design Concepts
Final Design Submittal

Idaho Panhandle National Forests, Latah County, Idaho
September 1, 2006

This document summarizes design concepts used to develop the restoration design for the St. Joe Garnet Workings in Latah County, Idaho. The workings consist of recreational garnet digs located in 281 Gulch, a tributary to the East Fork of Emerald Creek. The purpose of the design is to restore the site to approximate pre-mining conditions. Currently the site is partially reclaimed but overburden stockpiles need to be replaced in the drainages, streams need to be reconstructed with appropriate habitat features, and the site requires revegetation with grasses, sedges, forbs, shrubs and trees.

Road Improvements

The access road from the East Fork Emerald Creek Road to the site is about 2,200 feet long. To sustain truck traffic, portions of the road should be graveled to maintain a stable base and minimize sediment yield. Additional minor maintenance such as grading and improvement of cross-drains may also be required during construction. The contractor will be required to leave the access road and the Emerald Creek Road in a graded, travelable condition at project termination.

Dust will be generated while hauling on the access road and the East Fork Emerald Creek Road. To minimize fugitive dust, the contractor will be required to apply water as needed. Water sources are assumed to be available in 281 Gulch near the Forest Service cabin and from the East Fork Emerald Creek.

East Fork 281 Gulch Restoration

The East Fork of 281 Gulch has been partially restored. Access to the site is possible from the access road by taking small, tracked equipment approximately 700 feet directly up the bottom of the gulch. Area E1 has not been restored and requires replacement of the overburden stockpiled on the north side of the gulch, reclaiming a small sediment basin, and reconstruction of the stream channel through the reclaimed area. The gulch will be reconstructed to have a floodplain/riparian area throughout most of the disturbed width. Flood flows for this drainage were estimated using the publication *Estimating the Magnitude of Peak Flows at Selected Recurrence Intervals for Streams in Idaho* (C. Berenbrock, 2002, US Geological Survey WRI 02-4170). The stream channel will be sized to accommodate the 2-year (50% recurrence frequency) peak flow event (11.2 cubic feet per second; cfs). Events larger than the 2-year peak flow event will inundate the floodplain to varying degrees. However, even the 100-year event (51.3 cfs) will not create a flow that occupies the entire valley between the valley walls.

The reconstructed channel geomorphic design is based on streams of similar sizes in the vicinity, including upstream portions of the East Fork. Because the substrate in the East Fork is generally coarse, it should withstand the flows expected in this drainage without importation of bed material. The relatively steep gradient (about 7.7%) of the East Fork allows construction of numerous drops and pools. Drops should not exceed six-inches in height to allow easy passage for the local, small cutthroat trout population; and pools should be one-foot deep where possible. Pools will be spaced at variable distances along run sections of the reconstructed stream. The channel should meander with typical half-wave lengths of about 25 feet. However, the meander belt width should not exceed about 10 feet because of the relatively steep stream gradient.

The banks will be constructed from fabric encapsulated soil lifts, and locally available logs and rocks should be incorporated into the banks. Locally available rock and logs will also be used to construct drops, weirs, vanes, and bank logs. Cover logs will be placed over the stream in area E3 as well as E1.

West Fork 281 Gulch

The West Fork of 281 Gulch requires return of considerable overburden (about 1,800 bank cubic yards; cy) to the disturbed area, reclamation of three sediment basins, reconstruction of the stream channel, and stabilization of a slope failure. Access to the site is available from the north at two points. Fill material should be machine compacted after placement by operating wheeled equipment on the surface. A new stream channel will be constructed through the filled area. The valley gradient in the disturbed area is about 4.9%, which is steep enough to allow construction of frequent drop structures and pools. Pools will be spaced at variable distances along the reconstructed stream. The stream should meander slightly with half-wave lengths of about 25 feet and amplitudes of 10 feet or less.

The stream channel is sized to accommodate the 2-year (50% recurrence frequency) peak flow event, which is estimated to have a flow of 2.4 cfs. Because the fill material on which the stream channel will be built consists largely of fine grained material, a stream bed will be constructed from commercially available gravels and cobbles to prevent degradation of the channel. The streambanks will be constructed from fabric encapsulated soil lifts, and locally available logs and rocks should be incorporated into the banks. Locally available rock and logs will also be used to construct drops, weirs, vanes, and bank logs. Cover logs will be placed over the stream as well.

The sediment basins in the lower portion of the site will remain in place during upstream construction activities. The contractor will submit a dewatering plan for the largest lowest basin in this system that will prevent sedimentation of 281 Gulch.

Backfill Stockpiles

Some of the overburden taken from the West Fork of 281 Gulch will have been used for other reclamation purposes at the time the West Fork reclamation takes place. Only about 200 cy of the original overburden piles will be on-site, and this material will be replaced in the West Fork. Another 750 cubic yards of overburden is located on the East Fork Emerald Creek near Peewee Gulch. The East Fork Emerald Creek material will be trucked to the West Fork as well. In addition, about 850 cy of native material will be excavated from the footprint of the East Fork Emerald Creek stockpile and transported to the West Fork 281 Gulch. The lowered East Fork Emerald Creek area will be left as a wetland area and the entire area (including the existing roadway to the stockpile) revegetated.

Groundwater may present problems during construction of the Emerald Creek wetland area unless groundwater dewatering is undertaken. The intent of this work is to dewater saturated floodplain materials to allow equipment access for excavation and to allow hauling of non-saturated materials.

Slope Stabilization

Slope stabilization will consist of placement of several feet of fill, obtained from the overburden piles, near and on the toe of the existing slope failure. A stability analysis was performed which demonstrated that the regraded slope (maximum slope of 3H:1V) should have a factor of safety of about 1.44 (static analysis). The scarp near the upper portion of the slope failure will also be flattened and regraded to

blend with the surrounding topography. Following placement of fill and regarding, the surface will be revegetated.

Revegetation

The entire disturbed area will be revegetated including the East and West Fork disturbed areas, stockpile areas, East Fork Emerald Creek stockpile area, and any new access roads created during restoration activities. Three general prescriptions have been developed, one for riparian areas, one for wetland areas in the East Fork Emerald Creek, and one for uplands. The riparian prescription includes grasses or sedges, forbs, and shrubs. The upland prescription includes a cover crop, forbs, shrubs and trees. The riparian prescription will be used in near-stream areas in both the East Fork and West Fork of 281 Gulch and portions of the East Fork Emerald Creek area. The upland prescription will be used for higher portions of the West Fork disturbance, stockpile areas, and temporary roads. Species selection was based on field investigations conducted in November 2005, input from the USDA Forest Service, and plant availability from commercial sources. Many desirable species were not included due to their unavailability. Other species were unavailable locally at reasonable costs, requiring consideration of commercial sources outside the region.

The riparian seed mix consists of panicled bulrush (*scirpus microcarpa*), fowl mannagrass (*glyceria striata*), water sedge (*carex aquatilis*), western coneflower (*rudbeckia occidentalis*), and arrowleaf ragwort (*senecio triangularis*). The shrubs planned for the riparian zone are thinleaf alder (*alnus incana* ssp. *tenufolia*) and redosier dogwood (*cornus sericea*).

The upland seed mix consists of western coneflower (*rudbeckia occidentalis*), and arrowleaf ragwort (*senecio triangularis*) with first year cover grasses slender wheatgrass (*elymus trachycaulus*) and annual Italian ryegrass (*Lolium multiflorum*). Shrub plantings include Oregon boxleaf (*paxistima myrsinites*) and snowberry (*symphoricarpos albus*). Trees planned for upland planting include grand fir (*abies grandis*), western larch (*larix occidentalis*), western white pine (*pinus monticola*), Douglas fir (*pseudotsuga menziesii*), and western red cedar (*thuja plicata*).

The wetland seed mix consists of panicled bulrush (*scirpus microcarpa*), fowl mannagrass (*glyceria striata*), water sedge (*carex aquatilis*), and cattail (*typha latifolia*). Coyote willow (*salix exigua*) will be planted around expected wet areas. This prescription is intended for the East Emerald Creek Stockpile area after the stockpile is removed and native ground excavated. Planting/seeding densities are likely an overestimation based on a half acre of disturbance. However, the depression will result in some deepwater habitat in the middle and a gradient of shallowing water towards the edge of the depression. It is difficult to estimate planting densities without knowing 1) how deep the depression will be, and 2) how much of it will be occupied with water and for what duration. We recommend maintaining the seeding densities of the grasses because they are relatively inexpensive. The seed should be spread over the entire depression at the end of the summer just before the fall rains. The appropriate seed will germinate in the appropriate locations (depths) relative to their typical wetland gradient stratification. Ideally, the shrubs would be planted once the margin of the perennial edge of water is observed or determined. However, if the depression never really holds much more than seasonal water, we recommend planting willows throughout and eliminating the cattails from the prescription.

Densities for planting species are based on recommended USDA planting densities and professional judgment. For trees and shrubs, several species are planned. Therefore, the recommended planting density for one species is the minimum recommended planting density for that species divided by the number of species in that vegetation category. In general, seed applications are higher than recommended levels to account for viability and seed loss.

In the East Fork of 281 Gulch, only Area E1 will receive seeding, compost, and erosion control blanket. Areas E2 and E3 will be planted with riparian zone shrubs only. Area E1 will also receive the shrub planting. The two stockpile areas adjacent to Area E1 will be planted with upland vegetation. No reclamation is planned for the temporary access to the East Fork because no soil disturbance is anticipated if low-pressure, track equipment is used. The entire disturbed area on the West Fork of 281 Gulch will be revegetated. The riparian prescription will be used near the stream channel and other wet areas remaining after reclamation; other reclaimed areas including local stockpile footprints will be planted with the upland prescription. The overexcavated East Fork Emerald Creek stockpile footprint will be replanted with the riparian and wetland prescriptions.

Before application of the seed mix, soil shall be prepared by disking to reduce compaction. Organic matter shall be incorporated at a rate of 1.5% by weight in the top six-inches of soil (45,000 lb organic matter per acre). Balanced fertilizer (16-16-16 N-P-K) and additional phosphorus shall be incorporated only in upland areas. No fertilizer will be used in riparian or wetland areas to avoid water quality problems. No mulch will be used as the entire seeded area will be covered with erosion control blanket. After seeding an erosion control blanket shall be applied to all revegetated areas. The blanket consists of a biodegradable netting containing straw.

SCHEDULES B AND C

St. Joe Garnet Workings Restoration Final Design
Idaho Panhandle National Forests

PROJECT DESCRIPTION AND SPECIFICATIONS
St. Joe Garnet Workings Restoration

USDA Forest Service, Region 1
Idaho Panhandle National Forests
Latah County, Idaho

PART I - THE SCHEDULE
SECTION B - SERVICES AND PRICES

ST. JOE GARNET WORKINGS RESTORATION
IDAHO PANHANDLE NATIONAL FORESTS
LATAH COUNTY, IDAHO

Price Schedule - Under this price schedule, the CONTRACTOR shall complete the entire project by _____.

B-1 - BID SCHEDULE

Item No.	Description (Section)	Method of Meas.	Pay Unit	Estimated Quantity	Unit Price	TOTAL
1.0	**MOBILIZATION**					
1.0	Mobilization 20% of base bid (151)	LSQ	ls	1		
2.0	**ROAD CONSTRUCTION**					
2.1	Road Improvements (303)	LSQ	ls	1		
2.2	Provide and Place Subbase Aggregate (301)	AQ	t	100		
2.3	Dust Control (158)	AQ	kgal	40		
3.0	**SITE RESTORATION**					
3.1	Provide, Install, Maintain and Remove Temporary Erosion Control Measures (157)	LSQ	ls	1		
3.2	Clearing and Grubbing (201)	LSQ	ls	1		
3.3	Load, Haul, Place, and Compact Overburden (204) Compaction Method (d) & (e)	DQ	yd^3	1,800		
3.4	Site Grading (204)	DQ	ac	2.5		
3.5	Streambed Construction (204)	AQ	t	92		
3.6	Stream Bank Reconstruction (640)	AQ	lf	1,470		
3.7	Log Weir and Pool Construction (640)	AQ	ea	25		
3.8	Stream Log Installation (640)	AQ	ea	60		
3.9	Cover Log Installation - Laborer (623)	AQ	hr	20		
3.10	Cover Log Installation - Excavator with Thumb (622)	AQ	hr	10		
3.11	Install Farm Fence (619)	AQ	lf	1,910		
3.12	Install Wire Gate (619)	AQ	ea	5		
3.13	Emerald Creek Overburden Stockpile Dewatering System (641)	AQ	ls	1		

B-1 - BID SCHEDULE (Continued)

Item No.	Description (Section)	Method of Meas.	Pay Unit	Estimated Quantity	Unit Price	TOTAL
4.0	REVEGETATION OF DISTURBED AREAS					
4.1	Load, Haul, Place, Spread and Incorporate Organic Matter (625)	AQ	ac	2.5		
4.2	Seed Riparian Areas (625)	AQ	ac	1.0		
4.3	Fertilize and Seed Upland Areas (625)	AQ	ac	1.0		
4.4	Seed Wetland Areas (625)	AQ	ac	0.5		
4.5	Provide and Place Erosion Control Blanket (629)	AQ	yd^2	12,100		
4.6	Provide and Plant *Alnus incana* ssp. *tenuifolia (626)*	AQ	ea	473		
4.7	Provide and Plant *Cornus Sericea (626)*	AQ	ea	743		
4.8	Provide and Plant *Paxistima myrsinites* (626)	AQ	ea	275		
4.9	Provide and Plant *Symphoricarpos albus (626)*	AQ	ea	600		
4.10	Provide and Plant *Abies grandis (626)*	AQ	ea	60		
4.11	Provide and Plant *Larix occidetalis (626)*	AQ	ea	86		
4.12	Provide and Plant *Pinus monticola (626)*	AQ	ea	86		
4.13	Provide and Plant *Pseudotsuga mensiesii (626)*	AQ	ea	60		
4.14	Provide and Plant *Thuja plicata (626)*	AQ	ea	60		
4.15	Provide and Plant *Salix exigua (626)*	AQ	ea	350		
				TOTAL BASE BID		

DESIGNATED METHOD OF MEASUREMENT

DQ	Design Quantities
LSQ	Lump Sum Quantities
AQ	Actual Quantities
SQ	Staked Quantities

PAY UNIT ABBREVIATIONS

ls	lump sum	yd^2	square yard
ac	acre	lf	lineal foot
yd^3	cubic yard	t	ton
ft^2	square foot		

ONE AWARD WILL BE MADE. Proposals will be evaluated in accordance with Section M and L.
On site project work will be restricted to the time period of _____.

B-2 - NOTE: Payment for bond premiums in accordance with Clause 52.232-5, Payments under Fixed-Price Construction Contracts, shall not be in addition to the contract price. Include bond payments under 151.01 Mobilization.

Payment will be made on actual work performed as described in FP-03 109.01 unless otherwise noted.

PART I - THE SCHEDULE
SECTION B - SERVICES AND PRICES
ST. JOE GARNET WORKINGS RESTORATION
ENGINEER'S ESTIMATE
IDAHO PANHANDLE NATIONAL FORESTS
LATAH COUNTY, IDAHO
September 1, 2006

B-1 - BID SCHEDULE

Item No.	Description (Section)	Method of Meas.	Pay Unit	Estimated Quantity	Unit Price	TOTAL
1.0	**MOBILIZATION**					
1.0	Mobilization 20% of base bid (151)	LSQ	ls	1	$32,488.29	$32,488
2.0	**ROAD CONSTRUCTION**					
2.1	Road Improvements (303)	LSQ	ls	1	$4,000.00	$4,000
2.2	Provide and Place Subbase Aggregate (301)	AQ	t	100	$20.27	$2,027
2.3	Dust Control (158)	AQ	kgal	40	$100.00	$4,000
3.0	**SITE RESTORATION**					
3.1	Provide, Install, Maintain and Remove Temporary Erosion Control Measures (157)	LSQ	ls	1	$4,790.00	$4,790
3.2	Clearing and Grubbing (201)	LSQ	ls	1	$4,000.00	$4,000
3.3	Load, Haul, Place, and Compact Overburden (204) Compaction Method (d) & (e)	DQ	yd^3	1,800	$11.42	$20,557
3.4	Site Grading (204)	DQ	ac	2.5	$2,500.00	$6,250
3.5	Streambed Construction (204)	AQ	t	92	$20.27	$1,865
3.6	Stream Bank Reconstruction (640)	AQ	lf	1,470	$10.14	$14,906
3.7	Log Weir and Pool Construction (640)	AQ	ea	25	$190.00	$4,750
3.8	Stream Log Installation (640)	AQ	ea	60	$25.00	$1,500
3.9	Cover Log Installation - Laborer (623)	AQ	hr	20	$40.00	$800
3.10	Cover Log Installation - Excavator with Thumb (622)	AQ	hr	10	$110.00	$1,100
3.11	Install Farm Fence (619)	AQ	lf	1,910	$5.00	$9,550
3.12	Install Wire Gate (619)	AQ	ea	5	$200.00	$1,000
3.13	Emerald Creek Overburden Stockpile Dewatering System (641)	AQ	ls	1	$7,300.00	$7,300
4.0	**REVEGETATION OF DISTURBED AREAS**					
4.1	Load, Haul, Place, Spread and Incorporate Organic Matter (625)	AQ	ac	2.5	$6,250.00	$15,625
4.2	Seed Riparian Areas (625)	AQ	ac	1.0	$2,800.00	$2,800
4.3	Fertilize and Seed Upland Areas (625)	AQ	ac	1.0	$2,200.00	$2,200
4.4	Seed Wetland Areas (625)	AQ	ac	0.5	$2,600.00	$1,300
4.5	Provide and Place Erosion Control Blanket (629)	AQ	yd^2	12,100	$3.50	$42,350
4.6	Provide and Plant *Alnus incana* ssp. *tenuifolia (626)*	AQ	ea	473	$3.50	$1,654
4.7	Provide and Plant *Cornus Sericea (626)*	AQ	ea	743	$3.50	$2,599
4.8	Provide and Plant *Paxistima myrsinites* (626)	AQ	ea	275	$3.50	$963
4.9	Provide and Plant *Symphoricarpos albus (626)*	AQ	ea	600	$3.50	$2,100
4.10	Provide and Plant *Abies grandis (626)*	AQ	ea	60	$3.50	$210
4.11	Provide and Plant *Larix occidetalis (626)*	AQ	ea	86	$3.50	$301
4.12	Provide and Plant *Pinus monticola (626)*	AQ	ea	86	$3.50	$301
4.13	Provide and Plant *Pseudotsuga mensiesii (626)*	AQ	ea	60	$3.50	$210
4.14	Provide and Plant *Thuja plicata (626)*	AQ	ea	60	$3.50	$210
4.15	Provide and Plant *Salix exigua (626)*	AQ	ea	350	$3.50	$1,225
				TOTAL PROJECT ESTIMATE		**$194,930**

DESIGNATED METHOD OF MEASUREMENT

DQ	Design Quantities
LSQ	Lump Sum Quantities
AQ	Actual Quantities
SQ	Staked Quantities

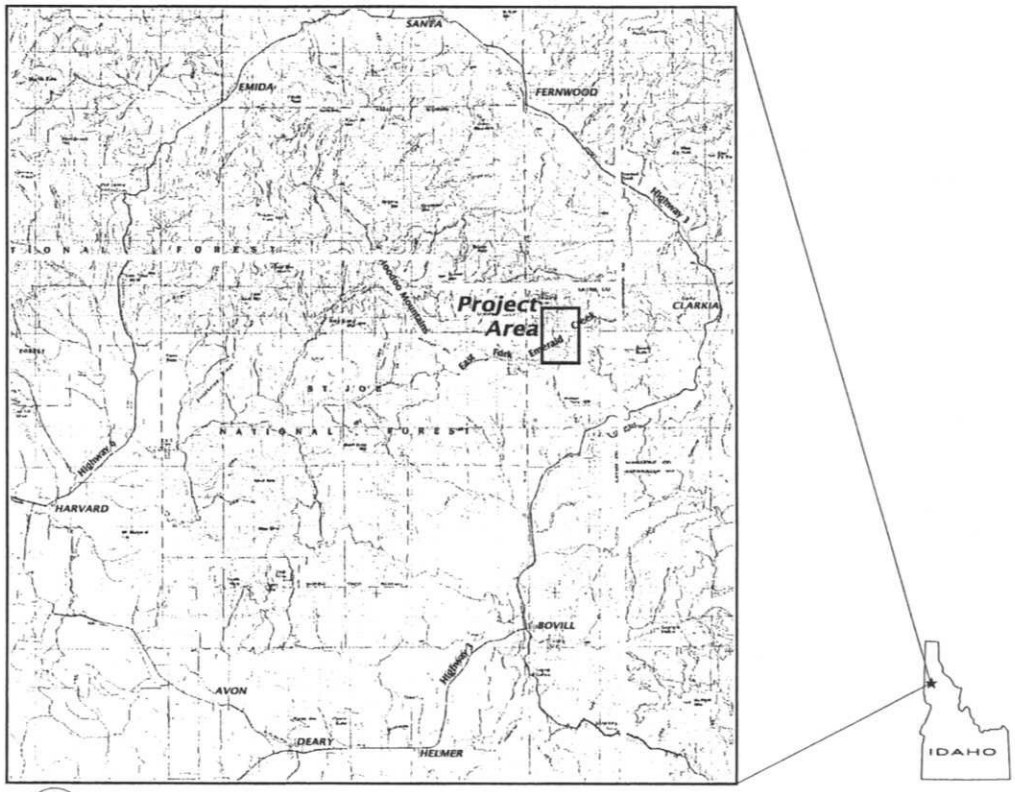
PAY UNIT ABBREVIATIONS

ls	lump sum	yd^2	square yard
ac	acre	lf	lineal foot
yd^3	cubic yard	t	ton
ft^2	square foot		

CONSTRUCTION DRAWINGS

St. Joe Garnet Workings Restoration Final Design
Idaho Panhandle National Forests

ST. JOE GARNET - WORKINGS RESTORATION



Construction Drawings Index

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APPROVED:

Forest Engineer
Idaho Panhandle National Forests — Date

REVIEWED:

District Ranger
St. Joe Ranger District — Date

APPROVED:

Gary Fischer, P.E.
Consulting Project Engineer — Date

PREPARED FOR:

United States Department of Agriculture
Forest Service
Northern Region
Idaho Panhandle National Forests
St. Joe District
Latah County, Idaho

PREPARED BY:

MAXIM Technologies
303 Irene Street
Helena, Montana 59601

September 2006

COVER AND INDEX SHEET 1

Area	Bid Item No.	Item Description	Material	Units	Estimated Quantity	Material Source
ROADS	2.1	Road Improvements	Road improvements	lf	2,200	
	2.2	Provide and Place Subbase Aggregate	Subbase Aggregate	t	100	Contractor
	2.3	Dust Control	Water	kgal	40	Government
SITE RESTORATION	3.1	Provide, Install, Maintain and Remove Temporary Erosion Control Measures	Straw Bales, Straw Wattles, Silt Fence	ls	1	Contractor
	3.2	Clearing and Grubbing		ac	0.3	
	3.3	Load, Haul, Place and Compact Overburden	Soil	yd^3	1,800	On-site, Emerald Cr.
	3.4	Site Grading		ac	2.5	
	3.5	Streambed Construction	Imported Streambed Material	t	92	Contractor
	3.6	Stream Bank Reconstruction	Both banks	ft	1,470	
			Woven coir fabric	sy	1,310	Contractor
			Non-woven coir fabric	sy	2,940	Contractor
	3.7	Log Weir and Pool Construction	Log and Rock	ea	25	Government
	3.8	Stream Log Installation	Log and Rock	ea	60	Government
	3.9	Cover Log Installation - Laborer	Log	hr	20	Government
	3.10	Cover Log Installation - Excavator with Thumb	Log	hr	10	Government
	3.11	Install Farm Fence	Fencing Materials	ft	1,910	Contractor
	3.12	Install Wire Gate	Gate Materials	ea	5	Contractor
	3.13	Emerald Creek Overburden Stockpile Dewatering System	Sump, Pump and Basin	ls	1	Contractor
REVEGETATION OF DISTURBED AREAS	4.1	Load, Haul, Place, Spread and Incorporate Organic Matter	Organic Matter	t	56.3	Contractor
	4.2	Seed Riparian Areas	Seed	ac	1.0	Contractor
	4.3	Fertilize and Seed Upland Areas	Fertilizer and Seed	ac	1.0	Contractor
	4.4	Seed Wetland Areas	Seed	ac	0.5	Contractor
	4.5	Provide and Place Erosion Control Blanket	Erosion control blanket	yd^2	12,100	Contractor
	4.6	Provide and Plant *Alnus ancana* ssp. *tenuifolia*	10T container	ea	473	Contractor
	4.7	Provide and Plant *Cornus Sericea*	10T container	ea	743	Contractor
	4.8	Provide and Plant *Paxistima myrsinites*	10T container	ea	275	Contractor
	4.9	Provide and Plant *Symphoricarpos albus*	10T container	ea	600	Contractor
	4.10	Provide and Plant *Abies grandis*	10T container	ea	60	Contractor
	4.11	Provide and Plant *Larix occidetalis*	10T container	ea	86	Contractor
	4.12	Provide and Plant *Pinus monticola*	10T container	ea	86	Contractor
	4.13	Provide and Plant *Pseudotsuga mensiesii*	10T container	ea	60	Contractor
	4.14	Provide and Plant *Thuja plicata*	10T container	ea	60	Contractor
	4.15	Provide and Plant *Salix exigua*	10T container	ea	350	Contractor

REV	DATE	DESCRIPTION	DRN BY	APP BY

Date: September 2006
Project #: 8681130.300
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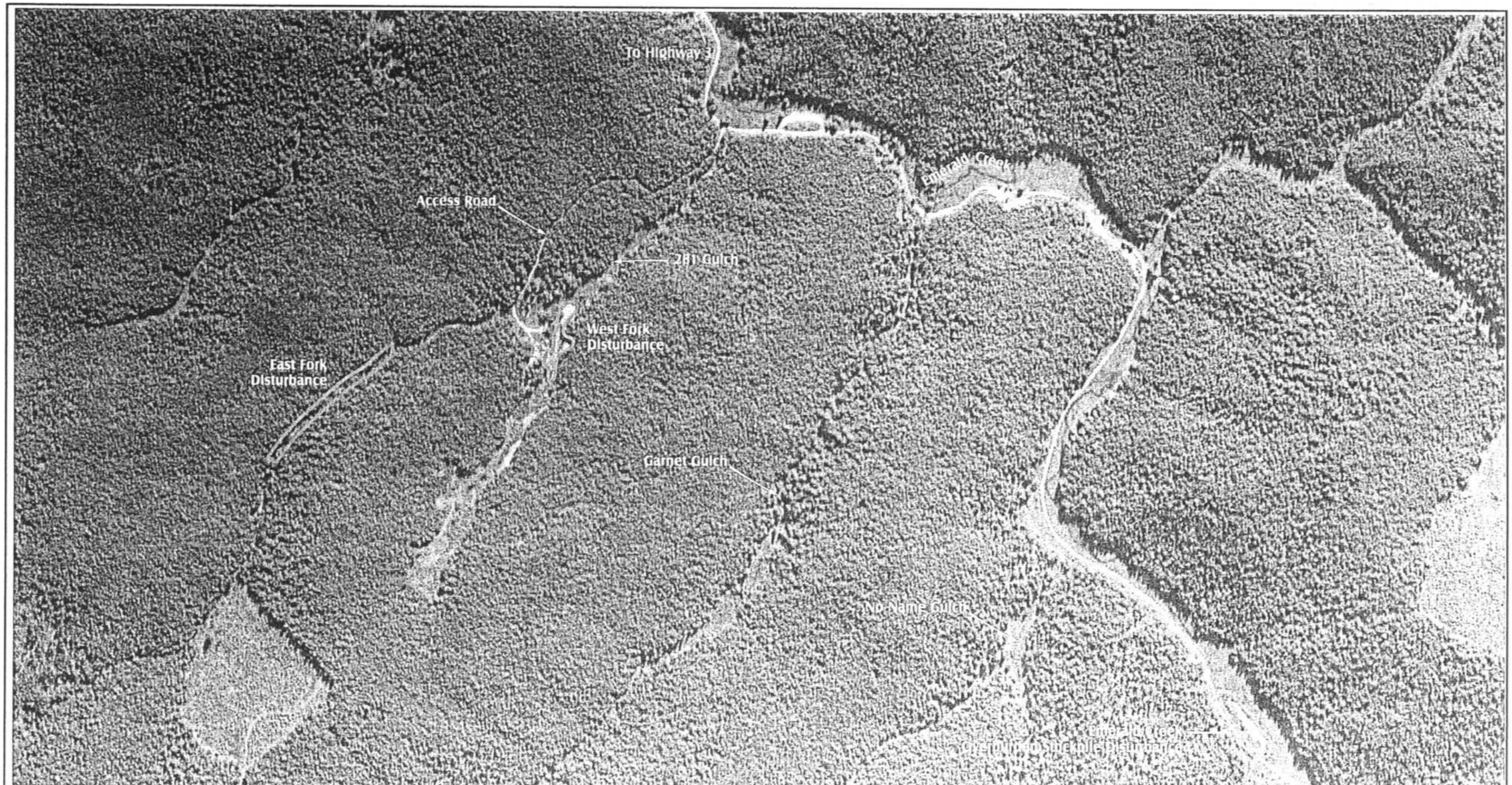
Project Title: St. Joe Garnet Workings Restoration

USDA FS

Sheet Title: Estimated Quantities

SHEET 2



N

0 Feet 500

Date: September 2006

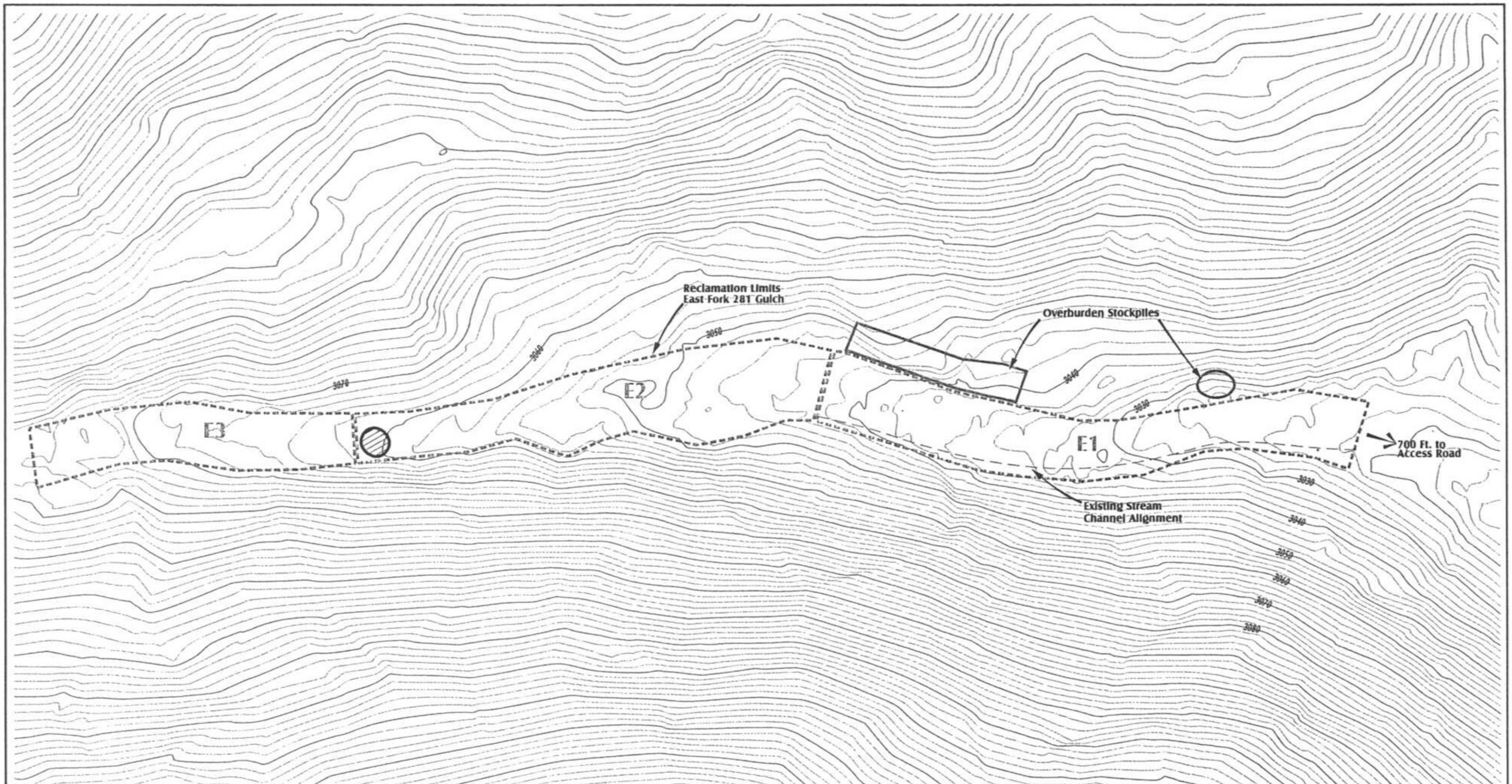
Project #: 8581130300

USDA

Project Title: St. Joe Garnet Workings Restoration

Sheet Title: Project Site Plan

SHEET 3

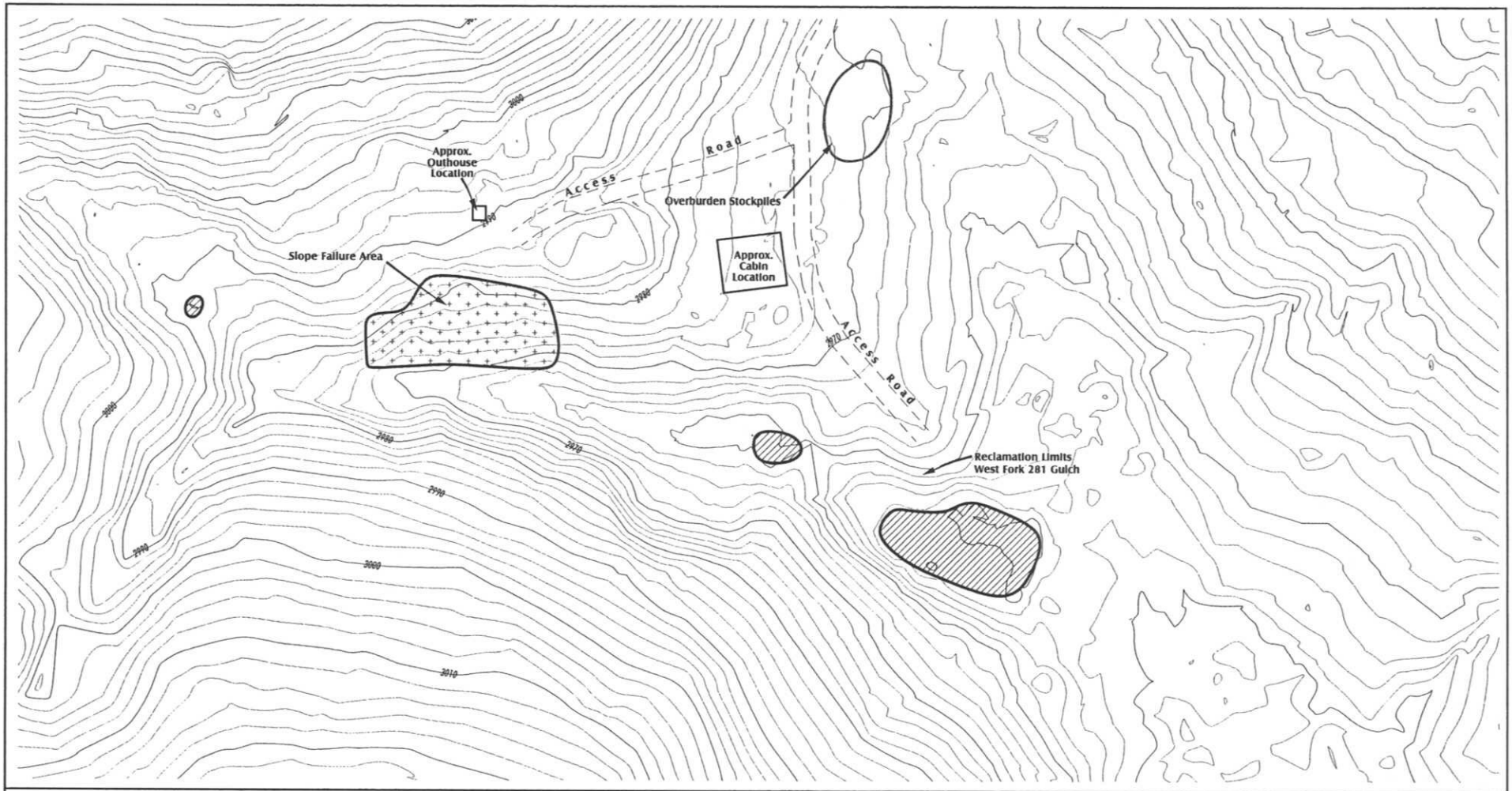


Sediment Basin
Existing Index Contours
Existing Intermediate Contours

0 Feet 50
Contour Interval = 2 ft.

REV	DATE	DESCRIPTION	DRN BY	APP BY

Date September 2006	Project Title St. Joe Garnet Workings Restoration
Project # 6541130 300	
USDA	Sheet Title East Fork 281 Gulch Existing Conditions SHEET 4



Sediment Basin
Existing Index Contours
Existing Intermediate Contours

N

0 Feet 50
Contour Interval = 2 ft.

REV	DATE	DESCRIPTION	DRN BY	APP BY

Date: September 2008
Project #: 8581130.300
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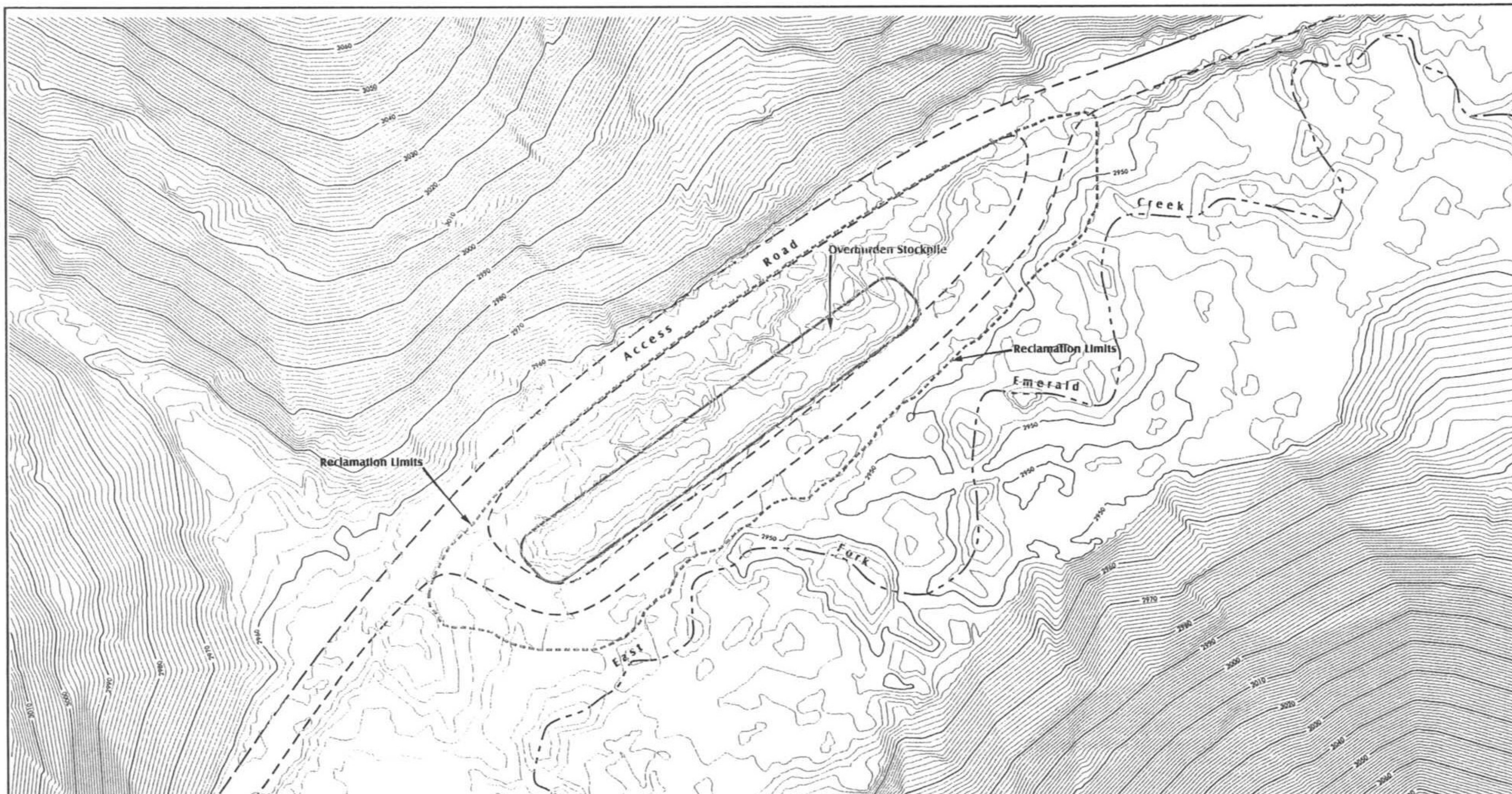
USDA FS

Project Title: St. Joe Garnet Workings Restoration

Sheet Title: West Fork 281 Gulch Existing Conditions

SHEET 5



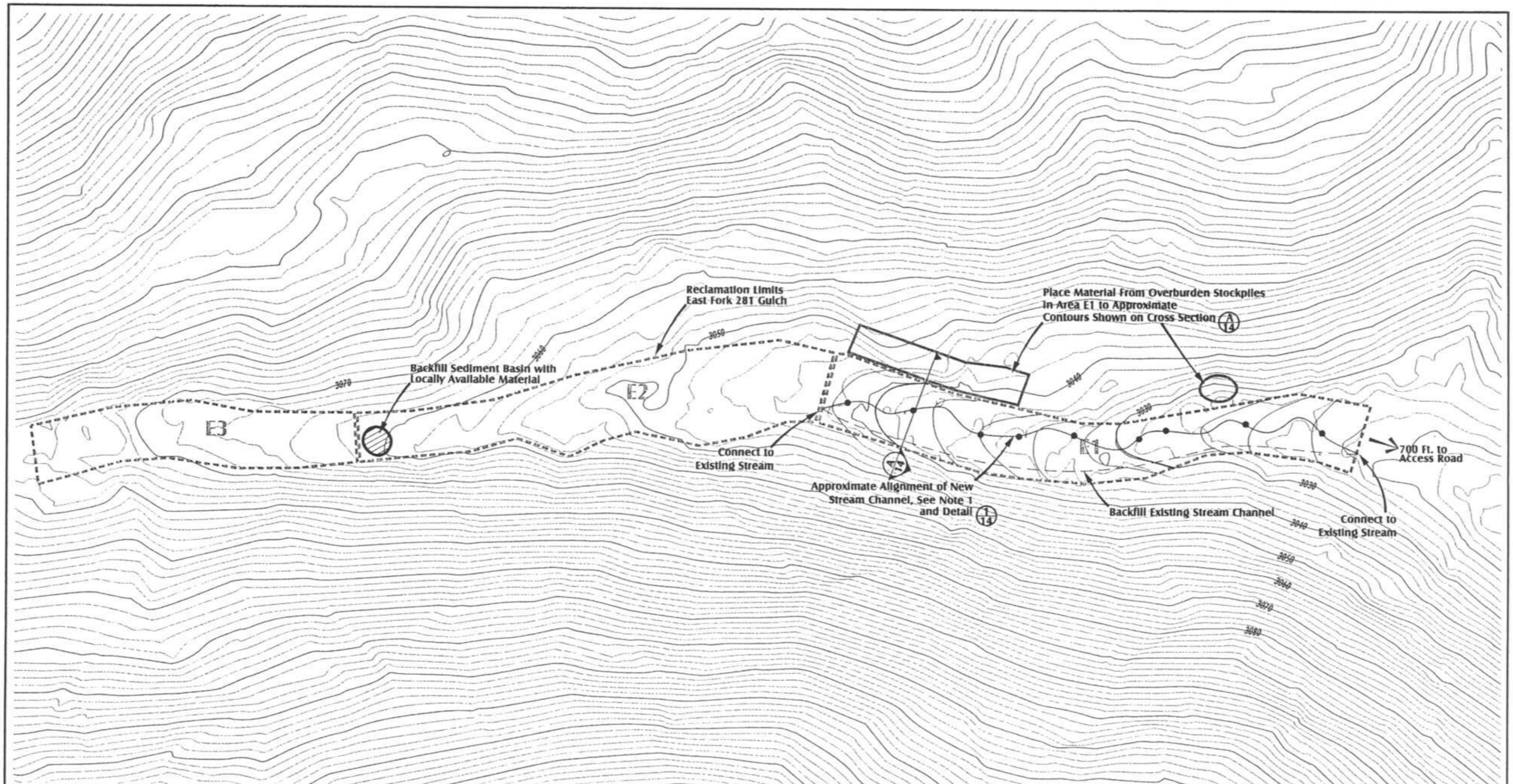
Existing Index Contours
Existing Intermediate Contours
Approximate Existing Creek Channel

REV	DATE	DESCRIPTION	DRN BY	APP BY

Date: September 2006
Project #: 6561130.300

Project Title: St. Joe Garnet Workings Restoration

Sheet Title: Emerald Creek Overburden Stockpile Existing Conditions SHEET 6



Notes:
1. Stream alignment shall have bends placed at an average spacing of 25 ft. Alignment to be determined by CO. Place log weir/pools on run (straight) sections.
2. Soil disturbance shall only occur in Area E1 and at sediment basin.
3. Small tracked equipment may access site from access road along gulch bottom.
4. Place cover logs in E1 and E3 at direction of CO. Cover logs in E3 shall be placed by hand only.
5. Bank logs (Sheet 14, Plan 4) and vanes (Sheet 14, Plan 5) will be located and placed at the direction of the CO.

Sediment Basin
Existing Stream Channel
New Stream Channel
Existing Contours
Regraded Contours
Construct Log Weir/Pool

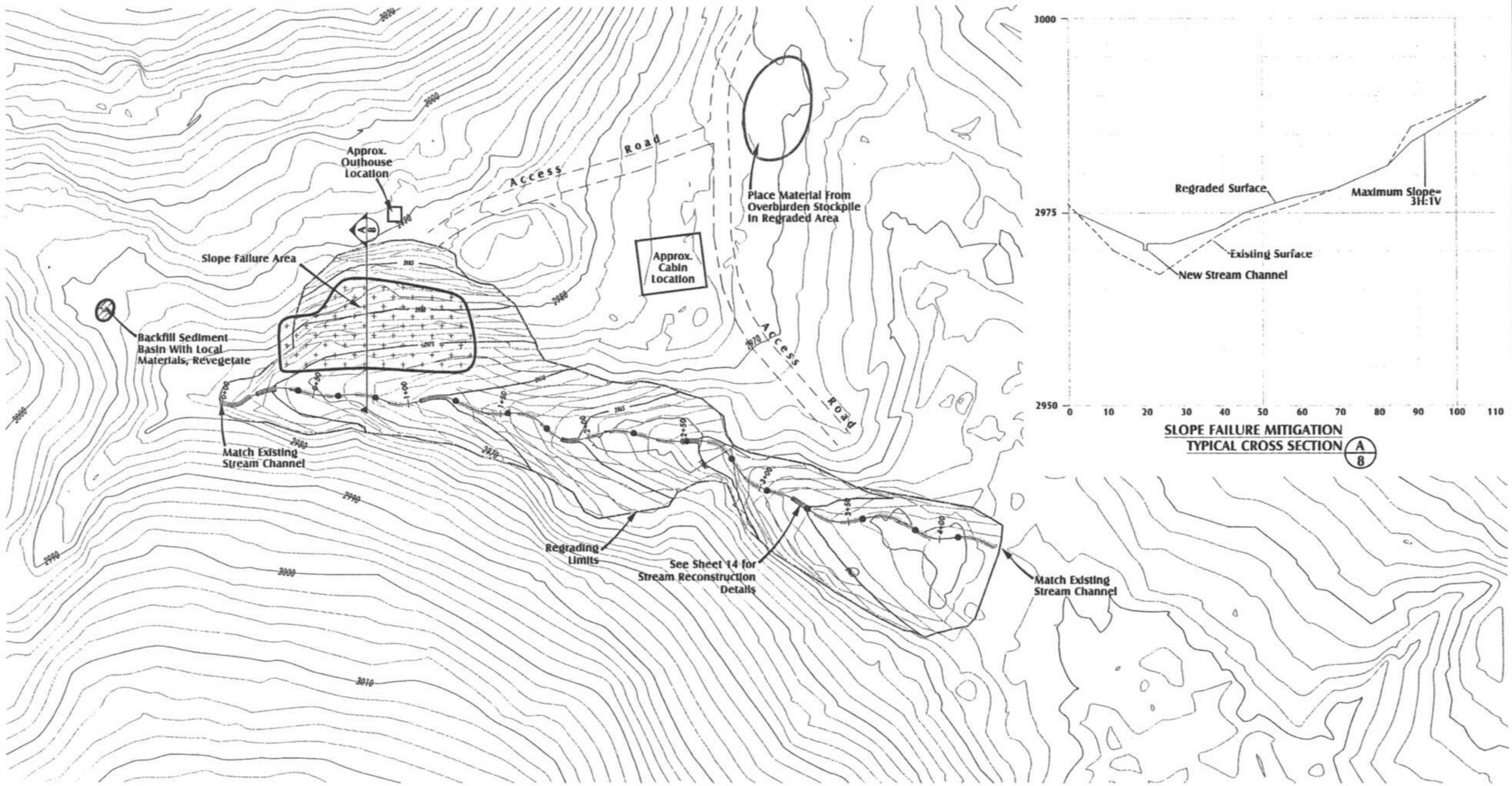
0 Feet 50
Contour Interval = 2 ft.

REV	DATE	DESCRIPTION	DRN BY	APP BY

Date: September 2006
Project #: 6561130.300

St. Joe Garnet Workings Restoration

East Fork 281 Gulch Restoration Plan
SHEET 7



Notes:

1. Use stockpiled overburden from on-site stockpile and Emerald Creek stockpile to recontour disturbed area.

2. Longitudinal profile of existing and reconstructed stream channel is on sheet 10. CO will stake approximate channel alignment and fill depth.

3. Place cover logs at direction of CO.

4. Bank logs (Sheet 14, Plan 4) and vanes (Sheet 14, Plan 5) will be located and placed at the direction of the CO.

- Sediment Basin
- Existing Index Contours
- Existing Intermediate Contours (2 ft. Intervals)
- Reclamation Index Contours
- Reclamation Intermediate Contours (1 ft. Intervals)
- New Stream Channel
- Construct Log Weir/Pool

N

0 Feet 50

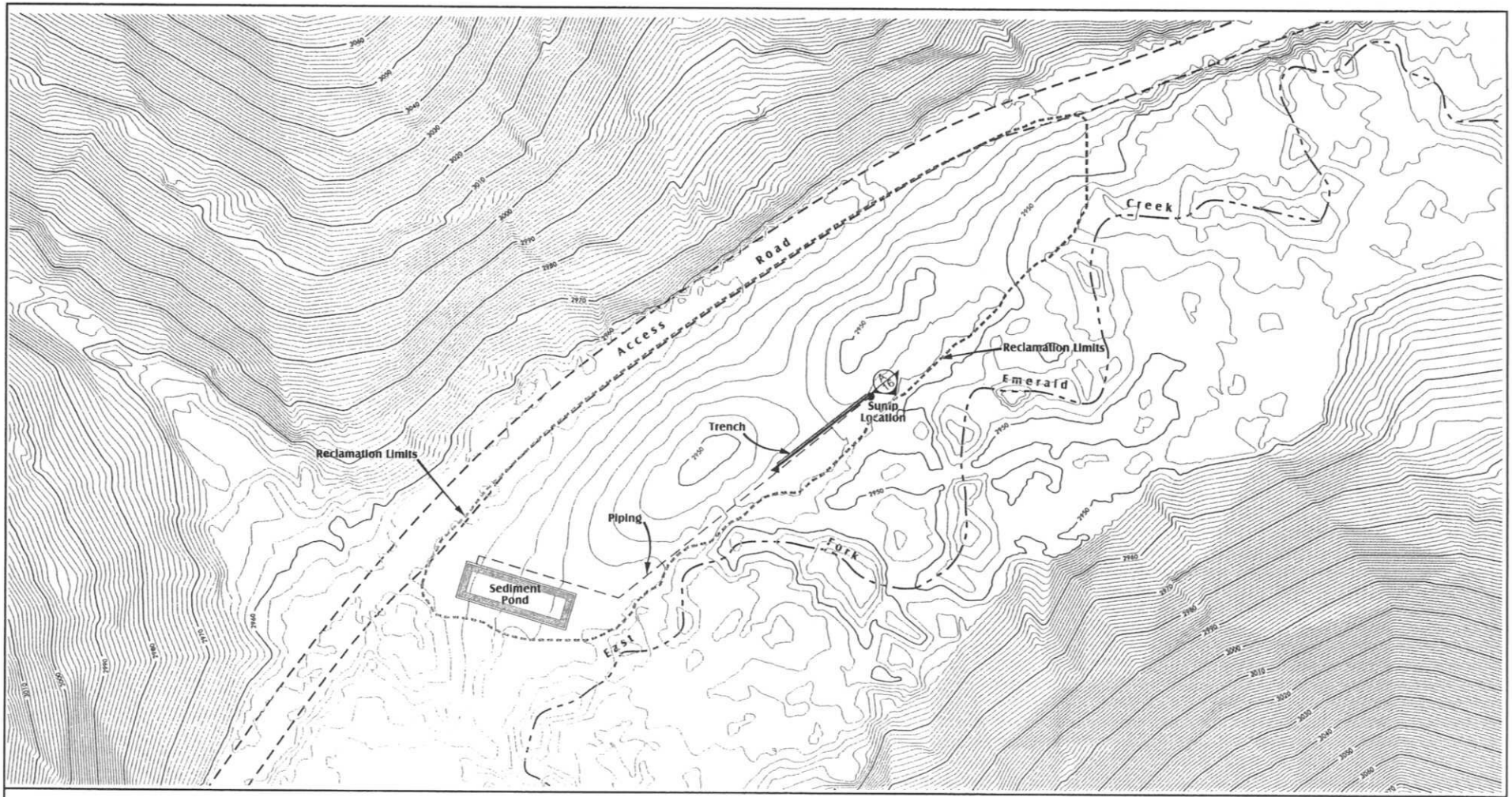
REV	DATE	DESCRIPTION	DRN BY	APP BY

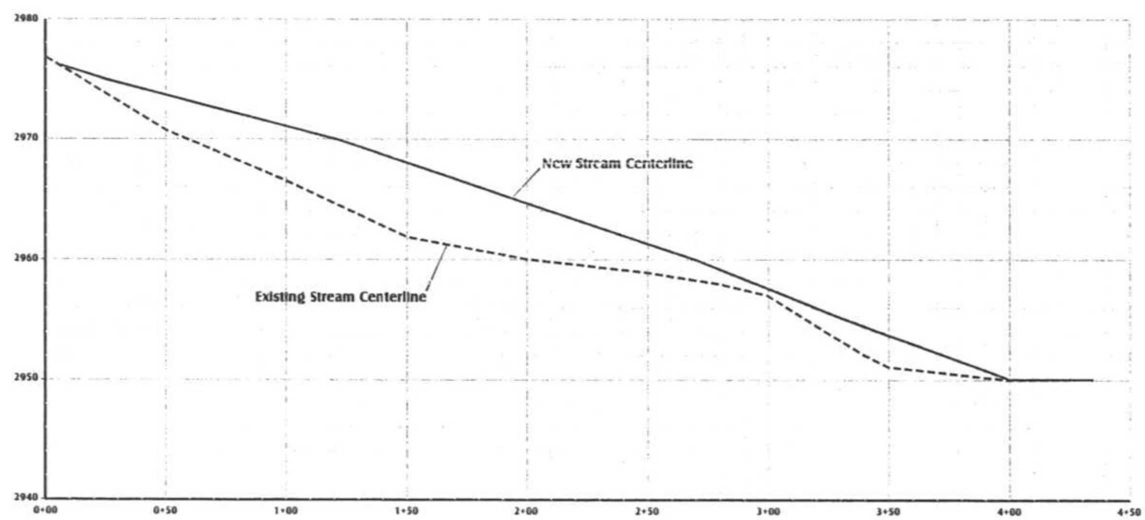
Date: September 2006
Project #: 6581130.300

Project Title: St. Joe Garnet Workings Restoration

Sheet Title: West Fork 281 Gulch Restoration Plan

SHEET 8


Access Road
Creek
Reclamation Limits
Emerald
Sump Location
Trench
Reclamation Limits
Piping
Fork
Sediment Pond
East
Existing Index Contours
Existing Intermediate Contours
Regraded Index Contours
Regraded Intermediate Contours
Approximate Existing Creek Channel
N
0 Feet 50
Contour Interval = 1 ft.
REV
DATE
DESCRIPTION
DRN BY
APP BY
Date September 2008
Project # 4581130.300
File
St. Joe Garnet
Workings Restoration
USDA
Emerald Creek Overburden Stockpile
Restoration Plan
SHEET 9

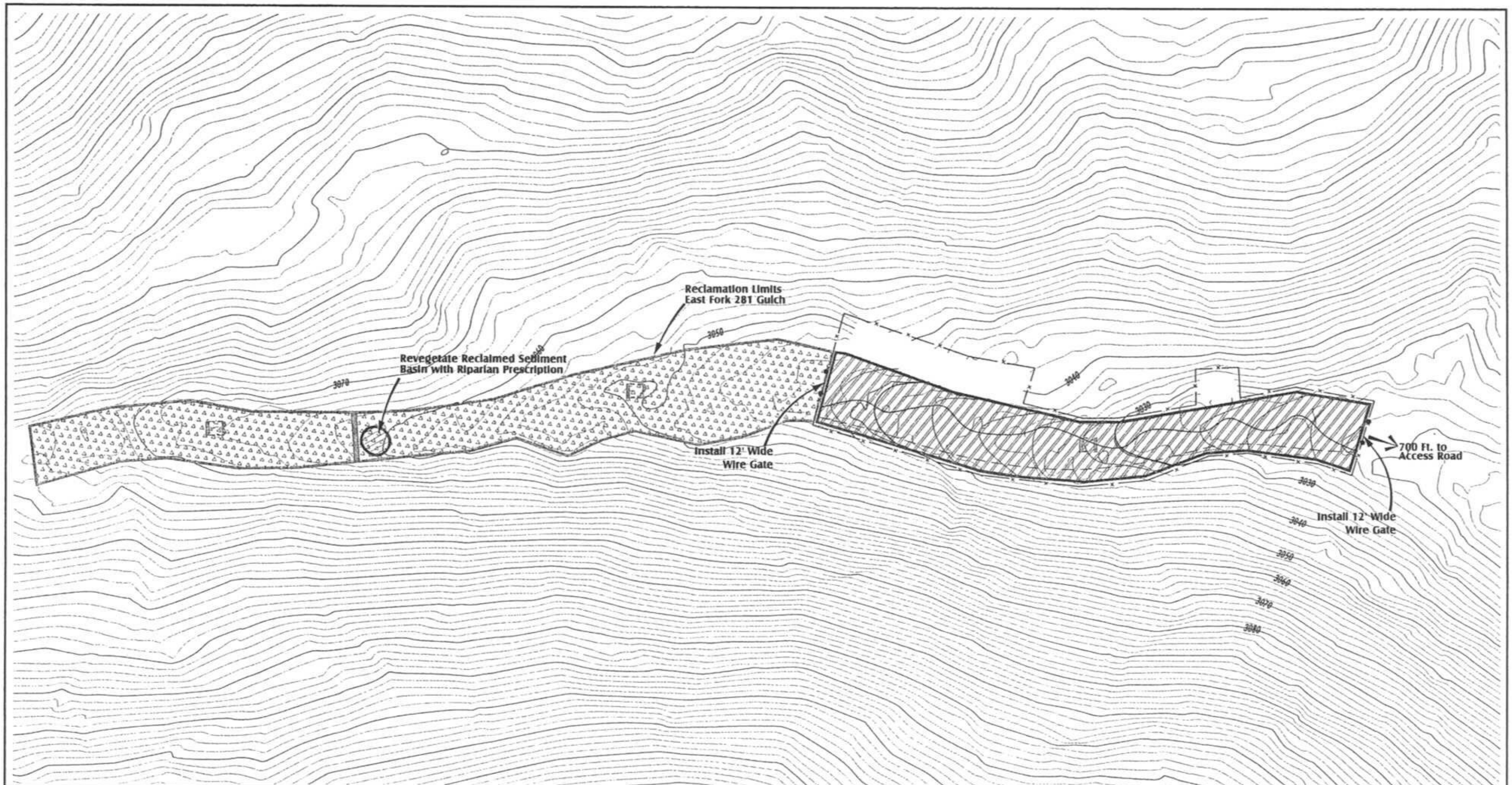


WEST FORK 281 GULCH
STREAM PROFILE

Horiz. Scale: 1"= 50'
Vert. Scale: 1"= 10'

REV	DATE	DESCRIPTION	DRN BY	APP BY

Date: May 2006	Project Title: St. Joe Garnet Workings Restoration
Project # 6561130.300	
File: [illegible]	
	Sheet Title: West Fork 281 Gulch Stream Profile SHEET 10



Notes:
1. Soil disturbance shall only occur in Area E1 and at sediment basin.
2. Small tracked equipment may access site from access road along gulch bottom.

- – – – Existing Stream Channel
- —— New Stream Channel
- Existing Contours
- Regraded Contours
- Riparian Prescription Shrubs Only
- Upland Prescription
- Riparian Prescription
- —×— Install 4-Strand Barbed Wire Fence

0 Feet 50
Contour Interval = 2 ft.

REV	DATE	DESCRIPTION	DRN BY	APP BY

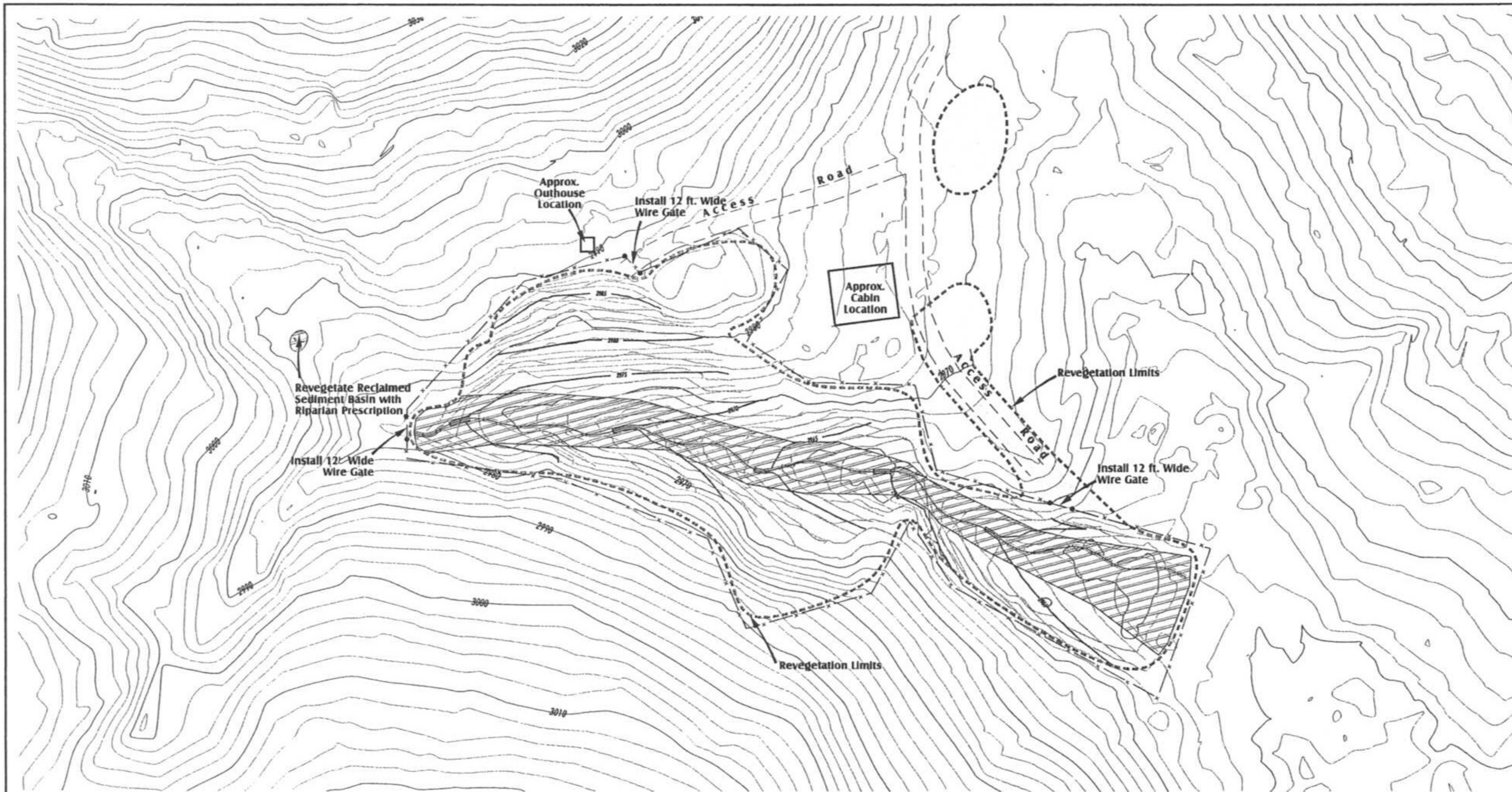
Date: September 2006
Project #: 6581130 300

Project Title: St. Joe Garnet Workings Restoration

Sheet Title: East Fork 281 Gulch Revegetation Plan

SHEET 11

USDA



Existing Index Contours
Existing Intermediate Contours (2 ft. Intervals)
Reclamation Index Contours
Reclamation Intermediate Contours (1 ft. Intervals)
New Stream Channel

Upland Prescription
Riparian Prescription
Install 4-Strand Barbed Wire Fence

N

0 Feet 50

REV	DATE	DESCRIPTION	DRN BY	APP BY

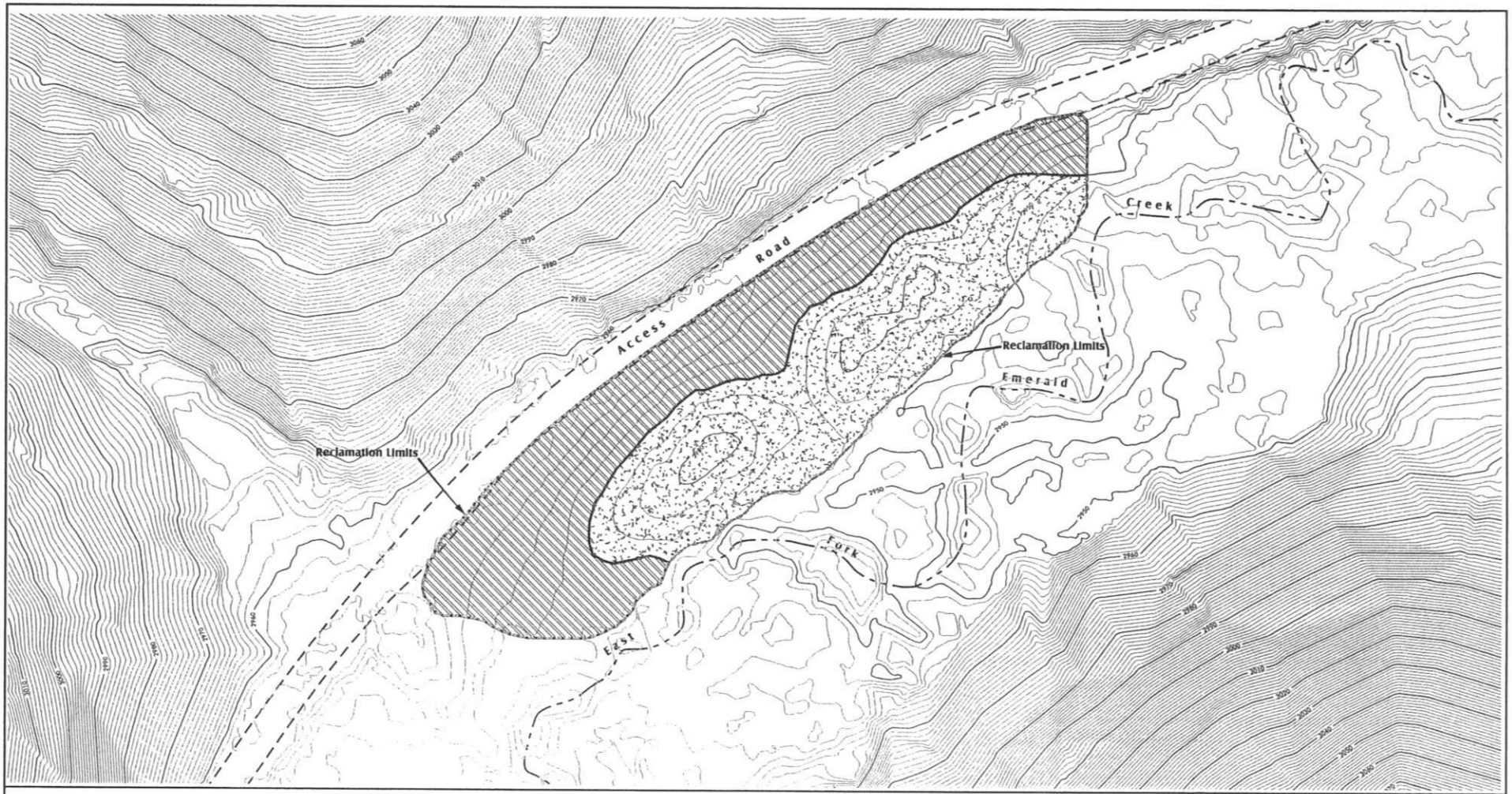
Date: September 2008
Project #: 6561130.300

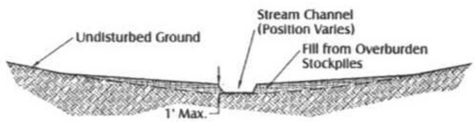
Project Title: St. Joe Garnet Workings Restoration

Sheet Title: West Fork 281 Gulch Revegetation Plan

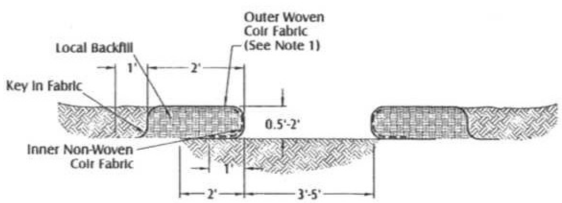
SHEET 12

USDA

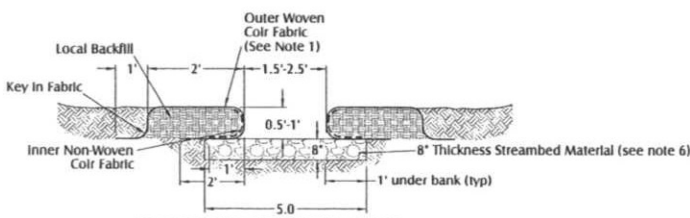

Access Road
Reclamation Limits
Reclamation Limits
Creek
Emerald
Fork
East
Existing Index Contours
Existing Intermediate Contours
Regraded Index Contours
Regraded Intermediate Contours
Approximate Existing Creek Channel
Wetland Prescription
Riparian Prescription
N
0 Feet 50
Contour Interval = 1 ft.
REV
DATE
DESCRIPTION
DRN BY
APP BY
Date September 2008
Project # 6581130.300
St. Joe Garnet
Workings Restoration
USDA
Emerald Creek Overburden Stockpile
Revegetation Plan
SHEET 13



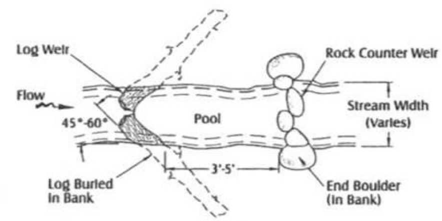
Typical East Fork 281 Gulch
Cross Section A/14
Not to Scale



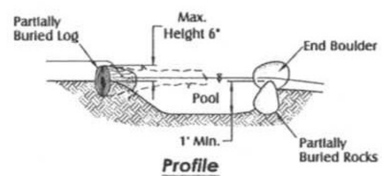
Typical East Fork 281 Gulch
Channel Detail 1/14
Not to Scale



Typical West Fork 281 Gulch
Channel Detail 2/14
Not to Scale

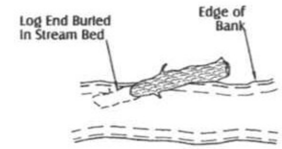


Plan

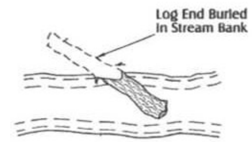


Profile

Log Weir and Pool 3/14
Not to Scale



Bank Log Plan 4/14
Not to Scale



Vane Plan 5/14
Not to Scale

Notes:
1. Construct fabric encapsulated soil lifts each side. Insert logs and large rock at direction of CO.
2. Logs used as weirs should have a diameter of at least 12 inches and should be buried in the streambed for at least one-half their diameter. Rock for counterweir and end boulders should have an intermediate axis of at least 12 inches.
3. Log weirs may be replaced with rock weirs constructed from rock with an intermediate axis 12 inches or greater. Place rock in approximate positions shown for logs and place end boulders at weir edge in streambanks.
4. Bank logs may have either the upstream or downstream end buried in the streambed.
5. Logs used as vanes should not extend further than the centerline of the stream. Vanes can face either upstream or downstream.
6. Streambed material shall be placed prior to bank construction and shall conform to the following gradation:

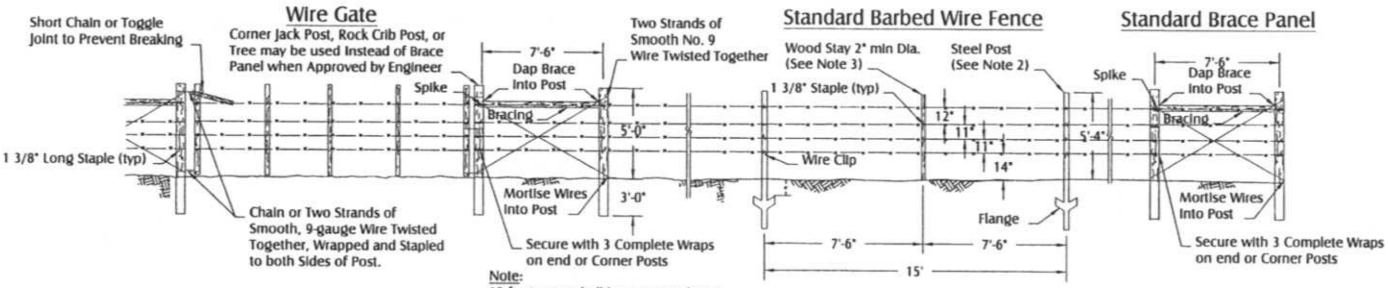
Size	% Passing
6"	100
3"	85 - 90
2"	45 - 65
1"	30 - 50
¾"	10-20
No. 4	<10

REV	DATE	DESCRIPTION	DRN BY	APP BY

Date: September 2006
Project #: 6561130 300
Project Title: St. Joe Garnet Workings Restoration
Sheet Title: Stream Reconstruction Details
SHEET 14

USDA

Wire Gate / Standard Barbed Wire Fence / Standard Brace Panel



Note:
12 foot gates shall have two end stays and three stays evenly spaced in span. If desired, two wire stays may be used, one on each side of the middle wood stay. Spacing of stays not to exceed 3 feet in wider gates. (Any additional stays required must be of wire).

Notes:

1. Standard four-wire gate will be 12 feet wide (opening) unless otherwise designated in the project specifications. End stays will be 3 1/2 inches minimum diameter. Center stays will be 2 1/2 inches minimum diameter.

2. 4-inch minimum diameter treated wood posts may be substituted for metal posts with approval of the CO.

3. Wood stays will be 2 inches minimum diameter, wire stay to by number 9 wire.

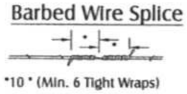
4. All barbed-wire to be 12 1/2 gauge, w-point, with barbs 4 to 5 inches apart.

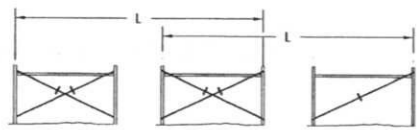
5. All posts in brace panels shall be rough sawn 6" x 6" x 8 feet Ponderosa Pine, Douglas Fir, or Western Larch, No. 2 or Standard Grade. All bracing shall be rough sawn 4" x 4" Ponderosa Pine, Douglas Fir, or Western Larch, No. 2 or Standard Grade. Post shall be pressure treated in accordance with AWPA C-2 Using one of the following treatments: (1) Pentachlorophenol meeting AWPA P-8 using an AWPA P-9 Type A solvent to a retention of 6 kg/m3; (2) Creosote meeting AWPA P1/P13 to a retention of 130 kg/m3. Penetration shall be as specified in AWPA C-2.

Note:
Use double end panels only when the angle is greater than 30° and the run length requires a double panel

Double End Panel
(For Angles Greater Than 30° and for Runs Greater Than 100 yards for Woven and 200 yards for Barbed)

Barbed Wire Splice

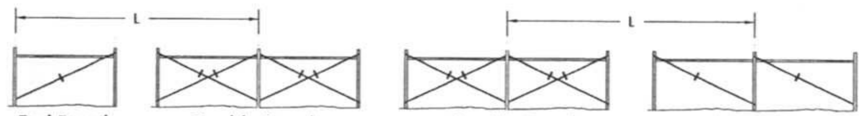




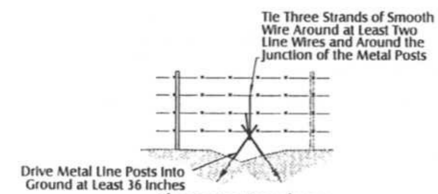
Single Panel   Single Panel   End Panel

Note:
Tie off on all shaded hatched posts.
End panels require brace wires only in one direction

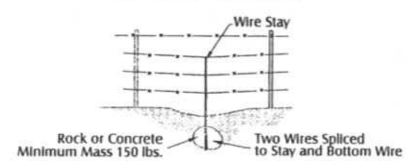
Fence Type	Run-L (in yards)	Panel Required
Barbed	100 or Less 100 - 200 200- 500	None Single or End Double



End Panel   Double Panel   Double Panel   Double End Panel (Straight Run)



Alternate Deadman

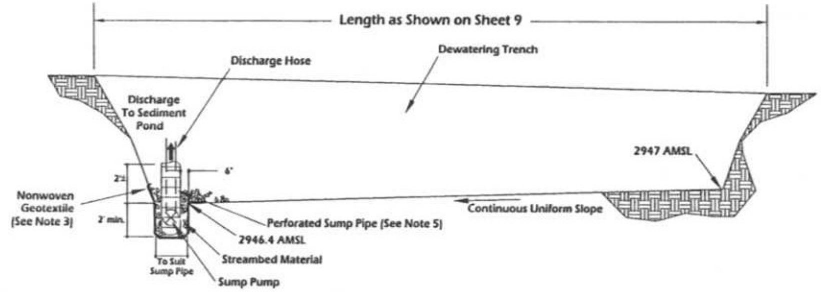


Primary Deadman

Not to Scale

REV	DATE	DESCRIPTION	DRN BY	APP BY

Date September 2006
Project # 6561130.300
File: \elote\st joe garnet\cadprd\fencedts.dwg
Project Title: St. Joe Garnet Workings Restoration
Sheet Title: Fence Details
SHEET 15
USDA



A
16
Typical Groundwater Dewatering Trench and Sump Profile
Not to Scale

NOTES:

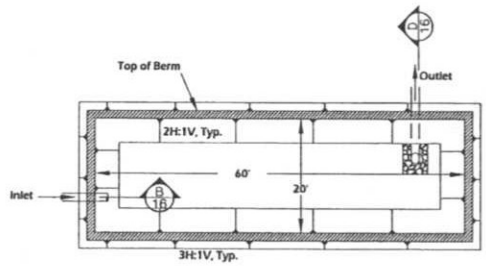
1. Discharge clarified water from sediment basin to Emerald Creek, using either pump outlet or gravity outlet. The creek channel banks shall be protected from erosion at the basin discharge point in a similar manner as the sediment basin inlet.

2. Outlet pipe shall be CMP or HDPE, smooth interior corrugated, Advanced Drainage Systems, Inc. Type N-12 or equal. Pipe and fittings shall be minimum 6" diameter.

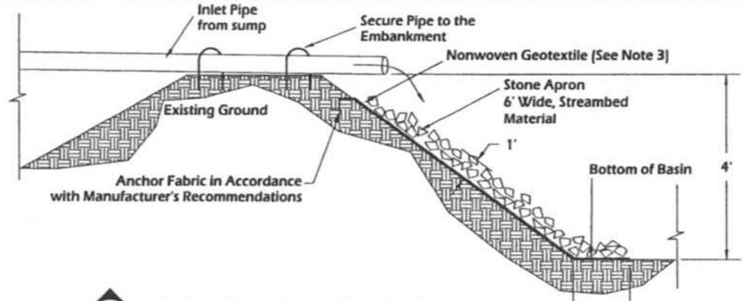
3. Geotextile shall be as described in the Special Provisions.

4. The fill for the sediment detention basin berm and dewatering trench shall be on-site materials from the basin and trench excavation. Fill shall be compacted in lifts of 12" using rubber tired equipment or rammer tamper. Fill shall have no rocks larger than 6" diameter. Each compacted lift shall be scarified to a depth of at least 2" prior to the placement of the next lift.

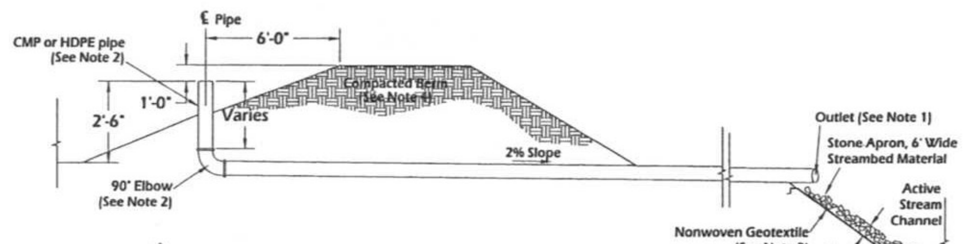
5. Sump pipe shall be 14 gage, 24" or 36" diameter CMP. Open space of perforations in sump pipe shall exceed 80 square inches per 100 feet of trench.



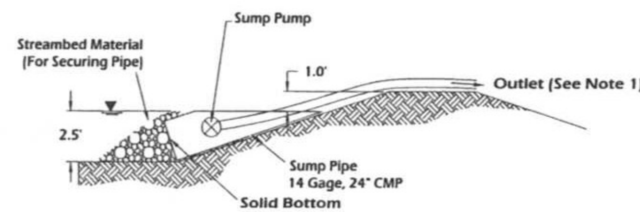
Plan View Sediment Detention Pond
Not to Scale



B
16
Inlet Section, Typical
Not to Scale



C
16
Gravity Outlet Section, Typical
Not to Scale



D
16
Pump Outlet Section, Typical
Not To Scale

REV	DATE	DESCRIPTION	DRN BY	APP BY

Date: September 2006
Project #: 6581130300
File: [illegible]

Project Title: St. Joe Garnet Workings Restoration

Sheet Title: Emerald Creek Overburden Stockpile Dewatering System Details
SHEET 16

USDA

STREAM AND RIPARIAN MONITORING PLAN

for the

East and West Forks of the 281 Gulch Restoration

Idaho Panhandle National Forests
Latah County, Idaho

STREAM AND RIPARIAN MONITORING PLAN

for the

East and West Forks of the 281 Gulch Restoration

Idaho Panhandle National Forests
Latah County, Idaho

Prepared for:

USDA Forest Service – Region 1
P.O. Box 7669
Missoula, MT 59807

Prepared by:

Maxim Technologies
P.O. Box 4699
Helena, MT 59604
August 1, 2006

Edited by:
St. Joe Ranger District
August 31, 2006

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1.0 INTRODUCTION

This monitoring plan has been developed for the USDA Forest Service (Forest Service), Idaho Panhandle National Forests, under contract No. GS-10F-0268K. The purpose of the plan is to establish an annual monitoring protocol for the East and West Forks of 281 Gulch following its restoration. A tributary of Emerald Creek, 281 Gulch is located in the Idaho Panhandle National Forests, south of St. Maries, Idaho (**Figure 1**). Although initial restoration efforts have been applied, recreational mining is an ongoing activity and restoration of the existing disturbance in the East Fork will continue in the future. The Forest Service has conducted non-commercial, recreational garnet mining in the East and West Forks. The Emerald Creek Garnet Area Final Environmental Impact Statement discusses existing conditions and effects of previous activities (FEIS pp. 40 – 198).

Monitoring objectives for the East and West Forks of 281 Gulch are wetland protection, attainment of water quality goals, and maintenance of fish and wildlife species. Specific wetland monitoring objectives are maintenance of:

1. Cover for weed prevention
2. Species diversity
3. Species populations

Specific water quality monitoring objectives are attainment of requirements for:

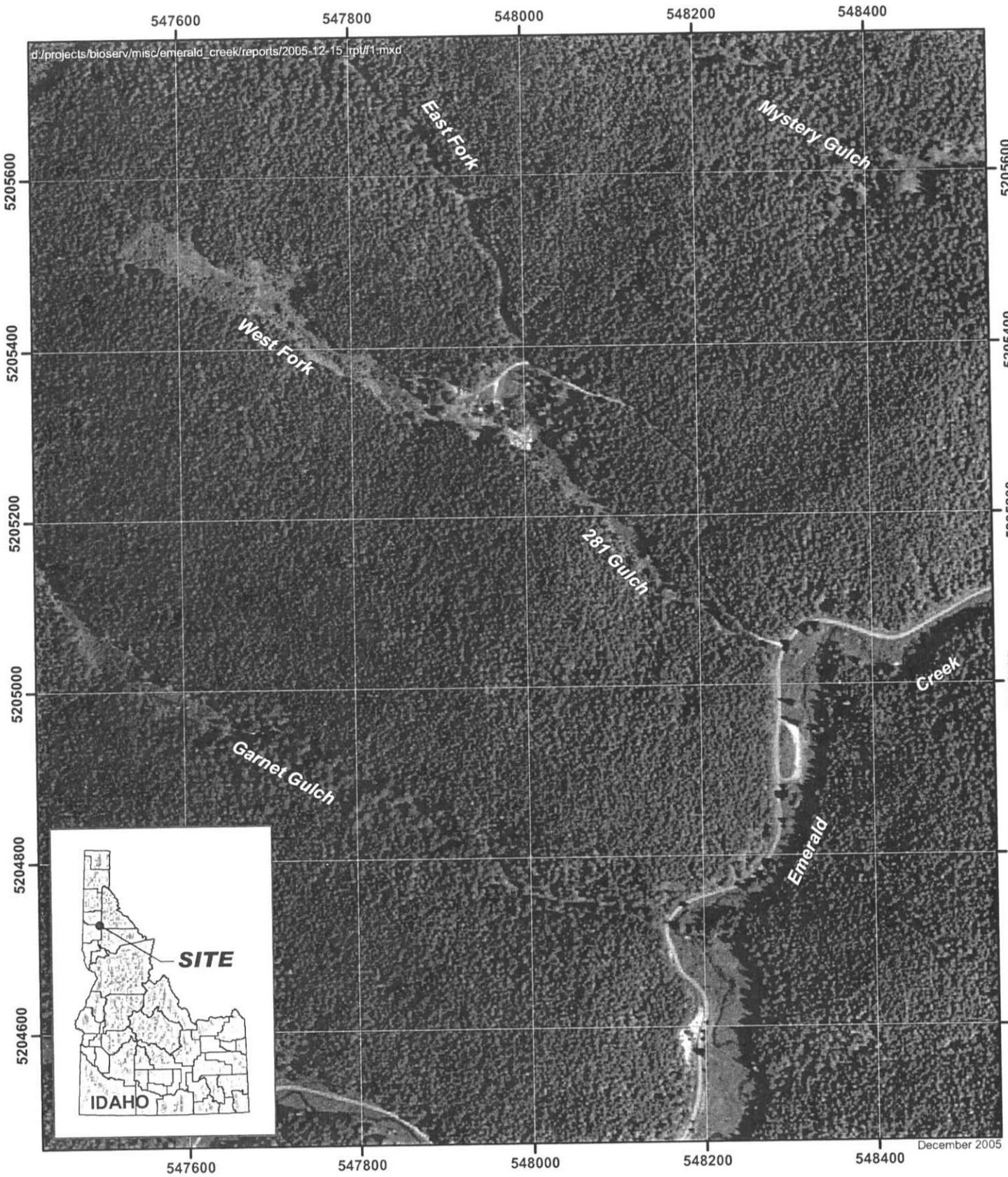
1. Temperature
2. Sediment
3. Streambank stability

Objectives for fish maintenance include:

1. Maintain fish access
2. Provide diverse habitat.

The objective for wildlife maintenance is to maintain adequate wetland habitat, both in quality and quantity, for sensitive species.

Restoration of the East and West Forks will generally consist of replacing overburden, establishing new channels, addition of CWD, and revegetation of the riparian areas and adjacent upland areas that have been disturbed. Monitoring of riparian and stream ecological and physical parameters as they relate to the restoration actions will provide an annual assessment of the restored function of the systems over time. These parameters will be compared with those from Garnet Gulch (**Figure 2**), an adjacent stream system of similar and comparable climate, elevation, aspect, gradient, substrate and geology, hydrology, and vegetation that has experienced relatively little human disturbance. Comparisons will provide baseline criteria for measurement of success while also providing for evaluation of year to year environmental variation (i.e. temperature and precipitation).



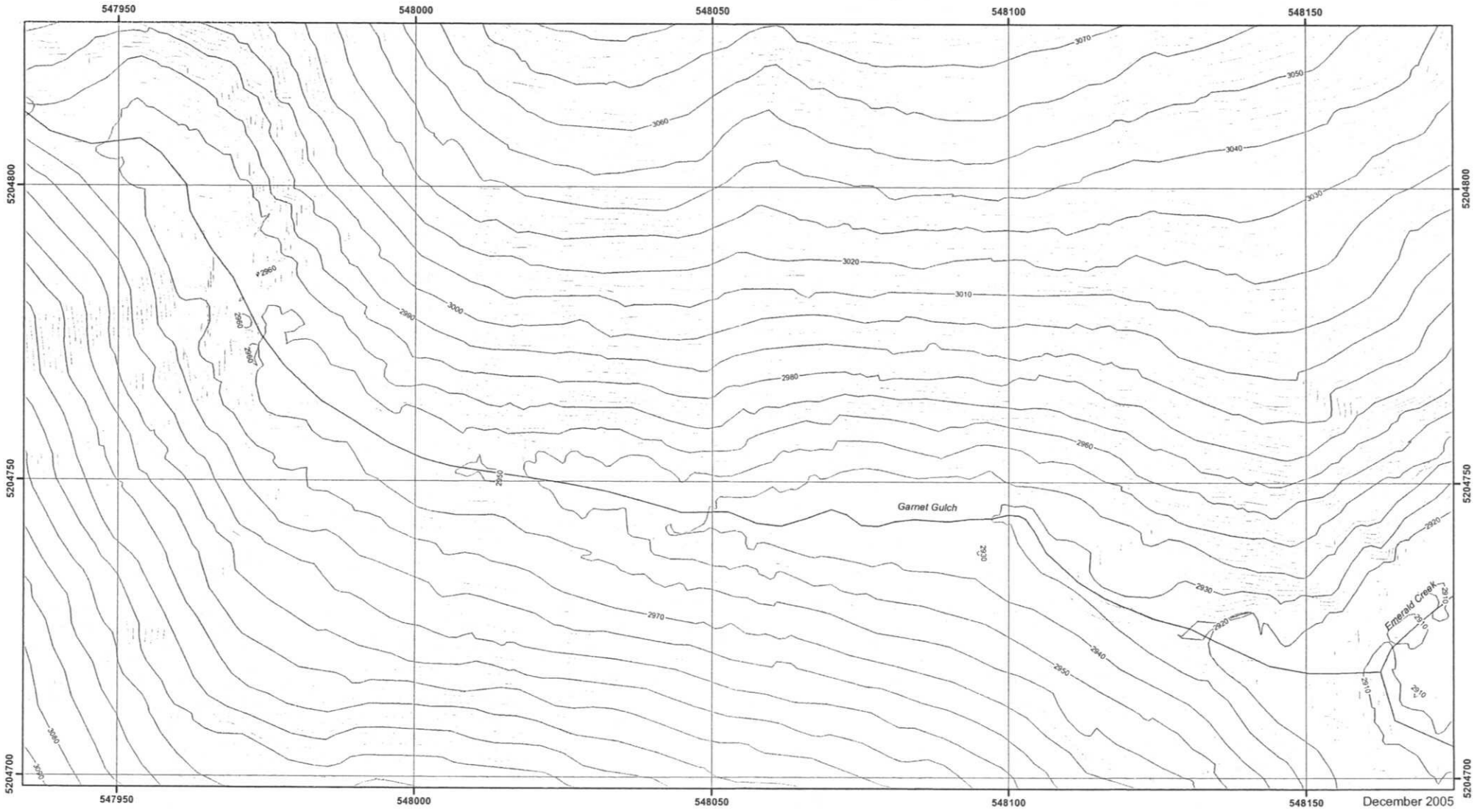
From USDA Preliminary 2004 Digital Ortho Image [Compressed County Mosaic (CCM)] of Latah County, Idaho from Imagery Acquired in the National Agriculture Imagery Program (NAIP)
Map Projection - NAD 1983 UTM Zone 11 North

N

0 500
Feet

MAXIM TECHNOLOGIES INC. 6561130.100

Project Site Location
Garnet Area Revegetation Project
Latah County, Idaho
FIGURE 1



Map Projection - NAD 1983 UTM Zone 11 North

N

0 50
Feet

MAXIM TECHNOLOGIES INC 6561130.100

Garnet Gulch
Garnet Area Revegetation Project
Latah County, Idaho
FIGURE 2

2.0 SITE DESCRIPTIONS

The East Fork has already received varying levels of restoration. Based on previous restoration efforts, and planned restoration actions, the East Fork can be divided into three sections: E1, E2, and E3 (**Figure 3**). E1, the furthest downstream, will require complete restoration entailing replacement of overburden, channel modifications, CWD supplements, and revegetation. In areas E2 and E3, channel modification and CWD supplements have already been implemented. However, both sections would likely benefit from additional revegetation. Previous disturbance and restoration, and proposed restoration, applies exclusively to the riparian area. No disturbance has occurred, or is planned, for the adjacent uplands in the East Fork.

The reclaimed portion of the East Fork system is 700' in length exhibiting a 7.7% slope. The E1 section is 0.18 acres. The E2 and E3 sections are 0.15 acres each. As previously discussed, these areas reflect only the riparian area as no restoration activities are planned for the uplands.

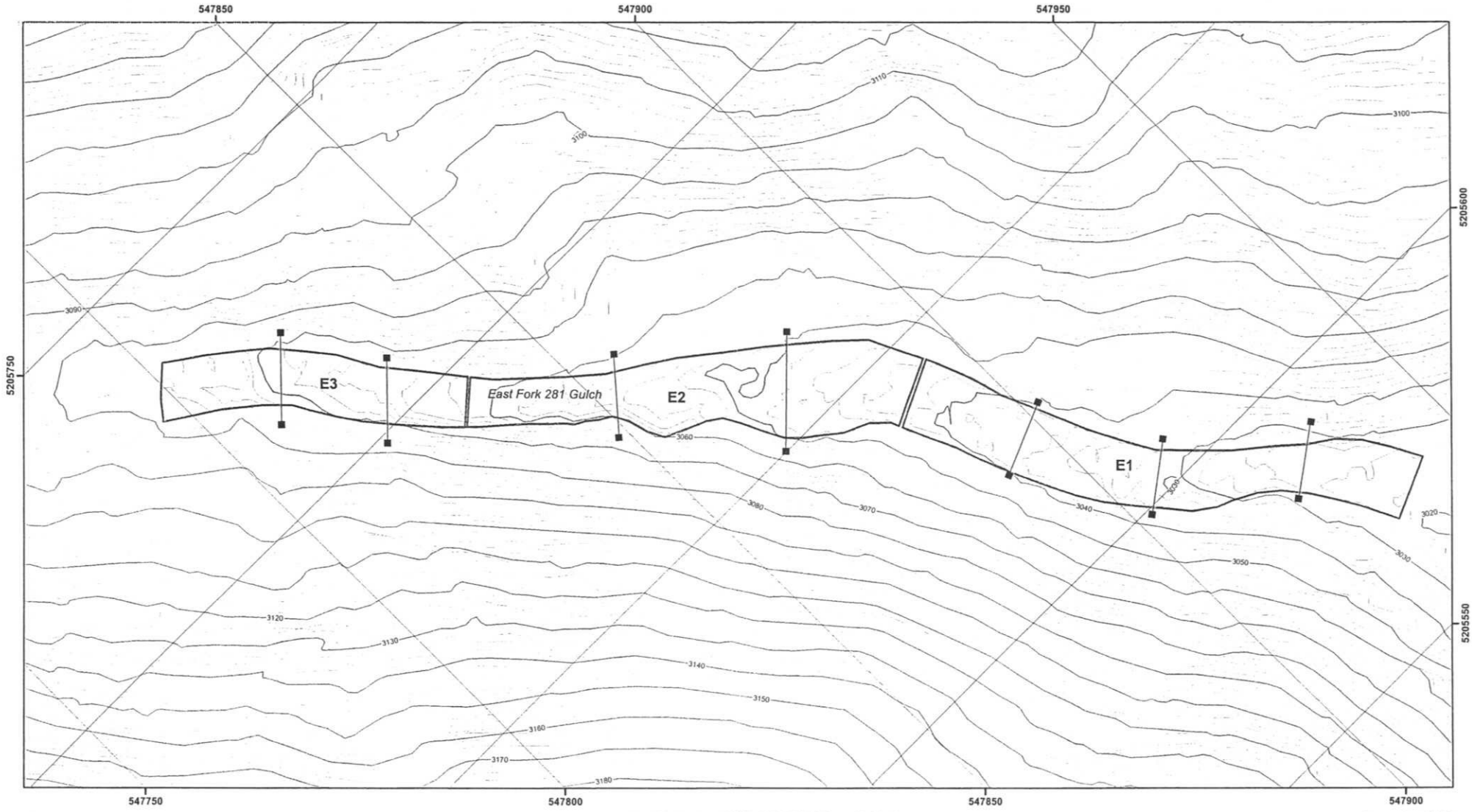
The West Fork project reach, 410' in length, 0.71 acres in area, and exhibiting a gradient of 4.9%, will receive the full level of restoration (**Figure 4**). Previous mining activities and indirect disturbances associated with those activities have resulted in a loss of sediment and substrate. Much of that loss is associated with direct removal of substrate in the form overburden. As a result, the existing channel is lower in elevation than it was historically. The existing channel has several potential fish passage barriers and minimal pool habitat. Additionally, the riparian area has been narrowed and reduced to sparsely vegetated steep slopes. Some of the removed overburden remains on site with the remainder located along Emerald Creek about 1.4 miles distant. To amend the existing stream system, fill from the overburden piles will be placed back in the channel and the historical riparian area. A new channel will be developed, CWD will be added, and the entire disturbed area will be revegetated. The expected disturbance associated with the restoration will include the adjacent uplands along much of the reach.

3.0 MONITORING PARAMETERS

The following parameters have been selected for monitoring in this plan:

- Water chemistry (pH, stream and air temperature, dissolved oxygen, specific conductance, turbidity) – The Emerald Creek Garnet Area EIS does not require monitoring of pH, air temperature, dissolved oxygen, and specific conductance; but they are listed here because standard water chemistry monitoring equipment collects all the listed water chemistry components.
- Herbaceous cover
- Noxious weed occurrence
- Wetlands
- Fish Habitat and Stream Morphology

Monitoring of these parameters will enable investigators to detect elements of the restoration that may require further attention to avoid a failure. While failure is not anticipated, unforeseen environmental factors can drive restoration projects into downward trends. Repeated monitoring also allows the land managers to adjust restoration efforts to ensure that the system is restored to its natural and historical function.



Map Projection - NAD 1983 UTM Zone 11 North

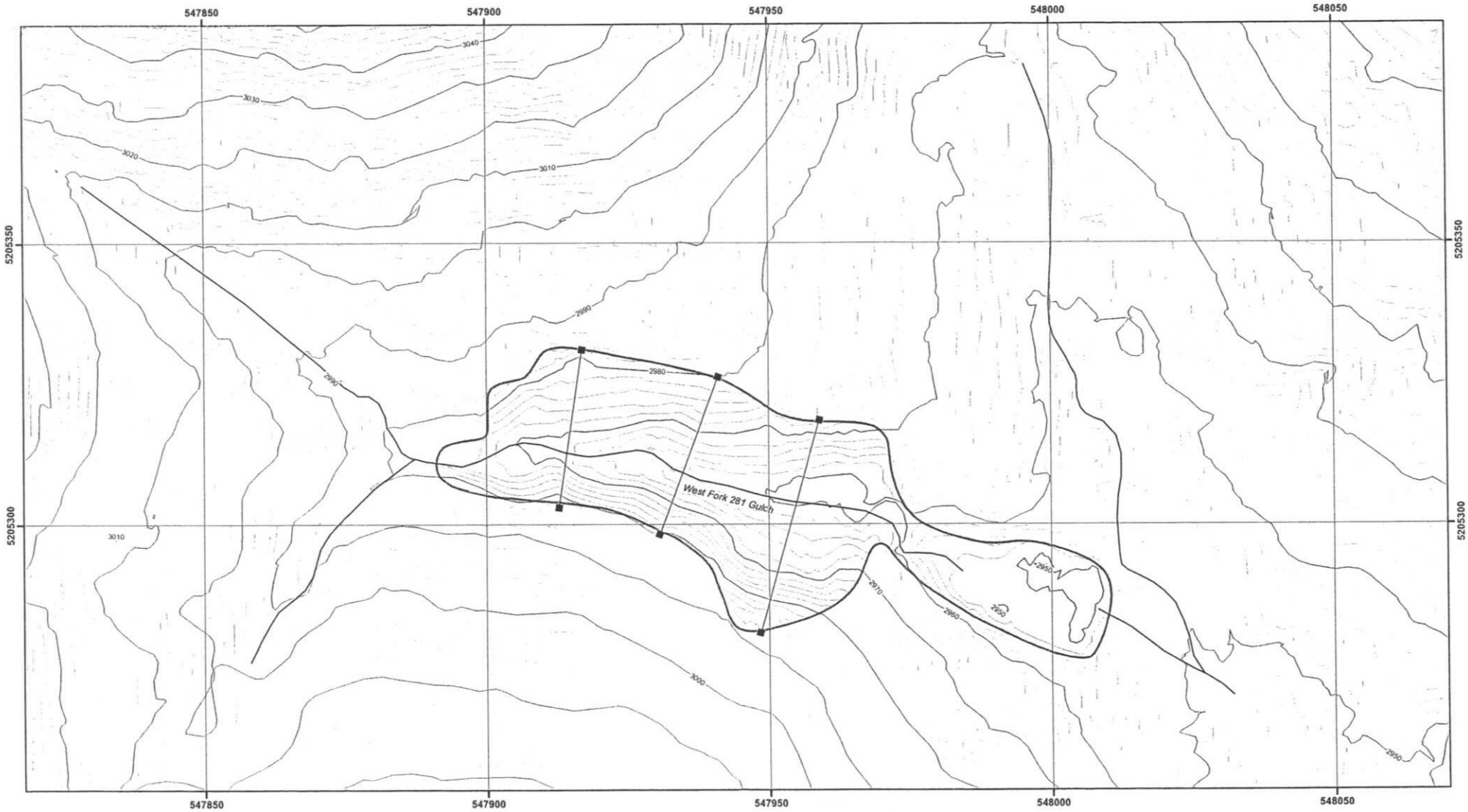
December 2005

Vegetation Transect

Reclamation Area

MAXIM TECHNOLOGIES INC. 6561130.100

East Fork of 281 Gulch
Garnet Area Revegetation Project
Latah County, Idaho
FIGURE 3



Map Projection - NAD 1983 UTM Zone 11 North

December, 2005

N

Vegetation Transect

Reclamation Area

West Fork of 281 Gulch
Garnet Area Revegetation Project
Latah County, Idaho
FIGURE 4

MAXIM TECHNOLOGIES INC. 6561130.100

4.0 MONITORING DESIGN

Monitoring should be in early summer when the likelihood of climax vegetative cover is greatest, and reproductive structures are present to aid in accurate identification of vegetation to species. To the extent possible, the period for monitoring should coincide from year to year. Water chemistry and vegetation monitoring will be conducted annually whereas the remaining items will be conducted at specified intervals. Once success for a particular item is achieved in an area, monitoring will no longer be required in that area.

Monitoring of most of the defined parameters will utilize a system of transects within the restored reaches. The exact location of the study area (i.e. the length of reach exhibiting disturbance and identified for restoration) will be delineated and permanently demarcated. Transects will be situated perpendicular to the stream channel and their length will vary depending on the width of the localized disturbance. The transect will begin on the river-left (left side of stream system when facing downstream) edge of disturbance and terminate on the river-right side of disturbance.

Seven transects will be placed in appropriate locations across the East Fork study reach (**Figure 3**). The following criteria should be considered when selecting appropriate locations for transects:

- Width of floodplain, longitudinal gradient, and depth to groundwater should be typical and representative of the majority of the stream study reach; and
- Transects should be placed at relatively equal intervals along the stream study reach when possible;

Three transects will be located in E1, and two each in E2 and E3. E2 and E3 will not be necessarily evaluated independent of each other. However, should significant differences develop between the two sections, based on transect monitoring over time, additional transects may be added to accurately monitor such developments. Existing disturbance and proposed restoration actions in the East Fork are confined to the stream-bottom. Therefore transects should extend from the upland / riparian interface on the river-left to the upland / riparian interface on the river-right. Transects in the East Fork are expected to be significantly shorter than the West Fork.

As previously discussed, disturbance, and proposed restoration, in the West Fork will carry into the adjacent uplands. Additionally, transects in the West Fork will be segregated into upland and riparian segments, predominantly for the purposes of vegetation monitoring and detection of slope slumping. Since the full West Fork reach will be receiving the relative same level of restoration, only three transects will be implemented (**Figure 4**). These transects will be appropriately located based on the criteria previously discussed above.

Transects in the reference reach in Garnet Gulch will spread across the entire riparian area and also up into the adjacent uplands for 10m on each side, regardless of riparian width. Three transects are planned for Garnet Gulch. Transects will be segregated into upland and riparian segments. When used as a comparison to the East Fork, only the riparian area of Garnet Gulch will be compared. Transects will be placed in locations that appear to most accurately represent the environmental and physical characteristics of the historical East and West Forks, as described above. CWD will be evaluated throughout the length of each study reach across all streams.

4.1 Transect Establishment and Design

As previously mentioned, transects in the East Fork will not extend into the uplands. Transects in the West Fork and Garnet Gulch will extend up into the upland. Fence posts and rebar will be utilized to demarcate transect locations. Generally, fence posts will be placed at the origin (river-left) and terminus (river-right) of each transect, respective of each study reach. Rebar will designate the river-left and -right transition from upland to riparian and riparian to upland (riparian / upland interface). In the Garnet Gulch reference reach, transects will extend 10 meters into the upland on both sides of the stream system and will originate and terminate with fence posts. In the East Fork, the transect will originate and terminate at the edges of the riparian area and will not extend into the upland. Therefore, fence posts will be used at the upland / riparian interface to demarcate the origin and terminus of the transect and rebar will be not be necessary. Rebar will also be placed approximately 1 meter away from the river-left and river-right edge of the channel of each study reach. Please refer to **Figure 5** for a detailed illustration of transect establishment and design.

4.2 Water Chemistry

Water chemistry parameters include pH, water and air temperature, dissolved oxygen, specific conductance, and turbidity. These measurements should be conducted prior to all other activity within the stream systems on the first day of monitoring. These measurements will be conducted in the field with a multi-parameter water sampling device. Sampling should be conducted directly downstream from the study reaches. In addition to in-stream temperature measurements, air temperature and time of day needs to be recorded as well to account for the relationship between air and water temperatures. Contiuous temperature monitors will be installed on the East Fork and West Fork from May through October. Other parameters will be measured once during flow conditions each year. The Emerald Creek Garnet Area EIS does not require monitoring of pH, air temperature, dissolved oxygen, and specific conductance; but they are listed here because standard water chemistry monitoring equipment collects all the listed water chemistry components.

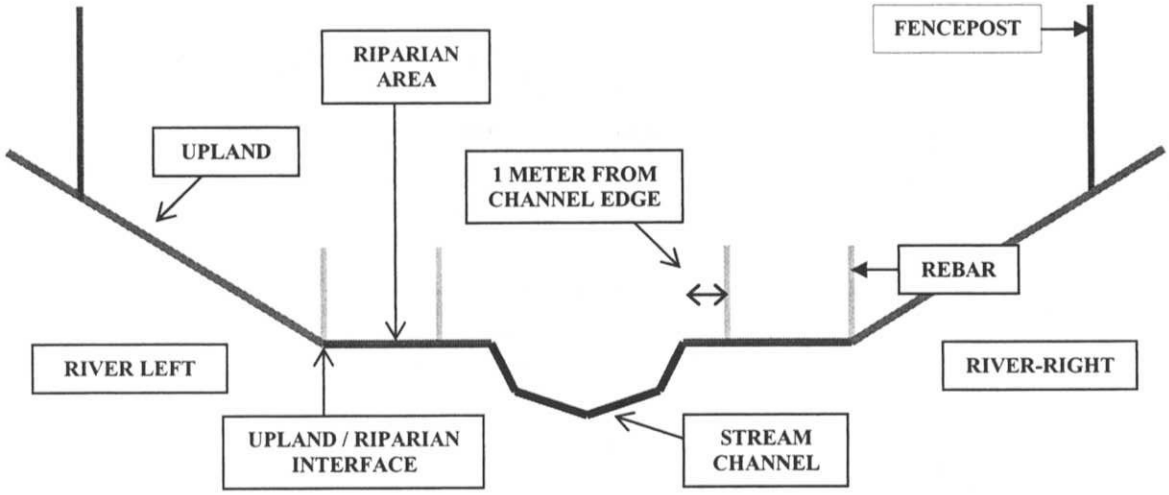
4.2.1 Objectives and Success Criteria

Results for the East and West Forks will be compared to Garnet Gulch. Investigators will consider the comparisons weighting the influence of environmental variables such as precipitation, temperature, and native and/or domestic utilization. No definitive success criteria will be identified due to the reactive nature of parameters. These parameters are being monitored for use as comparative indicators of riparian function as driven by the restoration. Annual values obtained in Garnet Gulch will be recognized as the optimum for these parameters and will be viewed as the standard limits. Successful functioning may be roughly achieved with a maximum variation of 10% in parameter values for pH, water temperature, dissolved oxygen, specific conductance, and turbidity. Monitoring can be suspended after these success criteria are met. Information collected in Garnet Gulch will be used as baseline data if garnet extraction operations occur in Garnet Gulch.

4.2.2 Construction Monitoring for Turbidity.

During construction, turbidity will be measured with a nephelometric turbidity meter to monitor sediment in the stream. Measurements will be taken twice daily during construction both upstream and downstream of disturbance areas.

Figure 5: Transect Design and Establishment.

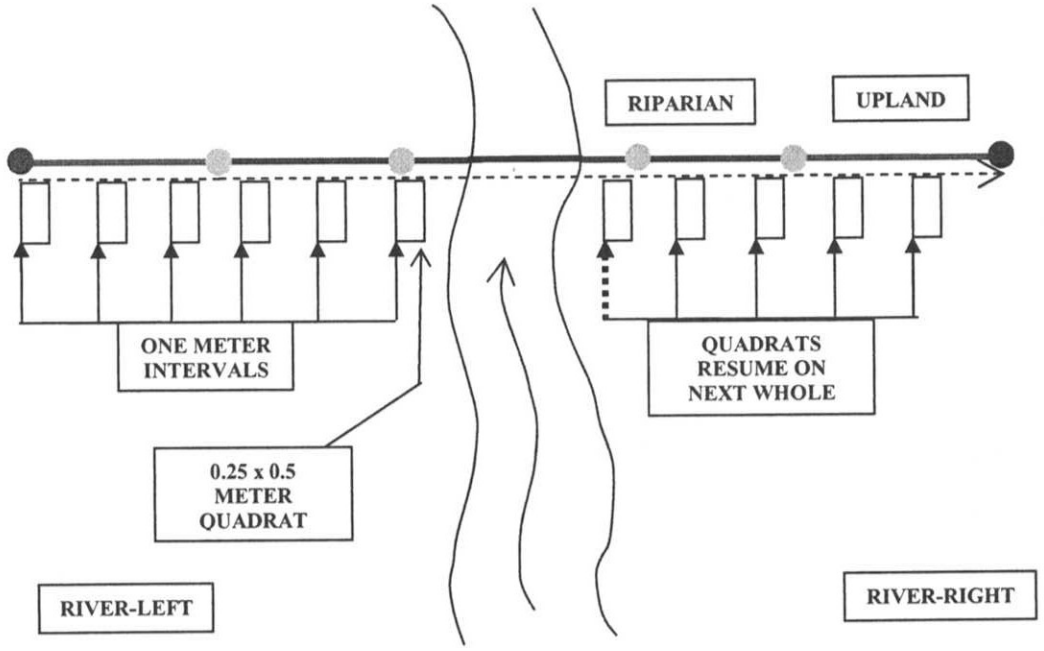


4.3 Herbaceous Cover

Herbaceous vegetation will be monitored along the transect every 1 meter starting at 0 meters on the river-left origin of the transect using a 0.25 x 0.50 meters (0.125m^2) quadrat, and sampling across the entire transect terminating on the river-right edge of the study reach. Investigators will place the bottom left corner of the quadrat on the whole meter marks (1, 2, 3, etc.) along the transect, placing the quadrat lengthwise, parallel to the stream, on the upstream side of the transect (**Figure 6**). The transect tape will be pulled tight across the stream channel and will not account for in-channel surface variation. In addition, the tape should be pulled tight across the upland and riparian areas, respectively, and not reflect variations in the ground surface. Investigators will make quadrat estimates of aerial cover up to the channel edge. The next quadrat will be placed across the channel (river-right) at the first whole meter mark with the bottom left corner of the frame. Refer to **Figure 6** for an aerial view of the vegetation sampling protocol.

The use of 0.125m^2 quadrats along a transect is based on professional judgment. Considerations included a statistically ample number of plots along the narrow riparian area and consequently short transect. A smaller plot frame would be required to detect initial small differences in large frequencies due to the relatively low richness of the prescribed revegetation plan. The length of the rectangular plot provides for future detection of increases in cover and species richness over time. Finally, the use of quadrats is more likely to obtain accurate repeatability of sample classes (i.e. quadrats being placed in the same location from year to year). For further discussion of vegetation monitoring, as related to the monitoring objectives of this project, please refer to Elzinga et al. 1998.

Figure 6: Illustration of Herbaceous Vegetation Monitoring Methodology.



Estimates of aerial cover for vegetation, litter, bare soil, and water will be made within each quadrat on a relative scale of 100%. While it is likely that absolute aerial cover will exceed 100%, relative cover will be used to make comparisons among plots, transects, and reaches. Vegetation will be identified to species to enable calculations of species richness, frequency, and diversity. Total absolute and relative aerial cover will be determined by species, totaled and summarized for each plot, and averaged for each transect and reach. Investigators will distinguish on field sheets when quadrat locations are within upland or riparian areas, or within the edge of channel markers. A sample field sheet is located in **Appendix A** of this document.

In order to increase accuracy and consistency, the sampling needs to be conducted at the same time of year annually. Mid- to late-July would be the optimum window for monitoring due to the greater likelihood of climax vegetative cover in addition to the presence of reproductive structures to aid in accurate identification of vegetation to species. In order to alleviate observer bias, it is necessary that the same investigator to make all estimates of vegetative cover for all quadrats for the year's monitoring efforts. When possible, the same investigator should make vegetative cover estimates annually. After the success criterion is met in an area, vegetation monitoring no longer needs to be conducted.

In order to avoid the trampling of vegetation along the transect associated with monitoring of other parameters, vegetation monitoring should be the first parameter undertaken, with the exception of water chemistry. In addition, all foot traffic associated with transect monitoring should be restricted to the downstream side of the transect when possible. All biological sampling should be restricted to the upstream side of the transect.

4.3.1 Objectives and Success Criteria

The overall objective is to achieve vegetative cover consistent with that of the historical East and West Forks. In order to define such achievement, success criteria are required. Success criteria will be based on values observed in Garnet Gulch, respective of riparian and upland designations. Riparian revegetation will be considered successful when mean herbaceous vegetative aerial cover is 75% of relative cover observed in Garnet Gulch. In addition, the majority of dominant vegetation (i.e. 51% of species with a frequency greater than 51%) is both hydrophytic and native.

Determination of upland cover success criteria is difficult. Upland herbaceous cover in mature systems can be significantly less than in recently disturbed systems. This is due to the lack of canopy cover in the disturbed systems and increase solar input. Therefore upland canopy cover values will be determined based on its ability to provide soil and slope stability. Success criteria of upland herbaceous vegetative cover will be defined as 75% mean vegetative and litter cover collectively, relative to total cover (100% minus bare ground). However, consistent with the riparian areas, successful vegetative cover will consist of a majority of dominant vegetation being native as an additional success criterion. Monitoring will be conducted annually.

4.4 Woody Species Survivability

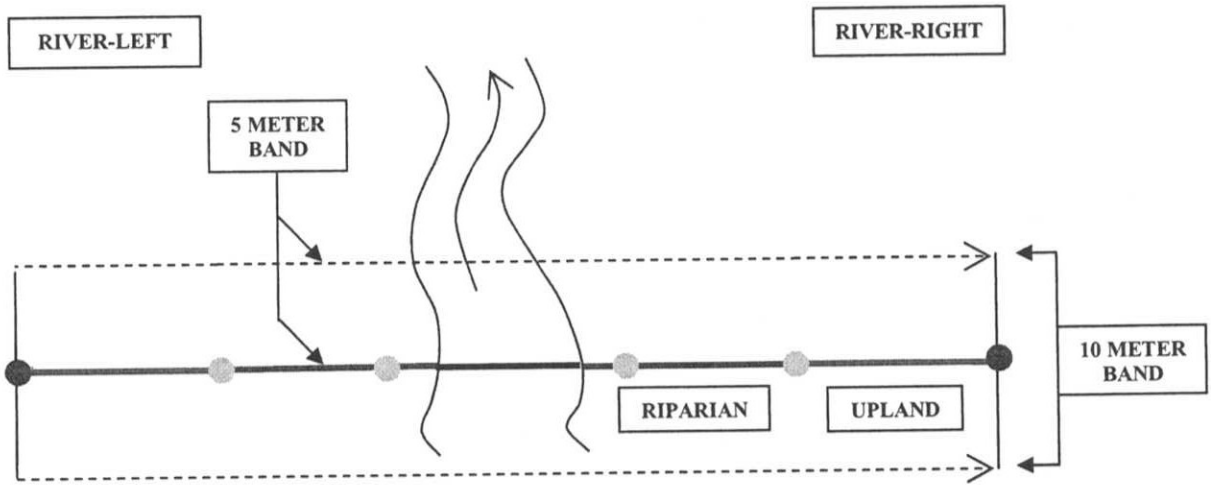
Woody species survivability will be monitored the first and third year after the completion of restoration activities. In order to assess woody species survivability, a total count of all live woody species planted immediately following restoration (baseline planting composition and density) will be conducted along a 10 meter band running parallel and centered along each transect (**Figure 7**). Each planted species encountered along the 10 m band of the transect will be tallied, measured for height, staked, mapped and briefly described for relocation purposes for monitoring in the first and third year. Measurements of height will be determined to provide an index of productivity and ultimately an indication of establishment (i.e. well established shrubs will likely exhibit higher productivity under suitable conditions due to greater root mass and distribution, as opposed to those that are poorly established). Measurements of height are necessary, as opposed to stem diameter, due to the multiple stems that many of the species identified for planting will produce over time. This method is a modified protocol described in the R1 FSH Reforestation Handbook. In the event of mortality of staked species, mortality will be generally categorized and reported as:

1. Environmental
    a. Heat and drought (insolation)
    b. Cold (frost or winter cold)
    c. Soil sloughing
    d. Water
2. Man-related
    a. Poor planting
    b. Poor quality nursery stock
3. Animal
    a. Cattle
    b. Big game (deer, elk, or moose)
    c. Pocket gophers
    d. Rabbits
    e. Mice or voles
4. Vegetation competition

Furthermore, detailed notes will be compiled on existing conditions of both live woody species and dead species. Refer to the R1 FSH Reforestation Handbook.

Survivability monitoring will not be conducted in the Garnet Gulch reference reach. Survivability monitoring is utilized to track the success of the plantings and make determinations for supplemental planting if necessary.

Figure 7: Illustration of Woody Species Survivability Monitoring Methodology.



4.4.1 Objectives and Success Criteria

The objective for woody species survivability is to establish a mature and sustaining canopy cover through the riparian and upland areas. A mature canopy cover provides stream temperature regulation, slope stability, surface and subsurface filtration, allocthonous litter inputs, and CWD. However, the monitoring commitment required to observe mature canopy cover is lengthy. Therefore it is necessary to make determinations on survivability and density of species after the third year of monitoring. A 50% mean survival rate will be recognized as the minimum success criteria. The 50% delimiter will be based on the total number of woody species observed as live during the first year of monitoring. 50% seems reasonable as planting density is high with the expectation of some die-off as well as providing immediate contributions to soil stability and filtration. Should survivability drop below 50% after three years, supplemental planting of woody species should be initiated.

4.5 Noxious Weed Occurrence

A total inventory will be conducted within the study reaches for the occurrence of Idaho state listed noxious weeds. No survey will be conducted in Garnet Gulch. Noxious weed surveys are conducted to assess the need for weed management of disturbed areas. **Table 1** lists all current Idaho state listed Noxious Weeds with potential and/or likelihood to occur within the study reaches (Prather et al. 2003). Upon the detection of noxious weeds, the Forest Service will implement appropriate management strategies consistent with the Idaho Panhandle National Forests Plan.

4.5.1 Objectives and Success Criteria

The objective of the restoration, as related to noxious weeds, is to prevent the establishment and/or proliferation of noxious weeds. Since noxious weeds can be directly managed, although sometimes not

successfully, and they are not considered a desired component of a mature system, their presence will not be tolerated. Noxious weed surveys will be conducted annually and weed treated when found.

TABLE I
Idaho Noxious Weeds with Potential to Occur in Study Reaches (Prather et al. 2003)

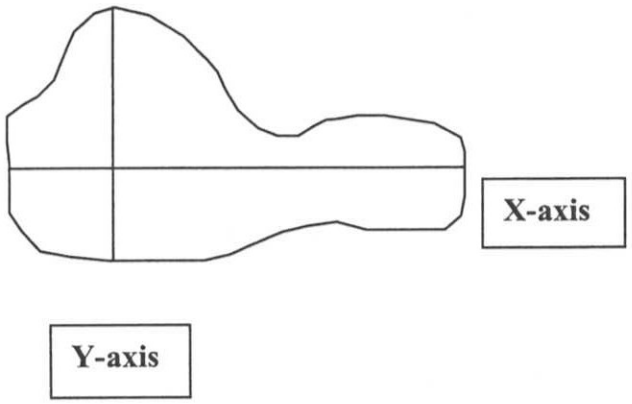
Species Name	Common Name
Acroptilon repens	Russian Knapweed
Aegilops cylindrica	Jointed Goatgrass
Ambrosia tomentosa	Skeletonleaf Bursage
Cardaria draba	Hoary Cress
Carduus nutans	Musk Thistle
Centaura diffusa	Diffuse Knapweed
Centaura maculosa	Spotted Knapweed
Centaura solstitialis	Yellow Starthistle
Chondrilla juncea	Rush Skeletonweed
Cirsium arvense	Canada Thistle
Conium maculatum	Poison Hemlock
Convolvulus arvensis	Field Bindweed
Crupina vulgaris	Common Crupina
Cytisus scoparius	Scotch Broom
Euphorbia dentata	Toothed Spurge
Euphorbia esula	Leafy Spurge
Hieracium aurantiacum	Orange Hawkweed
Hieracium pratense	Meadow Hawkweed
Hyoscyamus niger	Black Henbane
Isatis tinctoria	Dyer's Woad
Lepidium latifolium	Perennial Pepperweed
Linaria genistifolia ssp. *dalmatica*	Dalmatian Toadflax
Linaria vulgaris	Yellow Toadflax
Lythrum salicaria	Purple Loosestrife
Milium vernale	Milium
Nardus stricta	Matgrass
Onopordum acanthium	Scotch Thistle
Senecio jacobaea	Tansy Ragwort
Solanum elaegnifolium	Silverleaf Nightshade
Solanum rostratum	Buffalobur
Sonchus arvensis	Perennial Sowthistle
Sorghum halepense	Johnsongrass
Tribulus terrestris	Puncturevine
Zygophyllum fabago	Syrian Beancaper

4.6 Wetland Quality and Quantity

Both restored reaches and the Garnet Gulch will be annually surveyed and monitored for wetland quantity and quality. Each year, the project reaches will be surveyed along their entire length. Isolated perennial or intermittent pools will be tallied, located by GPS, and measured. Measurements will consist of determining the length of the pool along its greatest axis (X axis), followed by a measurement of

width perpendicular to the X axis at the pools widest point (Y axis). Figure 8 provides an illustration of this methodology. The pool will also be measured for depth at its deepest point.

Figure 8. Illustration of Wetland Pool Measurement Methodology.



Vegetation of each pool will be characterized and dominant and hydrophytic species will be identified. Amphibian surveys will be conducted annually in the tallied pools. Amphibian surveys will be consistent with protocol outlined in Heyer *et al.* 1994.

Each year, the previous year's pools will be relocated and re-surveyed. New pools will be tallied, located by GPS, and surveyed. In the event that pools cannot be relocated, or the pools have filled in, dried up, etc., such an outcome will be reported. However, the pools will not be removed from the annual monitoring list of pools. These pools will continue to be annually evaluated throughout the life of the project.

Each reach will be annually evaluated for the presence and development of hydric soils produced and maintained by anaerobic conditions resulting from soil inundation and/or saturation. Spaced evenly throughout the reaches, a minimum of ten soil pits will be dug and evaluated for hydric soils and hydrology consistent with the US Army Corps of Engineers (USACE) Wetlands Delineation Manual (1987).

Wetland hydrology will be determined by the minimal presence of inundated and/or saturated soil for at least 12.5% of the growing season at a depth within 12 inches of the soil surface (USACE 1987). Due to the difficulty of making this determination in the field, wetland hydrology will be determined through field observations consistent with the Wetlands Delineation Manual. These observations include:

- soil saturation and/or inundation within the upper 12 inches of the soil surface;
- water marks, drift lines, and/or sediment deposits on surrounding topography or vegetation; and/or
- oxidized root channels in the upper 12 inches.

Depth of surface water, to free water in pit, and to saturated soil will be measured.

Determination of hydric soils will also be conducted in a protocol consistent with the USACE Wetlands Delineation Manual (1987). At each soil pit, a soil profile at least 16 inches deep will be described by soil strata. At a minimum, matrix color and texture will be described for each soil strata within the profile.

Additionally the presence of mottling, gleying, concretions, sulfidic odor, and/or organic streaking will be noted. The presence of these hydric indicators will provide a positive wetland soil determination.

A sample wetland delineation form is provided in Appendix A.

4.6.1 Objectives and Success Criteria

The objective of evaluating wetland quantity and quality is to determine to what degree off-stream, isolated wetlands occur in the reference reaches, and if the restored reaches are exhibiting similar character. The isolated wetlands provide key ecological roles as habitat for wildlife, stream recharge, flood attenuation, and maintaining water quality. Overall, the ultimate goal is to ensure the restored reaches exhibit a similar pool/mile ratio as the reference streams. However, total surface area, amphibian abundance, richness, and diversity, and vegetative composition will be evaluated to make qualitative determinations on the success of establishing functional and valuable isolated wetland habitat in the restored reaches. Wetland pools will be evaluated annually.

4.7 Fish Habitat and Stream Morphology

Evaluation of fish habitat and physical stream morphology will be accomplished through the collection of data consistent with the R1/R4 (Northern/Intermountain Regions) Fish and Fish Habitat Standard Inventory Procedures Handbook (Overton *et al.* 1997). Investigators will use the Data Froms 1-4 provided within the publication for the collection of data related to stream channel morphology. Data parameters to be measured in the field include:

- elevation;
- lattitude and longitude;
- stream channel gradient;
- Rosgen channel type classification (Rosgen 1996);
- cover group (wooded or meadow);
- discharge;
- valley confinement (valley width divided by bankfull channel width);
- weather conditions;
- channel code and site unit numbers;
- habitat types;
- length;
- average wetted width;
- average wetted depth;
- number and average maximum depth of pocket pools;
- pool maximum and crest depth;
- step pool total;
- number of step pools >1m deep;
- average maximum depth of step pool complex;
- percent surface fines;
- substrate composition;
- bank length, stability, and undercut;
- channel shape;
- large woody debris singles, aggregates, and rootwads;
- riparian community types;

- substrate classes;
- large woody debris singe pieces length, diameter, percent submerged; and
- number of large woody debris aggregates

Snorkel tallies, and monitoring of parameters associated with Form 5 and 6 (as defined by Overton *et al.* 1997) will not be conducted. Air and water temperature will be continuously monitored with respect to water quality monitoring. However, continuous monitoring may cease once success criteria, relative to water quality, is met. At this point, air and stream temperature, as well as time of day, will be measured concurrently with field data collection. Measurement of discharge will be conducted from permanent locations along the reaches where unrestricted flows and consistent depths and widths are exhibited. Flow will be measured with a digital flowmeter. All measurements of stream gradient and reach lengths and widths will be determined with a laser level and total station.

4.7.1 Objectives and Success Criteria

The evaluation and monitoring of fish habitat parameters will provide the greatest indication of the overall physical similarities between the reference reaches and the restored reaches. The restoration of the stream channel, and its ability to resist erosion and downcutting, will ultimately define the success of channel and floodplain restoration. Quantitative comparisons to Garnet Gulch are not necessarily useful because of differing channel slopes, streamflows, and possibly substrate conditions. The different landscape settings of these streams could result in dissimilar values from the measured parameters. Therefore, the qualitative measure of success for channel morphology is the relative stability of each individual channel from year to year as determined by parameter measurements. However, it should be anticipated on these small drainages, that major changes in morphology could occur due to isolated events, such as a log falling across the stream at a transect. Monitoring will occur at the first, third, fifth, and tenth years.

5.0 PHOTO DOCUMENTATION

Each study reach will be thoroughly documented annually from permanently established photopoints. Photopoints will be established roughly along each transect in the center of each channel. Four photos will be taken at each photopoint/transect. One photo upstream, one downstream, one facing along the transect to the river-left and one along the transect to the river-right. It will be critical for investigators to accurately note the date and title each photograph in accurate order.

6.0 ASSUMPTIONS

The following assumptions were accepted in the development of this monitoring plan:

- With respect to monitoring of vegetation, it assumed that cattle will be excluded from the restored study reaches. Cattle exclusion was recommended in the revegetation prescription. If cattle will not be excluded, it will be necessary to implement monitoring that evaluates the impacts of utilization in the revegetated study reaches. Discussion of utilization was not provided in this monitoring plan.
- The entire monitoring effort is expected to take two investigators approximately 60 hours.

7.0 CONCLUSION

Restoration of the East and West Forks of 281 Gulch are scheduled for completion in 2006. A ten-year monitoring effort of environmental and physical parameters is scheduled to begin in mid to late July 2007. Monitoring parameters include water chemistry, herbaceous vegetative cover, woody species survivability, noxious weed occurrence, wetland quality and quantity, fish habitat and stream morphology, and photo documentation. Monitoring of most parameters will utilize a system of permanent transects. The annual monitoring effort is estimated to take two investigators approximately 40 hours to complete. Required equipment for the monitoring effort is provided in **Appendix B**. Monitoring results of the East and West Forks will be compared to those of Garnet Gulch. A set of defined success criteria has been established for most parameters (summarized in **Appendix C**). The success of the restoration is dependent on satisfying the standards of the success criteria in 10 years. Identification of a parameter exhibiting a failing trend warrants an adjustment and/or supplement to the initial restoration in order to amend the downward trend.

8.0 REFERENCES

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Appendix A

Sample Field Sheets

SAMPLE FORM – HERBACEOUS COVER

Transect:

Date:

		Plot #																				
Species Code	**Indicator Status**	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	**Average Percent Cover**
BARE GROUND																						
LITTER																						
WATER																						
Percent Cover by Plot:																						
Total Percent Cover:																						
Species Richness:																						
Total Species Richness:																						

Appendix B

Required and Recommended Equipment

REQUIRED EQUIPMENT

- 100m tape
- Metric tape measure
- 0.25 x 0.5m quadrat
- Multi-parameter water chemistry analyzer
- Appropriate field sheets for each parameter
- Digital flowmeter
- Laser Level and Rod and Total Station

ADDITIONAL RECOMMENDED EQUIPMENT

- 5 m staff
- Hip chain

Appendix C
Summary of Monitoring Design

Parameter	Method of Monitoring	Samples per stream reach	Success Criteria
Water Chemistry (pH, stream and air temperature, specific conductance, and turbidity)	Multi-parameter water sampling device and thermometer.	1	<10% variation from Garnet Gulch for pH, specific conductance, and turbidity.
Herbaceous Vegetative Cover	0.25 x 0.50 m quadrats every 1 meter along each transect.	3 transects in E1 of East Fork 2 transects in E2 of East Fork 2 transects in E3 of East Fork 3 transects in West Fork 3 transects in Garnet Gulch	Riparian: > 75%of mean vegetative cover in Garnet Gulch and majority of dominant vegetation hydrophytic and native. Upland: >75% mean vegetative and litter collective cover.
Woody Species Survivability	Total count within a 5 meter band along each transect.	3 transects in E1 of East Fork 2 transects in E2 of East Fork 2 transects in E3 of East Fork 3 transects in West Fork 3 transects in Garnet Gulch	>50% survival.
Noxious Weed Occurrence	Total Count	1	<5% increase annually
Wetland Quality and Quantity	Total pool count and dimension measurement Hydrology and hydric soil evaluation Amphibian surveys	1 total pool count for each reach Minimum of ten soil pits for each reach Each entire reach surveyed for amphibians	Qualitative similarity of restored reaches to Garnet Gulch
Fish Habitat and Stream Morphology	Data Forms 1-4 in Overton et al. 1997	Measurement and evaluation of each parameter in the suite for each reach.	None
Photo Documentation	Digital camera and permanent photo points	3 photopoints in E1 of East Fork 2 photopoints in E2 of East Fork 2 photopoints in E3 of East Fork 3 photopoints in West Fork 3 photopoints in Garnet Gulch	None.

Note: Stream Reaches are East Fork 281 Gulch, West Fork 281 Gulch, and Garnet Gulch.