APPENDIX G

DRAFT FRAMEWORK FOR COMPENSATORY MITIGATION FOR AND MONITORING OF UNAVOIDABLE IMPACTS TO WATERS OF THE UNITED STATES

DRAFT (September 6, 2013)

Framework for Compensatory Mitigation for and Monitoring of Unavoidable Impacts to Waters of the United States

Gateway West Transmission Line

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ACRONYMS AND ABBREVIATIONS

API	aerial photo interpretation
ATV	all-terrain vehicle
BLM	Bureau of Land Management
BMP	Best Management Practice
CFR	Code of Federal Regulations
Companies	PacifiCorp (doing business as Rocky Mountain Power) and Idaho Power Company
CWA	Clean Water Act
CWMP	Compensatory Wetland Mitigation Plan
DEQ	Department of Environmental Quality
DJ	Dave Johnston
EIS	Environmental Impact Statement
EPM	Environmental Protection Measure
GIS	Geographic Information Systems
HPTP	Historic Properties Treatment Plan
HUC	Hydrologic Unit Code
IDWR	Idaho Department of Water Resources
ILF	In-Lieu Fee Program
MWAM	Montana Wetland Assessment Method
NHD	National Hydrography Dataset
NWI	National Wetlands Inventory
O&M	Operations and Maintenance
OATT	Open Access Transmission Tariff
POD	Plan of Development
Project	Gateway West Transmission Line Project
ROW	Right-of-Way
USACE	U.S. Army Corps of Engineers
USFS	U.S. Department of Agriculture Forest Service

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1.0 INTRODUCTION

PacifiCorp (doing business as Rocky Mountain Power) and Idaho Power Company (Companies) have provided this *Framework Compensatory Mitigation Plan for Unavoidable Impacts to Waters of the United States* (Plan) to the Bureau of Land Management (BLM) as one of several plans to fully mitigate for impacts identified by the Companies and/or the permitting agencies from the construction, operation, and maintenance of the Gateway West Transmission Line Project (Project). The intent of this plan is to demonstrate that, through coordination with the U.S. Army Corps of Engineers (USACE) and other permitting agencies, the Companies have a robust and reliable approach to compensating for unavoidable impacts to waters of the United States and have fully committed to funding not only the direct compensatory mitigation projects but a monitoring program to report on the success of the projects over time.

This Plan has evolved from, and incorporates by reference, two prior documents, including the *Aquatic Permitting Program* (IPC and RMP 2010) and the *Framework for Compensatory Mitigation for and Monitoring of Unavoidable Impacts to Waters of the U.S. (May 2011).* It will be revised as final information is developed for impacts to aquatic resources and for the proposed mitigation project sites. The Companies plan to construct the Project in phases and will develop a complete Plan for each phase, which must be approved by the USACE prior to issuance of a Nationwide Permit for that phase, which in turn will be required by the BLM before issuing a Notice to Proceed for that phase.

As final plans are developed for each phase, they will be presented to and reviewed by other permitting agencies, such as the Idaho Department of Water Resources (IDWR), to assure compliance with their standards. Each final plan will meet USACE, BLM, and state standards before it is accepted and used to support the issuance of permission to begin construction.

This document describes the Companies' approach for mitigating Project-related impacts to waters of the U.S. and is intended to satisfy the mitigation requirements of the USACE[1] by assuring that there will be no net loss of function or area of waters of the U.S. resulting from construction, operation, and maintenance of the Project. The Project's estimated permanent impacts to wetlands are approximately 10.4 acres for the BLM-Preferred Route. Temporary impacts to wetlands are estimated at 71.2 acres for the BLM-Preferred Route. Other alternative routes, suggested by agencies, local groups, and cooperating agencies, have different and sometimes larger impacts to wetlands and riparian areas.

1.1 Project Description, Purpose, and Need

The Companies are electric utilities that transmit electricity via a grid of transmission lines located throughout a six-state region. As an essential service provider, the Companies are required to operate under the oversight and regulatory controls of the Public Service Commission of Utah, the Wyoming Public Service Commission, and the Idaho Public Utilities Commission. Although the objectives of these multiple commissions vary somewhat, they do share a common goal of ensuring utilities such as the Companies provide safe, reliable, adequate, and efficient delivery of electricity.

[1] 40 CFR 230; Compensatory Mitigation for Losses of Aquatic Resources; Final Rule; April 10, 2008 Federal Register

The Companies are also public utilities under the jurisdiction of the Federal Energy Regulatory Commission. The Companies are obligated to expand their transmission systems to provide requested firm transmission service and to construct and place in service sufficient capacity to reliably deliver resources to customers requesting service and existing customers as provided in their Open Access Transmission Tariff (OATT) (FERC 2008). The Companies commitment under the OATT also requires planning for the expansion of the system to ensure that its transmission system meets industry, regulatory, and reliability standards.

The proposed 10 transmission line segments and 12 substations that comprise Gateway West are needed to supplement existing transmission lines in order to relieve operating limitations, increase capacity, and improve reliability in the existing electric transmission grid, allowing for the delivery of up to 1,500 megawatts of additional energy for the Companies larger service areas and to other interconnected systems.

The Project is independent of, and will be built regardless of, any particular new generation project. The transmission grid of which it will become a part can be thought of in terms of hub and spokes, with a backbone connecting to the hubs. Each substation is a hub and receives or sends electricity along the spokes. For this system to work, a backbone of high-capacity transmission lines is needed to connect the hubs and transport the electricity from where it is or can be generated (in this case, mostly Wyoming but also Idaho), to where it is needed (in this case, mostly Idaho and Utah, though other markets may also be served).

A more detailed description of the Project is provided in the Plan of Development (POD), the most recent version of which was submitted to the BLM by the Companies August 15, 2013, and is incorporated herein by reference. The POD provides more detailed information on the purpose and need; proposed route; project-related facilities; details associated with construction, operation, and maintenance of the Project; and applicant-proposed environmental protection measures (EPMs). Table 1 provides a brief summary of the segments and their lengths, both Proposed and BLM-Preferred, as presented in the Final Environmental Impact Statement (EIS).

The Companies have advised BLM that they intend to build this Project in phases. Phase 1 encompasses Segments 1 through 4, from Windstar near Glenrock, Wyoming, to Populus, near Downey, Idaho, which the Companies call Segment D (Figure 1). Phase 2 encompasses the remaining segments (Figure 2). The Companies anticipate that construction will begin mid-2015 for Segments 1 through 4 and mid-2017 for the remaining segments. The Companies are still refining their schedule and may develop distinct work elements within Segments 1 through 4 for staged construction. The Companies will advise the USACE and the BLM of any further changes in schedule.

The BLM-Preferred Route coincides with the Proposed Route in Segments 1 through 4, 6, and 10. The BLM has chosen different alternatives for portions of Segments 5, 7, 8, and 9 (See Figures 1 and 2). The BLM-Preferred Route totals about 1,040 miles. This Plan is presented for the 1,000-mile Proposed Route but will be modified to apply to the Route finally approved by the BLM and other permitting agencies as needed.

Table 1. Segment Summary

Segment Number	Proposed Length	BLM-Preferred Length	Originating Substation	Terminating Substation
1W(a)	73.8	73.8	Windstar	Aeolus
1W(c)	73.6	73.6	Dave Johnston 230 kV	Aeolus
2	91.9	91.9	Aeolus	Creston
3	45.9	45.9	Creston 1/	Anticline
3A	5.1	5.1	Anticline	Jim Bridger 345-kV
4	197.6	197.6	Anticline	Populus
5	55.7	73.3	Populus	Borah
6 2/	0.5	0.5	Borah	Midpoint
7	118.2	130.2	Populus	Cedar Hill
8 3/	145.0	132.0	Midpoint	Hemingway
9 4/	162.8	171.4	Cedar Hill	Hemingway
10	34.4	34.4	Cedar Hill	Midpoint
TOTALS	**990.4**	**1,029.7**		

1/ Creston Substation has been eliminated from the Project but its location still serves as the terminus for Segments 2 and 3
2/ Segment 6 disturbance limited to substations and approaching structures only
3/ Segment 8 as proposed includes the Proposed Route with Alternatives 8D and 8E
4/ Segment 9 as proposed includes the Proposed Route with Alternative 9G

1.2 Plan Updates

This Plan is a living document. It has been updated to reflect the BLM-Preferred Alternative routes and now contains a more focused and site-specific proposal for compensatory mitigation for Segments 1 through 4. It will be updated to include the following when available and appropriate:

- Recommendations from the USACE, BLM, and state agencies on compensatory mitigation for impacts to waters of the U.S.;
- Other federal and state agency requirements when specified;
- Revised impact calculations based on avoidance and minimization measures, including changes in road alignment and facility micro-siting to avoid impacts;
- Further details on the Companies' proposed compensatory mitigation for unavoidable impacts to waters of the U.S., including a package for Segments 5 through 10 when the route locations have been resolved and design engineering completed.

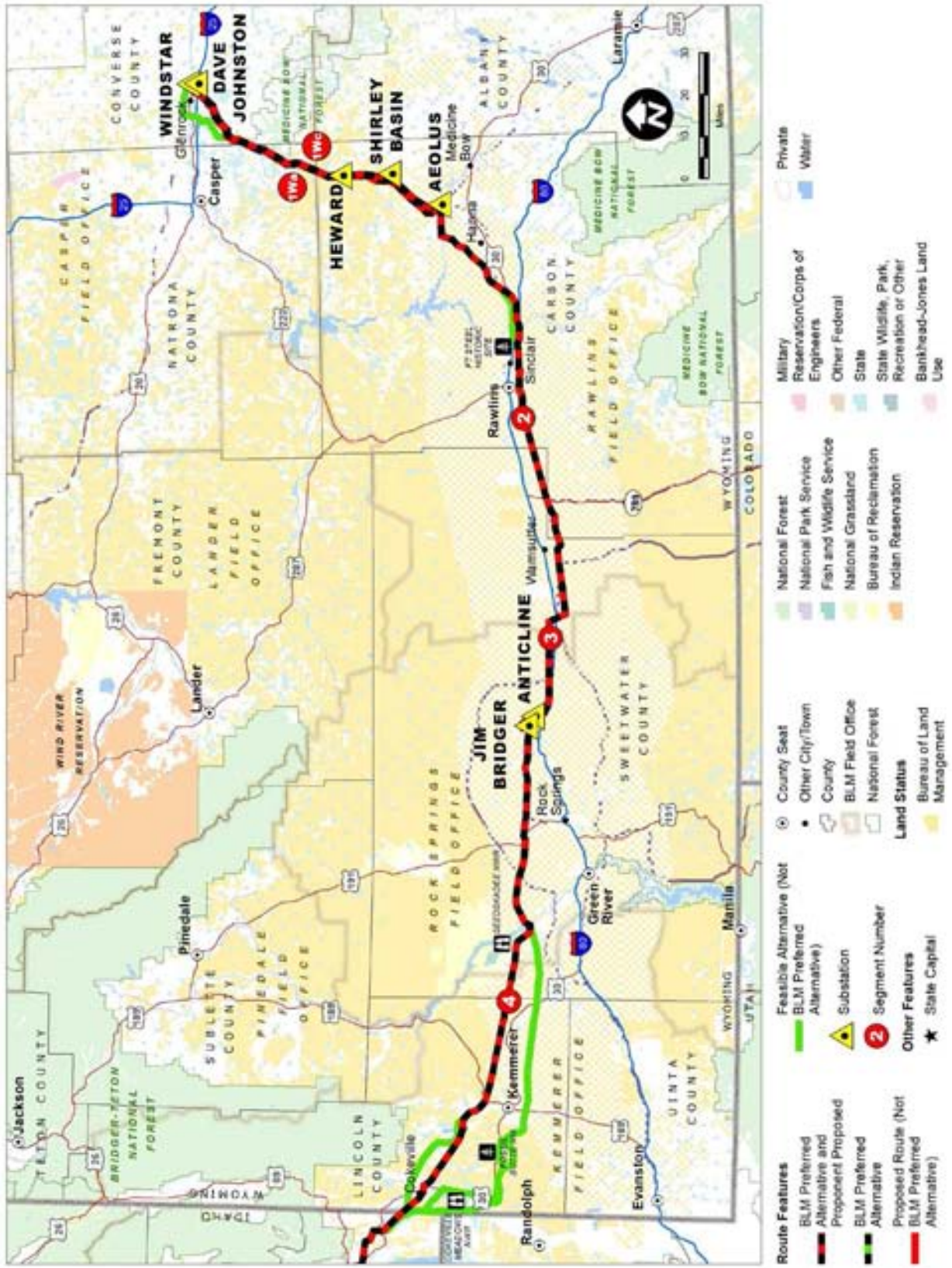


Figure 1. Wyoming Overview Map

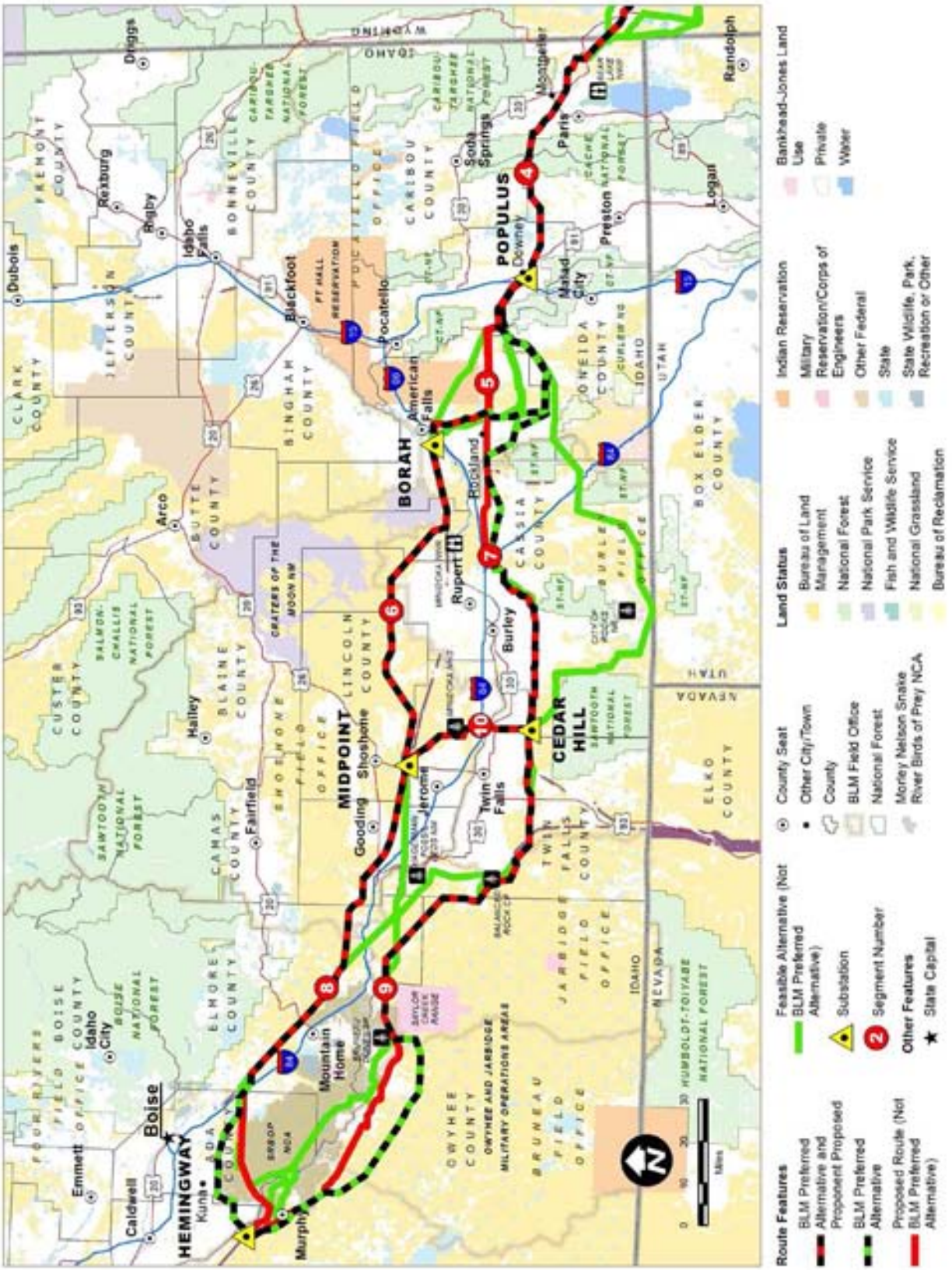


Figure 2. Idaho Overview Map

2.0 AQUATIC RESOURCE REGULATIONS

Construction, operation, and maintenance of the Project include ground-disturbing activities that include unavoidable residual impacts to aquatic resources remaining after all feasible measures of avoidance and minimization have been implemented. These remaining impacts must be fully compensated to assure no net loss of area or function of waters of the U.S. based on requirements of the Clean Water Act (CWA; 33 United States Code Section 1251 et seq.).

2.1 CWA – Section 404 Waters of the U.S. Permits

Section 404 of the CWA authorizes the USACE to regulate the discharge of dredged or fill material to the waters of the United States. Discharges are authorized through issuance of nationwide permits or individual permits for specific activities. The USACE jurisdiction over non-tidal waters of the United States extends to the "ordinary high water mark provided the jurisdiction is not extended by the presence of wetlands" (33 Code of Federal Regulations (CFR) § 328.4); and under Title 40 CFR § 230.3 (s)(1). Waters of the United States are defined as:

> *All waters which are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide, all interstate waters including interstate wetlands, all other waters such as intrastate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, the use, degradation or destruction of which would affect interstate or foreign commerce, including such waters which are or could be used by interstate or foreign travelers for recreational or other purposes, or from which fish or shellfish are or could be taken and sold in interstate or foreign commerce, or which are used or could be used for industrial purposes by industries in interstate commerce; all impoundment of waters otherwise defined as waters of the United States interstate commerce, tributaries of waters identified in paragraphs 1-4 of this section, the territorial seas; and wetlands adjacent to waters.*

Many wetlands are protected under the CWA as waters of the U.S. and special aquatic sites. Wetlands are defined by the USACE based on the presence of wetland vegetation, wetland hydrology, and hydric soils. Under Section 404, the USACE issues a number of nationwide permits for different types of activities that result in minimal individual and cumulative adverse effects on the aquatic environment and individual permits for larger and more complex impacts.

Nationwide permits. A nationwide permit is a general permit that authorizes a category of activities throughout the nation by streamlining the approval process for certain types of activities that have minimal impacts to aquatic resources. These permits are valid only if the conditions applicable to the permit are met. If the conditions cannot be met, a regional or individual permit is required. Section 404 Nationwide Permit 12 (77 *Federal Register* 10271-10272 February 2012) covers construction, maintenance, and repair of utility lines in all waters of the U.S. provided that there is no change in pre-construction contours. This nationwide permit also covers related facilities including substations, structure foundations, and roads; provided that these activities do not result in the loss of greater than 0.5 acre of waters of the U.S. Nationwide Permit 12 also authorizes temporary structures, fill, and work necessary to conduct utility line activities as long as (1) appropriate measures are taken to maintain normal

downstream flows and minimize flooding, (2) structures and fill consist of materials that would not be eroded by high flows, and (3) structures and fill are removed in their entirety and the affected areas are returned to pre-construction elevations and re-vegetated as appropriate upon project completion. Impact limitations for Nationwide Permit 12 cover all disturbances at a single crossing of a wetland or stream, or multiple crossings of the same wetland or stream.

Any permanent impacts over 0.1 acre to waters of the U.S. require full mitigation, regardless of permit type. Permanent loss of more than 0.5 acres of a water of the U.S. requires an individual (General) permit rather than coverage under a Nationwide Permit.

Nationwide Permits contain general conditions that address potential impacts to the environment that could result from dredge or fill of waters of the U.S., such as adverse effects to soils, migration and spawning habitats, endangered species, or historic properties. Supplemental documentation may be required as part of a pre-construction notification package (e.g. plant and wildlife survey reports, cultural resource survey reports) to support compliance with the general conditions of the Nationwide Permit. Compliance with the National Historic Preservation Act and the Endangered Species Act is being completed through the larger project consultation.

2.2 CWA - Section 401 Water Quality Certification

Pursuant to section 401 of the federal CWA, any permit or license issued by a federal agency for an activity that may result in a discharge into waters of the U.S. requires certification from the state in which the discharge originates. This requirement allows each state to have input into federally approved projects that may affect its waters (rivers, streams, lakes, and wetlands) and to ensure the projects will comply with state water quality standards and any other water quality requirements of state law. State certification ensures that the project will not adversely impact impaired waters (waters that do not meet water quality standards) and that the project complies with applicable water quality improvement plans (total maximum daily loads). The States must grant, deny, or waive section 401 certification for a project before a federal permit or license can be issued. The Departments of Environmental Quality (DEQs) for both Idaho and Wyoming must provide Section 401 Water Quality Certifications for the federally issued permits, including the 404 permits in both states. Therefore, the DEQ for each state must also approve the final mitigation plans as sufficient to meet state water quality standards before issuing the Water Quality Certification.

2.3 Executive Order 11990

Executive Order 11990, Protection of Wetlands (42 *Federal Register* 26961), directs all federal agencies to minimize the destruction, loss, or degradation of wetlands, and to enhance the natural and beneficial values of wetlands. Federal regulation and management of wetlands follows a “no net loss” policy. This plan is submitted to the BLM to demonstrate that issuance of a right-of-way (ROW) grant for this Project will comply with the intent and the terms of this Executive Order.

2.4 Idaho Stream Alteration Permit

An Idaho State Stream Alteration Permit must be obtained prior to altering any stream as defined by Idaho Administrative Code (37.03.07) which includes “… to obstruct, diminish, destroy, alter, modify, or change the natural existing shape of the channel or to change the direction of flow of water of any stream channel within or below the mean high water mark.”

According to staff of the IDWR in an April 2013 meeting (Mathews 2013), only streams that historically have perennial flow are considered jurisdictional, and there are no mitigation requirements under this permit.

3.0 AVOIDANCE AND ENVIRONMENTAL PROTECTION MEASURES

To the greatest extent possible, the Project has been sited and designed to avoid and minimize, impacts to waters of the U.S., as well as other resources, including historic properties listed on the National Register of Historic Places and species listed under the Endangered Species Act. This section describes the siting process for the Project, the environmental protection measures that the Companies will implement, and the road standards used by the Companies to minimize impacts where waterbodies must be crossed.

3.1 Siting

The identification of an initial proposed route for the Project was constrained by the purpose and need for the project, which includes interconnecting substations between Glenrock, Wyoming and the Hemingway Substation located southwest of Boise, Idaho.

The Companies originally proposed a series of segments, each of which must begin and end at a particular substation to meet the segments and Project's purpose and need. The route between substations was identified with the intent of avoiding as many environmental constraints as possible. Since the initial siting effort in 2008, reported in the Siting Study (IPC and RMP 2008, updated 2009), the Companies have been in continuous conversation with agencies and landowners and have substantially modified their initial Proposed Route to avoid important resources as knowledge of them became available, to accommodate landowner routing preferences where feasible, and to conform to a changing series of regulations and policies, including but not limited to the Wyoming Governor's Executive Order (2011-005) declaring sage-grouse core areas and permissible corridors through those areas in which transmission lines are to be sited.

Agencies and other groups identified concerns with the route proposed by the Companies and proposed partial or complete alternatives for that segment to the BLM. The BLM considered those alternatives and included them where the BLM determined that they met the BLM's purpose and need. The Companies worked closely with advocates of the alternative routes and conducted siting activities within the generally proposed alternative corridor to avoid known resource impacts where feasible, using the same tools and techniques used to determine the Proposed Route.

3.2 BLM Preferred Alternative

In December 2012, the BLM identified its modified Preferred Alternative for each of the segments. For Segments 1 through 4, the BLM identified the Proposed (as modified through consultation) as the Preferred Route (with the exception of the adoption of Alternative 4G, a route proposed by the U.S. Department of Agriculture Forest Service (USFS) in the Caribou-Targhee National Forest in Idaho). The routes for these four segments also represent the State of Wyoming's Preferred Route.

For Segments 6 and 10 in Idaho, the BLM also identified the Proposed as the Preferred. For Segment 5, the BLM identified Alternative 5B as its Preferred, which includes about 33 miles of the proposed route to the east and west of that alternative. For Segment 7, the BLM identified Alternatives 7B (to avoid the Deep Creek Mountains), 7C (to avoid an important historic trail area, 7D, and 7G, in addition to the needed portions of the originally Proposed Route to connect

the two substations. For Segment 8, the BLM identified the Proposed Route for most of its length, but preferring Alternative 8B, which avoids the Morley Nelson Snake River Birds of Prey National Conservation Area. For Segment 9, the BLM identified the Proposed Route from Cedar Hill to just south of Bruneau Dunes State Park, then selected 9E as modified, which dips south into the Owyhee foothills to avoid most of the National Conservation Area.

3.3 Environmental Protection Measures and Plans

The Companies have included a series of plans in the most recent POD (August 15, 2013). The Companies plan that their Construction contractors will provide the site-specific detail needed for these plans after final engineering is complete and impacts are known. The construction contractors will be responsible for submitting the final Plans to the BLM, USFS, and other appropriate agencies with regulatory authority for review and approval before receiving a NTP to begin construction. Many of these plans provide protection to wetlands either directly or indirectly. As submitted August 15, 2013, the Plans include the comprehensive list of EPMs found in Appendix Z of the POD. Plans that are currently proposed and that will provide protection to waters of the U.S. are listed below:

1. **Environmental Compliance Management Plan, Appendix C of the POD,** is the primary guidance document that states how the Companies upholds, documents, and manages compliance with the right-of-way grant, the POD, landowner agreements, and all federal, state, and local permits. It is a centralized Project environmental compliance reference and is thereby intended to facilitate environmental compliance across the entire Project.
2. **Framework Reclamation Plan, Appendix D of the POD,** includes site-specific construction mitigation, reclamation, and revegetation measures for each land management area crossed by the ROW within BLM-managed and National Forest lands. It will combine the Companies' best management practices (BMPs) with site-specific mitigation developed in consultation with agencies. Some measures will apply Project-wide, while others will be designed for specific areas.
3. **Framework Noxious Weed Plan, Appendix E of the POD,** provides methods to control the potential occurrence/infestation of noxious and invasive weeds during and following construction of the Project. The purpose of the plan is to ensure noxious weeds are identified and controlled during the construction of project facilities and all federal, state, county, and other local requirements are satisfied.
4. **Framework Stormwater Pollution Prevention Plan, Appendix F of the POD,** includes measures for temporary and permanent erosion and sediment control that will be used during construction, operation, and maintenance of the transmission line and ancillary facilities.
5. **Framework Spill Prevention, Containment, and Countermeasures Plan, Appendix G of the POD,** includes measures for spill prevention practices, requirements for refueling and equipment operation near waterbodies, procedures for emergency response and incident reporting, and training requirements.
6. **Plant and Wildlife Conservation Measures Plan, Appendix H of the POD,** presents the measures proposed by the Companies for avoidance and minimization of impacts to

special status plant and wildlife species as related to construction activities for the Project and outlines specific conservation measures to be implemented in the event that state or Federally listed species, BLM sensitive species, or USFS special status species or their habitats are identified within or adjacent to the Project right-of-way.

7. **Framework Stream, Wetland, Well, and Spring Protection Plan, Appendix I of the POD,** provides measures to protect these resources from potential impacts during construction, operation, and maintenance activities. The goals of this plan are to control Project-related erosion and sedimentation into streams and wetlands and minimize disturbance and erosion of streambeds and banks and protect springs and wells in the Project area from impacts due to blasting and hazardous materials contamination.
8. **Framework Paleontological Resources Protection Plan, Appendix J of the POD,** identifies the mitigation measures needed to avoid or reduce project-related impacts to paleontological resources, wherever feasible. This plan provides important background and contextual information useful for the paleontological resources mitigation program.
9. **Agricultural Protection Plan, Appendix K of the POD,** includes measures intended to mitigate or provide compensation for agricultural impacts that may occur due to construction of the Project. The measures are intended to be implemented on partially or wholly owned private agricultural land unless directed otherwise by the landowner.
10. **Framework Traffic and Transportation Management Plan, Appendix L of the POD,** includes measures that require compliance with federal policies and standards relative to planning, siting, improvement, maintenance, and operation of roads for the Project.
11. **Framework Blasting Plan, Appendix M of the POD,** outlines methods to prevent adverse impacts to human health and safety, property, and the environment that could potentially result from the use of explosives during project construction and mitigate risks and potential impacts associated with blasting procedures that may be required for construction.
12. **Framework Erosion, Dust Control, and Air Quality Plan, Appendix N of the POD,** provides measures to ensure protection of the air quality that will be affected by the Project. This plan is to be implemented during the construction, operation, and maintenance phases of the Project. These measures are intended to minimize dust and emissions from construction-related activities.
13. **Framework Fire Prevention and Suppression Plan, Appendix O of the POD,** includes measures to be taken by the Companies and its contractors to ensure that fire prevention and suppression measures are carried out in accordance with federal, state, and local regulations. The plan addresses the specific requirements of the USFS and BLM and provides BMPs for fire management on privately owned lands.
14. **Framework Hazardous Materials Management Plan, Appendix P of the POD,** reduces the risks associated with the use, storage, transportation, production, and disposal of hazardous materials (including hazardous substances and wastes). This Plan will identify Project-specific mitigation measures and other specific stipulations and methods to address spill prevention, response, and cleanup procedures for the Project.

15. **Framework Construction Emergency Preparedness and Response Plan, Appendix Q of the POD,** will provide an overview of methods to be implemented if the need for emergency management is imminent. This document will describe the existing support structure, chain of command, and emergency communications protocols.
16. **Operations, Maintenance, and Emergency Response Plan, Appendix R of the POD,** will include measures to be employed while conducting routine, corrective, and emergency operations and maintenance activities. Measures identified comply with applicable state and federal laws and policies; ensure consistency across and within federal jurisdictions; and allow for the Companies to access the transmission line and ancillary facilities in a timely, cost effective, and safe manner.
17. **Cultural Resources Protection Plan, Appendix S of the POD,** identifies the mitigation measures needed to avoid or reduce project-related impacts to cultural resources, wherever feasible. This plan provides important background and contextual information useful for the cultural resources protection program and appends the PA and Project-wide Historic Properties Treatment Plan (HPTP). Included in the HPTP are the Monitoring Plan, Inadvertent Discovery Plan, Native American Graves Protection and Repatriation Plan, and trail mitigation plan.
18. **Preconstruction Checklist, Appendix T of the POD,** identifies when specific actions related to completion of plans are to take place as well as when Contractor secured permits are to be applied for.
19. **Transmission Line Framework Flagging, Fencing, and Signage Plan, Appendix U of the POD,** describes the methods that will be used in the field to delineate limits of disturbance and protect sensitive environmental and cultural resources during Project construction.
20. **PacifiCorp's Transmission Construction Standards, Appendix V of the POD,** provides standards for all aspects of transmission line construction.
21. **PacifiCorp's Transmission and Distribution Vegetation Management Program Specification Manual and Idaho Power Company's Transmission Clearing Specifications and Framework for Managing Noxious Weeds, Appendix W of the POD,** cover the vegetation management program for both distribution and transmission. They include program descriptions, specifications, and protocols.
22. **The Land Description of Project Components on Federally Managed Public Lands, Appendix X,** provides an Aliquot part subdivision down to the quarter-quarter section for the transmission line ROW, regeneration stations, substations, permanent and temporary access roads, and temporary multipurpose areas and fly yards.
23. **Other Information, Appendix Y of the POD**, includes Project documents such as the Biological Opinion and permits that have been issued.
24. **Environmental Protection Measures, Appendix Z of the POD,** is a list of all EPMs that are included in Appendices C through SR organized by resource to provide an easy reference document.

3.4 Road and Waterbody Crossing Standards

The Companies plan to use existing roads and waterbody (e.g., channel, river, and streambed) crossings where practicable and feasible. The Companies conducted siting and design engineering to avoid new crossings of perennial streams, rivers, or artificial water conveyances such as canals, where possible. New roads have been planned to cross waterbodies only where avoidance is infeasible and largely where waterbodies are ephemeral or intermittent.

Road construction, which includes widening and revising turning radii for existing roads where necessary, will occur between existing roads and each facility, including transmission structures. Repair or maintenance of existing roads was not included in impact calculations if the original road prism is not proposed to be enlarged. Examples of road crossing and culvert standards are found in Attachment A. The stream conditions, including expected maximum flow, will dictate the type of stream crossing. The Construction Contractor is responsible for mapping each stream crossing and identifying crossing type and size for each.

Where constructing a new waterbody crossing is impractical or will require a bridge or a very large (>48-inch-diameter) culvert, existing waterbody crossings will be used and access redesigned to avoid a new crossing. All canals and ditches will be avoided by using existing crossings, as will all large perennial bodies like rivers. The following waterbody crossing types will be employed where avoidance is not possible:

- **Type 1—Drive through:** Crossing of a channel with only minimal vegetation removal and no cut or fill needed. This is typical for much of the low-precipitation sagebrush country with rolling topography and streams that rarely flow with water.
- **Type 2—Ford:** Crossing of a channel that includes grading and stabilization. Stream banks and approaches will be graded to allow vehicle passage and stabilized with rock or other erosion control devices. The stream bed will in some areas be reinforced with coarse rock material, where approved by the land-management agency, to support vehicle loads, reduce erosion, and minimize sedimentation into the waterway.
    - The rock will be installed in the stream bed such that it will not raise the level of the streambed, thus allowing continued movement of water, fish, and debris. A ford crossing results in an average disturbance profile of 25 feet wide (along the waterbody) and 50 feet long (along the roadway) for 1,000 square feet or 0.02 acre at each crossing. Disturbance amount is estimated based on need to get equipment into the riparian area to build the 14-foot-wide travelway and protect it from erosion by adding armoring.
- **Type 3—Culvert:** Crossing of a waterbody that includes installation of a culvert and a stable road surface established over the culvert for vehicle passage. Culverts are designed and installed under the guidance of a qualified engineer who, in collaboration with a hydrologist and aquatic biologist where required by the land management agency, recommends placement locations; culvert gradient, height, and sizing; and proper construction methods.

- Culvert design considers bedload and debris size and volume. The typical disturbance footprint for culvert installation is estimated to be 50 feet wide (along the waterbody) and 150 feet long (along the road) for 7,500 square feet or 0.17 acre at each crossing. Ground-disturbing activities will comply with Agency-approved BMPs. Construction will occur during periods of low water or normal flow. The use of equipment in streams will be minimized. All culverts will be designed and installed to meet desired riparian conditions, as identified in applicable unit management plans. Culvert slope will not exceed stream gradient. Typically, culverts are partially buried in the streambed to maintain streambed material in the culvert. Sandbags or other non-erosive material are placed around the culverts to prevent scour or water flow around the culvert. Adjacent sediment control structures such as silt fences, check dams, rock armoring, or riprap may be necessary to prevent erosion or sedimentation. Stream banks and approaches may be stabilized with rock or other erosion control devices. Culverts will be inspected and maintained annually for the life of the Project (estimated at 50 years or longer) for proper operation and to protect water quality.

The performance of low water stream crossings will be monitored for the life of the access road, and maintained or repaired as necessary to protect water quality. The Companies have a standard set of BMPs in their road and construction manuals (examples in Attachment A) and will use additional BMPs where required by land-managing agencies during construction.

For waterbodies that are primarily dry, the crossing options include Type 1 through 3, and require agency consultation for crossings on federal lands. For 303(d) listed streams with sediment as the primary contaminant of concern, additional erosion and sediment control devices (e.g., turbidity curtains) will be used if flow is present during installation of in-stream structures and other BMPs are not effective.

3.5 Wetlands Crossings with Access Roads

During construction and for routine and emergency operations, access across wetlands to each structure location is necessary. Two methods of minimizing impact to wetlands were evaluated but are not proposed:

- Constructing at-grade roads with geotextiles and road materials which allow for water through-flow. This type of road will be below water during certain times of the year which could make locating the roads difficult, and the depth of the water over the drivable surface may make travel over the submerged road surface impractical or not feasible.
- Constructing using helicopters in wetlands. The single-circuit 500-kV towers will be designed such that they can be erected by helicopter if needed. In each case, the use of ground based vehicles is still required, thus not eliminating the need for an access road to each structure to complete construction or during inspections and live-line maintenance activities.

A combination of methods for road construction in wetlands is proposed:

- Construction of permanent above-grade roads that will be utilized during construction, operation, and maintenance. This will typically entail placement of permanent fill in wetlands such that the travel surface is higher in elevation than the ordinary high water

level. The construction of above-grade access roads allows for the use of the types of equipment needed for construction, operation, maintenance; and for expedited access for emergency restoration throughout the year.

- Construction or use of temporary roads during construction, followed by restoration of the disturbance after construction. The Companies only propose this approach in the area of extensive wetlands in the Bear River Plain, in part because it is feasible to store the amount of matting needed for emergency access in the immediate vicinity. Smaller wetland and riparian area crossings will be constructed using permanent crossing methods because it is not feasible to provide for temporary crossing materials for scattered crossings along a thousand miles of the Project. Where feasible in areas where temporary roads will be used, construction equipment may travel overland if the area is dry. If construction occurs when the ground is solidly frozen, ice roads could be constructed.

If construction must occur when the ground is wet, temporary matting materials will be installed to allow access for heavy vehicles and equipment. The mats typically come in the form of heavy timbers bolted together. They are often used over a geotextile that is applied directly over the wet soil surface. When construction use is complete, the mats are removed and the geotextile taken up. This approach will be used where feasible, since it further reduces vegetation damage and compaction and reduces the time for full restoration. Mats spread the concentrated axle loads from equipment over a much larger surface area than the tires alone, thereby reducing the bearing pressure on fragile soils. Matting has a limited service life before replacement is required and must be stored for maintenance and emergency restoration activities. Table 2 shows an estimate of miles of temporary roads for construction access in the three largest wetland areas crossed by the Proposed Route. Though exact locations may change during final design, the Companies are committed to using temporary crossings wherever feasible in these three important wetland areas. They are able to make this commitment only in the Bear River area because they already have storage facilities near enough to the area where mats will be used to allow for quick deployment in case of emergency.

Table 2. Access Road Wetland Crossings in the Bear River Plain

Location	Segment 4 Mileposts	Approximate Miles			
		Total New or Improved Access Roads	New or Improved Access Road in Uplands	Proposed for Permanent Fill in Wetlands	Proposed for Temporary Access in Wetlands
Cokeville	123.0-126.8	2.2	1.3	0.0	0.9
Bear River	133.5-134.5	1.8	0.0	0.0	1.8
Montpelier	148.0-153.6	7.9	5.1	0.0	2.8

Where temporary road access is utilized, road areas will be rehabilitated after construction. Any geotextiles and matting used will be removed and wetland vegetation allowed to re-vegetate. No permanent roads will be available for routine operations inspections or repairs. Operational inspections and repairs will be scheduled for times when the ground is dry or frozen and access will be overland along the road alignment by all-terrain vehicle (ATV). Emergency repairs requiring heavy equipment will access the damaged area using matting if necessary. After emergency repairs are completed, matting will be removed and the wetland areas allowed to restore naturally.

3.6 Avoidance and Minimization

The Project comprises critical infrastructure for the Companies and the western U.S. electrical grid. Because of the need to operate this line almost continuously and to avoid unplanned outages, permanent access to the line and structures is a critical component of the project. The Companies propose to use permanent fill to construct above-grade service roads in waters of the U.S. except in the Bear River Plain as explained in Section 3.5, above. This provides the most flexibility for construction and operations and maintenance (O&M) activities and expedited access for emergency restoration throughout the year. Service and access roads account for the majority of unavoidable impacts to waters of the U.S. for this Project. Required vegetation management for the safe O&M of the line also contributes to wetland impacts.

Where avoidance through engineering design was not possible, impacts are being minimized where feasible through relocation or redesign of project features. For example, impacts have been minimized by reducing desired vegetation management areas and road width to the minimum needed for safe operation and compliance with regulatory requirements. Permanent and temporary direct and indirect impacts to waters of the U.S. that result from construction and O&M activities are similar in nature but tend to vary in extent. Removal of vegetation and the introduction of fill material to waters of the U.S. could directly alter their ability to serve as wildlife habitat; their ability to trap sediment and nutrients; and their ability to moderate flood flow or facilitate surface water flow. This could also result in indirect impacts such as increased water and soil temperatures and/or alteration of species composition (which can also change the function) within these areas. Any blasting that may occur within or adjacent to a waters of the U.S. could fracture the bedrock and alter the hydrology of a perched water table and potentially lead to drier conditions that impair re-vegetation efforts. Withdrawal of water for use during construction may temporarily impact waters of the U.S. by reducing the water input that they normally receive.

Service road maintenance and vegetation management could result in minor impacts to wetlands or riparian areas. Vehicle traffic in wetlands and riparian areas has the potential to permanently alter soil characteristics and drainage patterns unless proper precautions are taken. Indirect impacts during maintenance may include compaction of soils, alteration of drainage patterns, erosion, and sedimentation. Erosion control and sedimentation runoff measures such as water bars, culverts, sediment basins, or perimeter control will be installed as required to minimize erosion.

Although some Project-related disturbances to vegetation will be temporary and associated with construction activities, long-term impacts will occur in forested wetlands because of ongoing vegetation management and the time it takes for re-vegetation efforts to mature. Construction impacts in forested wetlands and forested riparian areas will generally involve a conversion to a different wetland type (i.e., a change to shrub or herbaceous type), rather than a loss of wetland or riparian acreage. The Companies will not actively restore forested wetlands because of the potential for trees to interfere with the transmission line. It is likely that recovery will be fairly rapid in herbaceous and shrub wetlands, and construction in these types is not likely to cause a conversion to a different wetland type.

4.0 PRELIMINARY ESTIMATION OF IMPACTS TO WATERS OF THE U.S.

Preliminary impacts were identified through detailed remote sensing and image interpretation with ground-truthing. Wetland delineations and detailed mapping of stream crossings have been conducted on Segments 1 through 4 on public lands and on private lands where access was granted in 2012 and 2013. Estimates provided here for Segments 5 through 10 are based on indicative (desktop) engineering and Geographic Information System (GIS) estimates of impact based on available information and are provided for the BLM-Preferred Route. Ongoing route discussions for some of these segments will likely result in changes to the route and therefore to impacts to waters of the US.

4.1 Methods

4.1.1 Desktop Assessment

In preparation for field work, Tetra Tech collected available data sources to be used for identifying the locations of wetlands within the study area. These sources included:

- National Wetlands Inventory (NWI) (USFWS 2012);
- National Hydrography Dataset (NHD) (USGS 2012);
- Natural Resources Conservation Service Hydric Soils List for Sweetwater County (USDA NRCS 2012);
- ESRI, Inc. World Imagery—The map features 0.3-meter resolution imagery in the continental United States (ESRI 2012); and
- Project specific Sanborn aerial imagery—Project-specific color infrared aerial imagery was flown by Sanborn (a contracted vendor) in three phases to capture seasonally optimal and distinguishable vegetation color signatures across the study area. Images were acquired with an Ultracam-D Vexcel digital camera from an average elevation of 7,000 feet above ground surface (varied from 6,000 to 8,000 feet depending on terrain elevation). Photos were taken as four-band color images: blue, green, red, and near infrared images (Tetra Tech 2010).

A desktop vegetation mapping exercise was conducted by Tetra Tech in support of the Gateway West EIS. Wetland features were identified and digitized by combining aerial photo interpretation (API) with the datasets described above (Tetra Tech 2010). Riparian and wetland areas greater than 0.1 acre were digitized. NWI and NHD layers were used for estimation of impacts to Waters of the U.S. for Segments 6 through 10.

4.1.2 Field Methods for Wetland Delineations

Tetra Tech biologists conducted wetland delineations for Segments 1 through 4 from 2010 to 2013 in accordance with standard USACE protocol defined in the USACE Wetland Delineation Manual (Environmental Laboratory 1987), with the Arid West Regional Supplement (USACE 2008a) and the Western Mountains Regional Supplement (USACE 2008b) providing additional guidance.

4.1.3 Field Methods for Non-wetland Waters

Biologists investigated and characterized non-wetland waters, identified during the desktop review described above, from June through August 2013 for Segments 1 through 4 on public lands and those private parcels where access was allowed. Several possible non-wetland water crossings are located on parcels where access was denied and will be investigated when access is granted. All perennial (having flowing water year-round) and intermittent (having flowing water during certain times of the year, when groundwater provides water for stream flow) features were investigated and characterized where access was available.

Field investigation included confirming stream type (i.e., perennial, intermittent, or ephemeral), defining the ordinary high water mark, noting vegetation and current site conditions and collecting a representative photograph of the site.

4.1.4 Functions and Values Assessment

The Montana Department of Transportation Montana Wetland Assessment Method (MWAM) (Berglund and McEldowney 2008) was developed for use in a regulatory context to evaluate wetland features where proposed impacts may occur (Fennessy et al. 2004), which is the intent of this assessment. Further, direction from the USACE indicated the MWAM should be used to characterize wetland functions and values (Brochu 2010; Johnson 2013). As a result, the MWAM was selected because it scores wetland functions and values, is rapid, is repeatable, and is widely accepted for assessing potentially impacted wetlands.

The function and value variables are as follows:

- Habitat for Federally Listed or Proposed Threatened and Endangered Species
- Habitat for Animals or Plants with a State Rated S1-S3
- General Wildlife Habitat
- General Fish Habitat
- Flood Attenuation
- Short and Long Term Surface Water Storage
- Sediment, Nutrient, and Toxicant Retention and Removal
- Sediment/ Shoreline Stabilization
- Production Export/ Food Chain Support
- Groundwater Discharge/ Recharge
- Uniqueness
- Recreation/ Education Potential

A functional point is a score between 0.1 (lowest) and 1.0 (highest) assigned to each function and/or value. The sum total value of the variables is expressed as a percentage of the total possible score, this percentage, in conjunction with other criteria, is used to determine the overall ranking of a wetland.

Functional units were calculated for a wetland by multiplying the functional points by the Assessment Area or study area. Functional units will be used to determine the success of

mitigation by comparing pre-construction to post-construction functional units for both the impacted areas and the compensatory mitigation project areas.

4.1.5 Gap Analysis

Tetra Tech biologists performed an API desktop analysis utilizing NWI, NHD, vegetation mapping, previously delineated wetlands, and current aerial imagery coverage to identify wetland features that intersect disturbance layer from the design route in Segments 1 through 4 that have not been visited in the field. This design route incorporated wetland avoidance changes identified from previously delineated wetlands. During API, wetlands were identified and grouped into the following three categories:

- High – There is a high (almost certain) probability the site is a wetland based on visual similarity to delineated wetlands in the area, 'greener' visual contrast to surrounding lands, topographic position, and local hydrology;
- Moderate – There is a moderate probability the site is a wetland based on visual similarity to delineated wetlands in the area, 'greener' visual contrast to surrounding lands, topographic position, and local hydrology. These sites were typically identified by NWI in arid locations and may or may not meet wetland criteria;
- Low – There is a low probability the site is a wetland based on visual similarity to delineated wetlands in the area, 'greener' visual contrast to surrounding lands, topographic position, and local hydrology. These sites were typically identified by NWI as riverine in arid locations.

Moderate and high wetland categories are presented in the gap analysis and were selected to prioritize wetland field work and inform future wetland avoidance considerations during design review. These un-surveyed wetland features were assessed for functions and values as described above, based on estimated wetland acreage and function and value variables.

4.2 Impacts to Waters of the U.S.

Tables 3 and 4, below, present the estimated impacts to both wetlands and riparian areas adjacent to stream crossings.

Table 3. Segment D Impacts to Waters of the U.S.

HUC 6	Construction Impacts		Operational Impacts		
	Non-wetland Waters (linear feet)	Wetlands (Acres)	Non-wetland Waters (linear feet)	Wetlands	
				Acres	Functional Units
Great Divide Closed Basin*	9,294	0	1,135	0	0
White-Yampa	1,033	0	209	0	0
North Platte	51,184	14.26	7,063	2.03	7.12
Upper Green	39,981	9.32	5,497	0.25	0.89
Upper Bear	5,601	4.77	895	1.11	3.91
Lower Bear	6,966	24.72	1,577	3.83	13.43
Upper Snake	4,218	0.03	55	0.01	0.03
TOTAL	118,277	53.10	16,431	7.24	25.38

*No wetlands identified in this HUC.

Table 4. Segment E impacts to Waters of the U.S.

HUC 6	Construction Impacts		Operational Impacts		
	Non-wetland Waters (linear feet)	Wetlands (Acres)	Non-wetland Waters (linear feet)	Wetlands	
				Acres	Functional Units
Great Salt Lake	2,678	0.82	342	0	0
Lower Bear	8,284	0.06	1,723	0.02	0.05
Middle Snake	60,278	5.92	9,449	0.76	2.36
Upper Snake	94,239	11.31	13,600	2.35	7.28
TOTAL	165,479	18.11	25,114	3.13	9.69

5.0 MITIGATION FRAMEWORK

The USACE recognizes three mechanisms for providing compensatory mitigation for unavoidable permanent impacts to waters of the U.S. Temporarily impacted areas will be restored to pre-disturbance conditions and are not included in the Framework. Listed in order from most favorable (preferred by the USACE) to least favorable, these include mitigation banks, in-lieu fee programs, and permittee-responsible compensatory mitigation. Both mitigation banks and in-lieu fee (ILF) programs involve off-site compensation activities that are conducted by a mitigation bank or an in-lieu fee program sponsor. Permittee-responsible mitigation is the most traditional form of compensation and continues to represent the majority of compensation acreage provided each year (USACE 2008c). As its name implies, the permittee retains responsibility for ensuring that required compensation activities are completed and successful. Compensatory projects can be located at or adjacent to the impact site (i.e., on-site compensatory mitigation) or at another location generally within the same watershed as the impact site (i.e., offsite compensatory mitigation).

Project impacts will be largely confined to the requested ROW for the transmission line and roads, occur in multiple locations, and will generally be less than 0.5 acre at each site. There are currently no mitigation banks or in-lieu fee programs available in Wyoming or southeastern Idaho for the Companies to mitigate their proposed impacts. Mitigation banks (Section 5.1 and the in-lieu fee program (Section 5.1.2) are briefly discussed in the following sections as these mitigation mechanisms may be available as the Companies develop Segment E in Idaho. The Companies are presently considering multiple locations on Company-owned property where wetland enhancement, restoration, or creation may be feasible (permittee-responsible mitigation). These sites are further discussed in detail in Section 5.2.

5.1 Wetlands

5.1.1 Mitigation Banks

The USACE prefers the use of mitigation banks, but has indicated that the Project does not fall within the service areas of any approved and operational mitigation banks (Johnson 2010; Joyner 2010). In addition, it is unlikely any approved mitigation banks will be operational within service areas appropriate for this Project on a schedule that would allow for timely Project permitting. The Companies are not considering creating a mitigation bank as part of this Project and recognize that creating a bank may take more time than the construction schedule will allow.

5.1.2 In-lieu Fee Program

The Companies will consider the use of ILF programs to mitigate unavoidable impacts to waters of the U.S. if programs are available and applicable. Second in preference for meeting compensatory mitigation requirements, ILF programs have been developed in some parts of the U.S., but few are present in the project area. The Companies are also considering a combination of ILF and permittee-responsible mitigation including a combination of restoration, enhancement of existing wetlands, and creation of new wetlands. In most locations, the Companies do not have qualified staff to provide long-term maintenance and monitoring for permittee-responsible projects and plan to engage a responsible third party through binding contracts to provide these services. The Companies also consider that a conservation easement instrument will be

appropriate to commit the portions of those properties belonging to the Companies to "in perpetuity" wetland uses.

5.1.3 Permittee Responsible Mitigation

In Segment D, the Companies are proposing to use permittee responsible mitigation. While the USACE guidance (*Federal Register* Vol. 65, No. 216; Nov 7, 2000) states a preference for on-site and in-kind mitigation, the Companies are proposing off-site mitigation that includes in-kind and out-of-kind activities in the same 6th-order watershed. The Companies are not proposing on-site mitigation because of the need to access structures and associated facilities over the life of the project.

In discussion with USACE staff, the Companies have proposed a 1:1 ratio of functional units lost to functional units gained through actions at the proposed mitigation sites. The Companies recognize that the USACE may require larger ratios depending on the type of wetland to be mitigated for and the possible delay in mitigation results. The Companies remain committed to compensate for impacts as specified by the USACE. Preliminary evaluation of each of the three proposed mitigation sites indicates that there is ample opportunity at each of the three sites to accommodate reasonable mitigation ratio work and still fully compensate for Project impacts from Segment D.

5.2 Proposed Mitigation Sites

Previous discussion with the USACE have indicated that offsite compensatory mitigation, if employed, must be located in the watershed in which the disturbance has taken place and that the watersheds must be 6th order Hydrologic Unit Code (HUC) or smaller. Figure 3 identifies the 6th order HUC boundaries crossed by the project.

Each mitigation site will be evaluated for its baseline conditions, including a functions and values assessment. A control site will be established at or near each site to assist in documenting the improvement in functions and values due to the improvements at the mitigation site. A detailed plan will be prepared for each of the three sites that will include:

1. Mitigation goals and objectives
2. Baseline information for impact and proposed mitigation sites
3. Mitigation site selection and justification
4. Mitigation work plan, including location, detailed engineering drawings, planting prescriptions

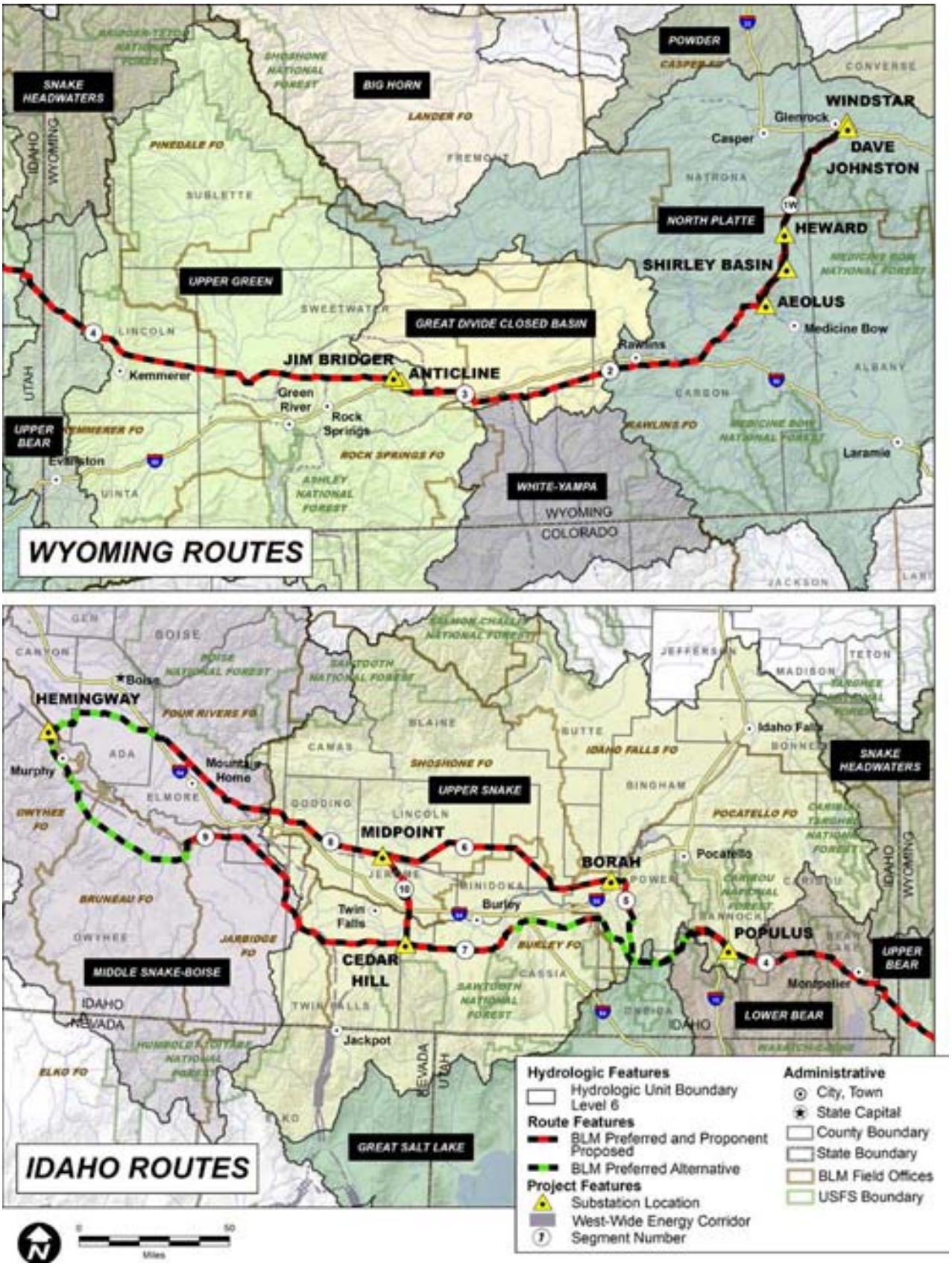


Figure 3. 6th Order HUCs across the Project

5. Performance standards, including success criteria that will be used to monitor and determine if, and how quickly the site will meet conditions required to fully compensate for lost functions.
6. Site protection and maintenance
7. Monitoring plan, including short and long term monitoring
8. Adaptive management plan
9. Financial assurances

Although detailed design engineering has been completed for Segment D, not all wetland locations have been field evaluated to a lack of right of entry. Additionally, micro-siting and contractor changes may affect the final wetland and non-wetland waters impacts from the project once complete. To be prepared for any increase in impacts beyond that identified to date, the Companies will plan for an additional 15 percent increase in mitigation site functions over the minimum required as a contingency.

5.2.1 Upper and Lower Bear River HUC 6 Watersheds: Ovid Creek

PacifiCorp Energy (affiliated with Rocky Mountain Power) owns several large parcels of land west of Montpelier, Idaho, as part of the Bear River Hydroelectric Project (Figure 4). Relicensed for 30 years in 2003, the Bear River Project is subject to a Settlement Agreement. The Settlement Agreement and new license require the provision of recreational enhancements, in-stream flows to benefit aquatic resources, and various funds to conserve and benefit natural resources near the project. Therefore, PacifiCorp Energy has dedicated staff and resources that already manage various natural resources projects in the vicinity of the Gateway West Project. One of the properties owned by PacifiCorp and leased for meadow hay and grazing operations to a local rancher, is found on Ovid Creek, to the west of the main Bear River but within the larger Bear River floodplain, hereafter referred to as the “Ovid Creek” parcel (Figure 5).

Ovid Creek was purchased in the 1980s to allow PacifiCorp to better control the flooding in the Bear River floodplain that occurred during very high runoff periods. Ovid Creek, from which PacifiCorp owns irrigation water rights, runs adjacent to and through the parcel. The parcel is flood irrigated every spring/summer using those rights. Water is conveyed through ditches and by manipulation of water levels at the Bern Dam control structure. The lessee manages irrigation to produce one or two cuttings of hay. During the fall and winter months, the parcel is used to graze and winter cattle.

In evaluating Ovid Creek for wetland and non-wetland waters mitigation opportunities, the Companies have considered lowering the ground surface elevation to meet the shallow seasonal groundwater in the area and allowing for additional palustrine and or shrub scrub wetlands to expand as a result of a hydrologic connection to Ovid Creek. Monitoring wells will be used to evaluate changes in shallow groundwater levels and are further described in Section 5.2.1.1. There are also opportunities to improve the streambank condition of Ovid Creek by selectively fencing more susceptible portions from intensive domestic livestock use. This is one opportunity to gain mitigation credit from impacts to non-wetland waters.

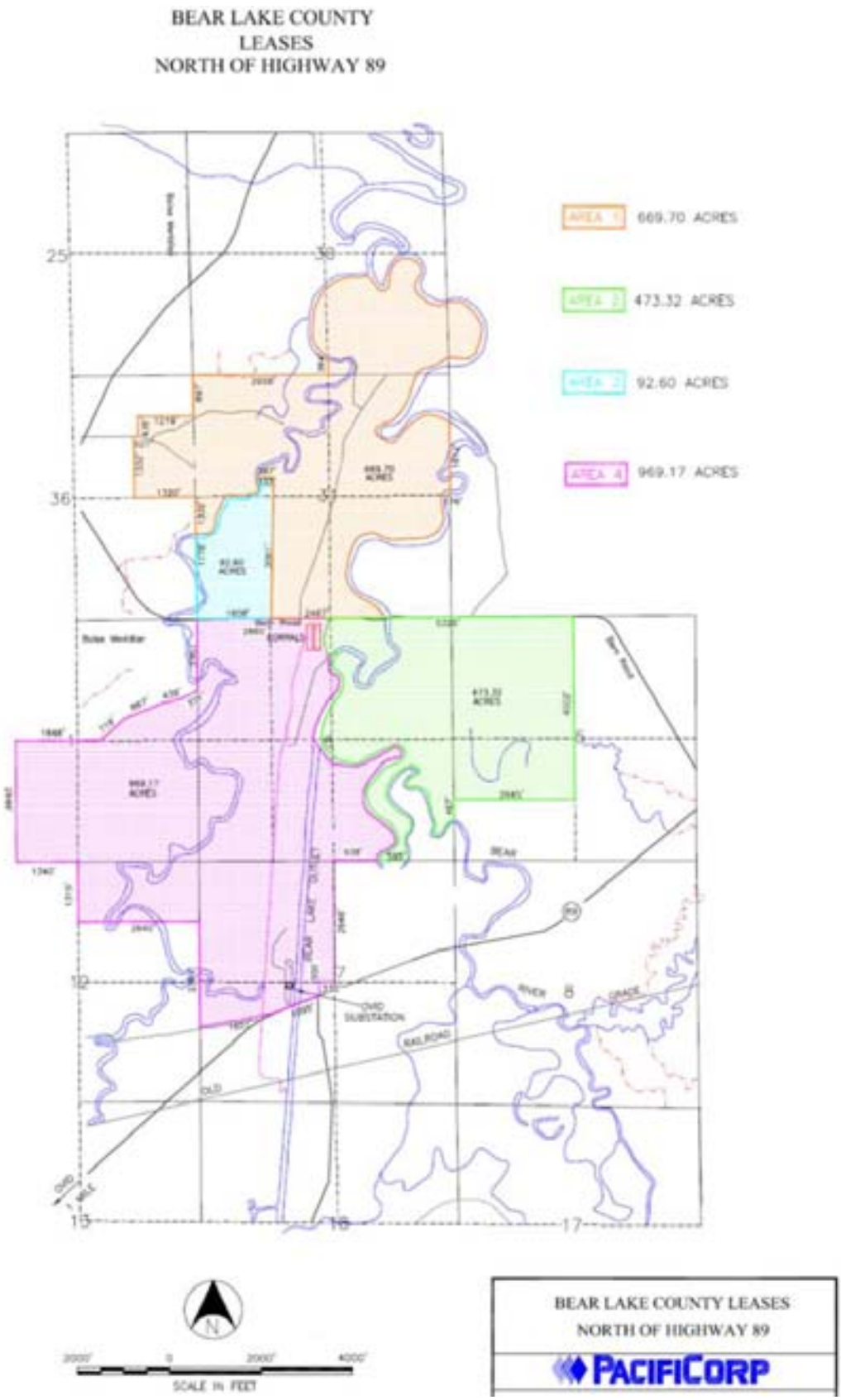


Figure 4. Bear Lake County Leases

Mitigation Parcel

Potential Wetland Area

ROCKY MOUNTAIN POWER

IDAHO POWER

Gateway West
Transmission Line Project

Figure 5

Ovid Creek
Mitigation Site

Bear Lake County, Idaho

Source: Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

Ovid_Wetlands_Mitigation_Area_20130813 corey.yurtinus 8/22/2013

Through PacifiCorp's Hydro Resources Management group, PacifiCorp approved a Property Transaction Notice and Approval Form in late 2010 to allow a portion of this property to be transitioned from its current land use to use as a site for wetland restoration and enhancement. As part of its commitment to develop this portion of the property as a wetland mitigation site to compensate for unavoidable adverse impacts to waters of the US within the Bear River drainage, the Companies have begun the following activities:

- Install a series of monitoring wells across the parcel to periodically monitor shallow groundwater (December 2012);
- Research existing water rights owned by PacifiCorp to determine if any changes in beneficial use or location need to be recorded to assure a perpetual supply of water for the proposed wetland restoration project (December 2012);
- Conduct a detailed topographic survey of the parcel (one foot contour interval) to assist in the development of a mitigation site plan (summer 2013);
- Conduct an on-site wetland delineation on the parcel (summer 2013); and
- Conduct an on-site functions and values assessment of the parcel (summer 2013).

5.2.1.1 Existing Site Conditions

Monitoring Well Data

In December of 2012, the Companies installed 12 monitoring wells on the Ovid Creek parcel to evaluate the fluctuations in the shallow groundwater. Frequency of well monitoring varies with the seasonal change and irrigation conditions at the parcel. Results to date indicate shallow groundwater approximately four feet below ground surface in December and again in August, but rising to the ground surface with surface inundation for nearly a month in May. This was in response to seasonal runoff and overbank flooding of Ovid Creek. A good hydrograph will be prepared for the site upon completion of a year's monitoring.

Shallow groundwater depth measurements over the year will be correlated to precipitation data for the area and compared to historic precipitation patterns to determine if this year is average, above or below average in precipitation and runoff. Once that is determined, a contour map of the shallow groundwater can be developed. This information will be used to determine how much excavation may be needed to intercept this shallow groundwater during the growing season across most years.

Desktop wetlands delineation and Functions and Values Assessment

During the spring of 2013, a desktop evaluation of the existing wetlands and their functions and values was conducted which identified approximately eight acres of wetlands with corresponding 42 functions and values units. As Table 3 indicates, approximately 5 acres with corresponding 17.3 functions and values units will be impacted in the Upper and Lower Bear River HUC 6 watersheds. Additionally, approximately 2,500 feet of non-wetland waters are proposed to be impacted in these watersheds.

5.2.1.2 Mitigation Approach

Using the monitoring well data, the existing wetland delineation and functions and values units as well as what the potential impacts from the Gateway project are in these watersheds, the Companies will prepare a site specific Compensatory Wetland Mitigation Plan (CWMP) that will detail the extent of the excavation at the Ovid Creek site with a prediction of the "lift" of

functions and values units by creating new palustrine emergent and shrub scrub wetlands. The Companies will also estimate the change in stream functions from riparian fencing at this parcel.

5.2.2 Upper Green River HUC 6 Watershed: Naughton

PacifiCorp Energy (affiliated with Rocky Mountain Power) owns large parcel of land east of Kemmerer, Wyoming along HWY 30 and includes several miles of the Hams Fork River (Figure 6). This parcel, hereafter referred to as the "Naughton" parcel is approximately 260 acres in size. It is currently leased to a local rancher that uses the site for limited domestic livestock grazing. The parcel is divided by fencing into three smaller pastures where the leasee rotates a small number of horses and cattle.

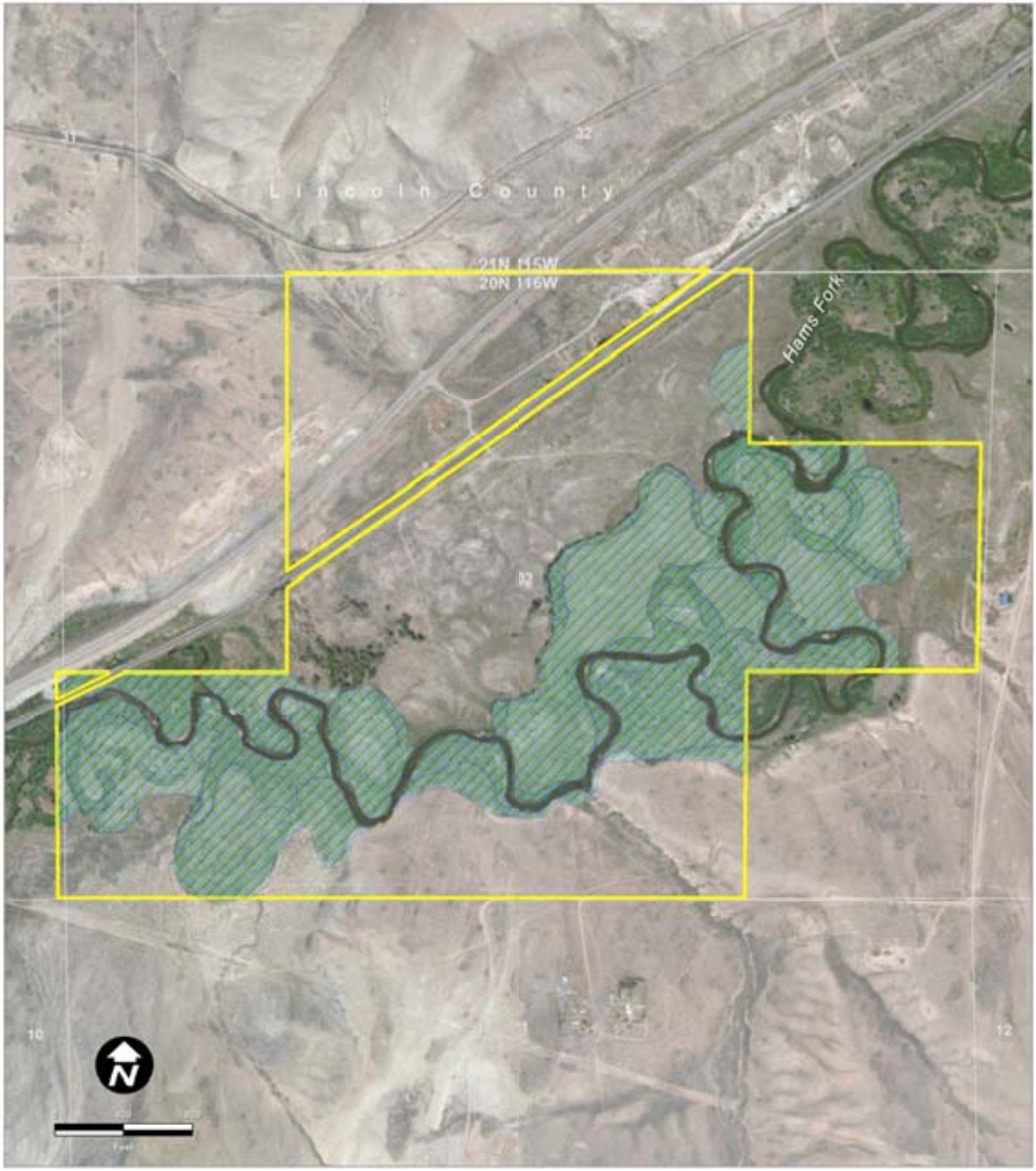
In evaluating Naughton for wetland and non-wetland waters mitigation opportunities, the Companies have considered lowering the ground surface elevation in a historic meander of the Hams Fork River to meet the shallow seasonal groundwater in the area which will allow for additional palustrine and or shrub scrub wetlands to expand as a result of a hydrologic connection to the Hams Fork. One active eagle next and one historic next are located on this parcel.

The Companies are considering the development of a walk-in interpretative trail that provides remote viewing of the eagle nest(s) and an opportunity to better understand how a wetland/riparian community functions on the landscape. This would greatly increase the values units in the function and values impact assessment. There are also opportunities to improve the streambank condition of the Hams Fork River by selectively fencing more portions from intensive domestic livestock use while still allowing wintering big game to use the water source and riparian cover. This is one opportunity to gain mitigation credit from impacts to non-wetland waters.

PacifiCorp is currently in the process of approving a Property Transaction Notice and Approval Form (similar to what was done with the Ovid Creek Parcel) to allow a portion of this property to be transitioned from its current land use to use as a site for wetland restoration and enhancement.

As part of its commitment to develop this portion of the property as a wetland mitigation site to compensate for unavoidable adverse impacts to waters of the US within the Upper Green River HUC 6, the Companies have begun the following activities:

- Research existing water rights owned by PacifiCorp to determine if any changes in beneficial use or location need to be recorded to assure a perpetual supply of water for the proposed wetland restoration project (summer 2013);
- Determine how much of the parcel will be used as mitigation and conduct a detailed topographic survey (one foot contour interval) in any areas proposed for excavation to assist in the development of a mitigation site plan (summer, 2013);
- Conduct an on-site wetland delineation on the parcel (summer 2013); and
- Conduct an on-site functions and values assessment of the parcel (summer 2013).



Mitigation Parcel

Potential Wetland Area

ROCKY MOUNTAIN POWER

IDAHO POWER

Gateway West
Transmission Line Project

Figure 6

Naughton Mitigation Site

Lincoln County, Wyoming

Source: Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

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5.2.2.1 Existing Site Conditions

Desktop wetlands delineation and Functions and Values Assessment

During the spring of 2013, a desktop evaluation of the existing wetlands and their functions and values was conducted for the Naughton site. This resulted in identifying approximately 48 acres of wetlands with corresponding 290 functions and values units. As Table 3 indicates, approximately 0.25 acre with corresponding 0.89 functions and values units are proposed for impact in the Upper Green River HUC 6 watershed. Additionally, approximately 5497 feet of non-wetland waters are proposed to be impacted in these watersheds.

5.2.2.2 Mitigation Approach

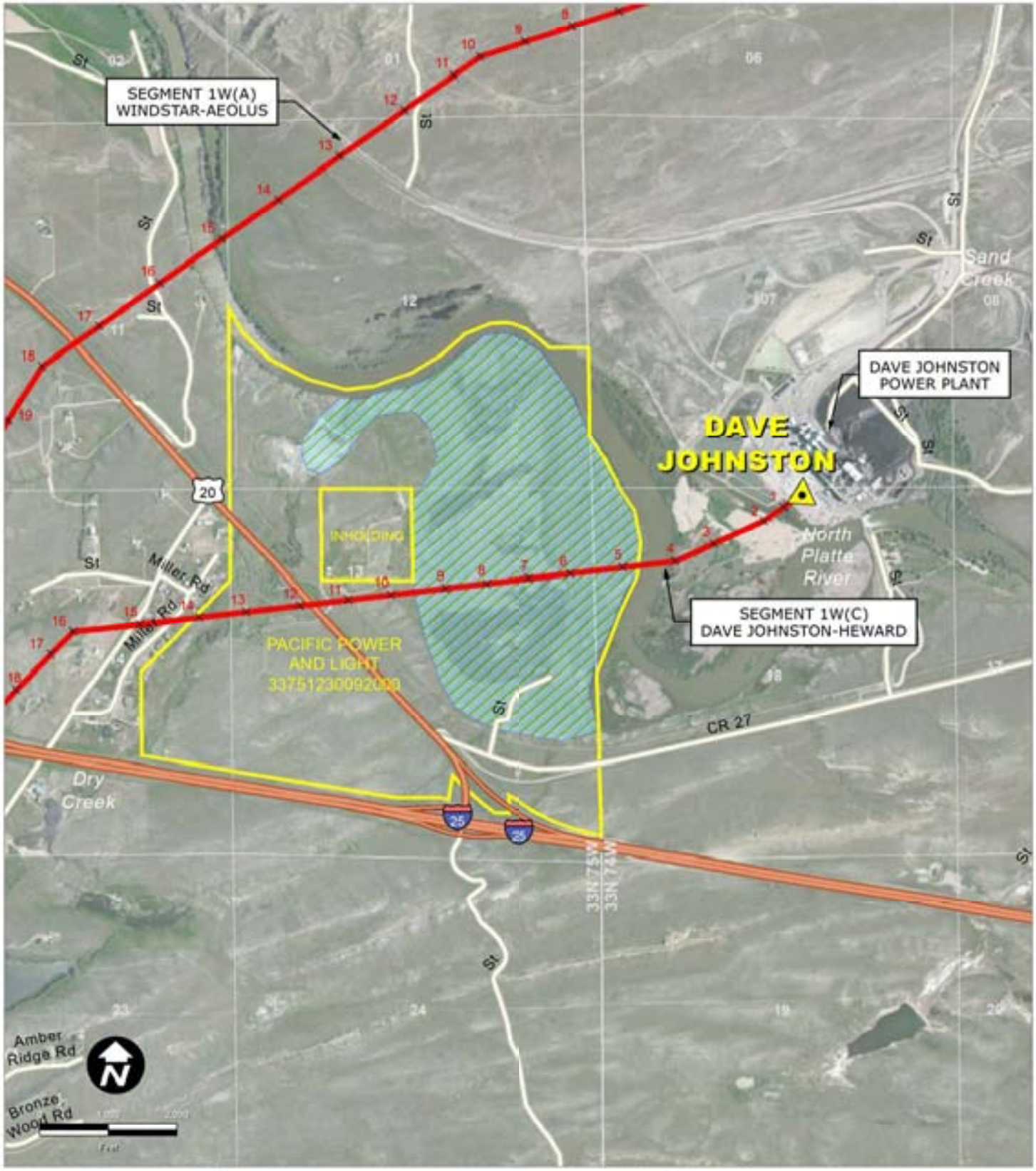
Using the existing wetland delineation and functions and values units as well as what the potential impacts from the Gateway project are in this watershed, the Companies will prepare a site specific CWMP that will detail the extent of the excavation at the Naughton site with a prediction of the "lift" of functions and values units by creating new palustrine emergent and shrub scrub wetlands, installation of an interpretative trail and possible riparian fencing at this parcel.

5.2.3 North Platte HUC 6 Watershed: Dave Johnston

PacifiCorp Energy (affiliated with Rocky Mountain Power) owns a large parcel of land immediately southwest of the Dave Johnston power plant near Douglas, Wyoming and includes several miles of river frontage along the North Platte River (Figure 7). This parcel, hereafter referred to as the "DJ" parcel is approximately 500 acres in size. It is currently leased to a local rancher that uses the site for limited domestic livestock grazing (horses and cattle). The parcel also has a walk in access agreement with the Wyoming Game and Fish Department, allowing for hunting for waterfowl and big game (archery).

In evaluating the DJ site for wetland and non-wetland waters mitigation opportunities, the Companies have considered lowering the ground surface elevation in a historic oxbow from the North Platte River to meet the shallow seasonal groundwater and allowing for additional palustrine and or shrub scrub wetlands to expand as a result of a hydrologic connection to the North Platte River. Additionally, there are also opportunities to better protect the streambank condition of the North Platte River by selectively fencing more susceptible portions from intensive domestic livestock use. This is one opportunity to gain mitigation credit from impacts to non-wetland waters. Lastly, PacifiCorp Energy is working with the Wyoming Game and Fish Department and has developed a habitat restoration plan for the site that involves large scale removal of Russian olive trees and replacing them with more wildlife friendly shrubs. PacifiCorp may opt to assist in the funding of this project, which would increase the wildlife habitat functions of the site. Continued agreement with Wyoming Game and Fish Department to allow public access would also increase the recreation/education value units for the site.

PacifiCorp is currently in the process of approving a Property Transaction Notice and Approval Form (similar to what was done with the Ovid Creek Parcel) to allow a portion of this property to be transitioned from its current land use to use as a site for wetland restoration and enhancement.



Substation
Structure
Transmission ROW Centerline
Mitigation Parcel
Wetland Area

ROCKY MOUNTAIN POWER
IDAHO POWER

Gateway West
Transmission Line Project

Figure 7

Dave Johnston Mitigation Site

Converse County, Wyoming

Source: Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

DJ_Wetlands_Mitigation_Area_20130814 corey.yurtinus 8/22/2013

As part of its commitment to develop this portion of the property as a wetland mitigation site to compensate for unavoidable adverse impacts to waters of the US within the North Platte HUC 6, the Companies have begun the following activities:

- Research existing water rights owned by PacifiCorp to determine if any changes in beneficial use or location need to be recorded to assure a perpetual supply of water for the proposed wetland restoration project (summer 2013);
- Determine how much of the parcel will be used as mitigation and conduct a detailed topographic survey (one foot contour interval) in any areas proposed for excavation to assist in the development of a mitigation site plan (summer 2013);
- Conduct an on-site wetland delineation on the parcel (summer 2013); and
- Conduct an on-site functions and values assessment of the parcel (summer 2013).

5.2.3.1 Existing Site Conditions

The Companies are currently conducting a desktop wetland delineation and functions and values assessment. As Table 3 indicates, approximately 2.03 acres with corresponding 7.12 functions and values units are proposed for impact in the North Platte River HUC 6 watershed. Additionally, approximately 7,063 feet of non-wetland waters are proposed to be impacted in these watersheds.

5.2.3.2 Mitigation Approach

Using the wetland delineation and functions and values units as well as what the potential impacts from the Gateway project are in this watershed, the Companies will prepare a site specific CWMP that will detail the extent of the excavation (if proposed) with a prediction of the "lift" of functions and values units by creating new palustrine emergent and shrub scrub wetlands at this parcel.

6.0 CONCLUSION

The Companies have sited and designed the Project to avoid waters of the U.S., including wetlands, to the greatest extent feasible. The BLM and other permitting agencies, not the Companies, select the final route to be permitted. The Companies are therefore limited in their options for avoidance and minimization to the route, and oftentimes to the specific roads, required by the permitting agencies.

Where feasible and within the constraints dictated by the BLM and other agencies' Preferred Route, the transmission structures, access roads, and ancillary facilities have been sited and designed to avoid water features including wetlands and wet creek crossings. Where not feasible to entirely avoid such crossings, the Companies have designed the road network to use existing crossings wherever feasible. The proposed crossings are the smallest possible impact given the need to safely and quickly access each structure in the event of a failure.

In one instance, the Companies have been willing to reduce their standard of a permanent above-grade road to each structure and facility to minimize permanent loss of wetlands. In the Bear River floodplain, the Companies have nearby storage available for geotextiles, timber mats, and the equipment and resident staffing to place and remove such temporary road structures in an emergency if needed. In addition, in that area, routine maintenance can be conducted from ATVs during the dry season without permanent roads. These unusual conditions pertain only in this area and do not apply to the rest of the Project, where riparian or wetland crossings are isolated and far from any facility in an emergency.

Crossings of waters and wetlands have been designed and field-checked to avoid new crossings where feasible and to minimize the impact of proposed crossings where total avoidance is not possible. For example, crossings are routinely designed to cross as close to perpendicular to the water body as possible to minimize impacts.

Impacts from the Project to waters and wetlands have been avoided and minimized wherever feasible. The small remaining unavoidable impacts represent the least damaging practicable alternative for the safe and compliant construction and operation, including emergency access, for the Project. These remaining impacts will be fully compensated for as coordinated with, and ultimately approved by, the USACE.

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ATTACHMENT A
ROAD AND CULVERT CROSSING EXAMPLES

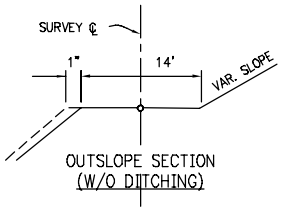
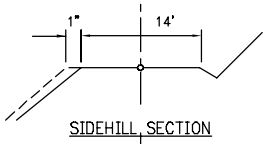
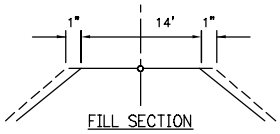
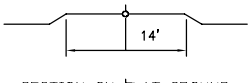
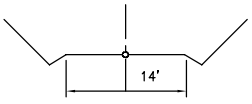
Roads—Construction

A. Scope

This standard provides information about constructing transmission line access. All road construction/improvements, fords, structure/equipment landings, and lay-down yards shall be held to a minimum. On level terrain, road construction may only require back-dragging a blade to remove brush to facilitate construction. In undulating or mountainous terrain the following standards shall apply.

B. Index

The index below provides a quick reference to detailed figures contained in this standard for road construction with varying slopes and conditions.

Referenced Road Cross Section	ACCESS ROAD SECTION
Figure 2	
Figure 3 Figure 4 Figure 5	
Figure 2	
Figure 2	
Figure 2	

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C. Planning

Before construction can take place. the road system must be planned and located properly. Poor planning or road location is associated with the following most common causes of road failure (Furniss et al. 1991):

- Improper placement and construction of road fills.
- Insufficient culvert sizes.
- Very steep road grades.
- Improper placement or sidecast of excess materials.
- Removal of slope support by undercutting.
- Altering drainage by interception and concentration of surface and subsurface flows.

A plan showing existing and new road locations shall be developed and shall be shown on the company's access road charts, plan maps, and transportation plan map. Road locations shall be marked on the ground by survey stakes and blue-and-white, striped flagging. GPS coordinates shall be obtained to define the road center–line. These coordinates shall be used to create the transportation plan map. Road information shall also be placed on transmission line plan maps.

In the event of conflict between the drawings and the staked locations, the latter shall take precedence and transportation plan maps and the transmission line plan maps shall be revised accordingly. Any culverts and gates listed in access road charts are required. Fords, drainage improvements, rip-rap fills and crushed rock requirements listed in the access road charts are anticipated; however, requirements will be determined based on actual site conditions encountered. If changes are made in the field, the maps shall be revised to show these changes.

Because roads are long-term features, their location must be carefully chosen to provide safe access, avoid long-term maintenance problems, reduce potential for degrading water quality, and minimize costs over the short and long term. For more information see the references in Section H.

D. Road Construction

Roads shall be constructed in a manner that will support equipment for construction of the transmission line and to provide access roads for line inspection and maintenance equipment after the line has been constructed.

All construction access roads on federally managed public lands are subject to approval prior to construction. Other federal, state, and local landowners may require approvals before road construction commences on their property. Where side slopes exceed 60 percent, a full bench cut will be reburied. No side-casting of material will be allowed in these areas; end-haul of material will be required to a designated location approved by the federal agency or other property owner. Close coordination with the federal agency will be required.

The detail drawings provided in this standard for completing cuts and fills, providing drainage, and installing culverts are furnished as guidelines for the road construction. Actual road construction cut slopes, fill slopes, drainage requirements, rip-rap, and

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crushed rock needs will be determined during construction based on site conditions. Cut and fill quantities shall balance when possible, reducing the material removed or brought in for road completion.

During road construction, consideration shall be given to restoration required after construction completion, including re-vegetation, rock cover, and other drainage and erosion control factors. Clearing and grading shall be minimized to reduce the restoration requirements for disturbed areas. The visual impact of roads on the surrounding areas shall be considered at all times during construction.

Crushed rock shall be sound, hard, durable, angular, or sub-angular rock, suitable for road base courses. Crushed rock shall be well graded 2″ to 1/4″ size (3″ to minus-size skip-graded is a minimum acceptable substitute).

Rip Rap shall be sound, hard, durable, rock ranging in size from 2″ to 8″ as specified on drawings and as required by conditions.

Any improvements made, including spur roads, fords, bridges, equipment landings and lay-down areas, shall be held to a minimum. Following completion of the work, the removal of these improvements shall be at the discretion of company or its representative.

Roads shall be sufficiently wide, but not less than 14′ in width. The construction shall provide bench cuts, grading, filling, compaction, and ditches necessary to accommodate heavy construction equipment and other heavily loaded vehicles. Roads shall be installed in accordance with the figures in this standard.

All roads shall be constructed with a smooth, uniform surface and shall be outsloped where practical to provide drainage and minimum erosion. Avoid outsloped roads where they will direct runoff onto erodible fill, embankments, or where they would cause off-camber curves. Where outsloping is not practical, sufficient water dips, water bars, or ditching, shall be installed as shown in the Section E of this standard. See standards TA 503, *Roads—Water Bars and Water Dips* and TA 504, *Roads—Culvert Installation* for further detail on proper drainage.

Outsloping a road means building the road surface so that it is tilted outward 2-3 percent so water can run off the road surface (see Figure 1). Outsloping works well under the right conditions. The following conditions are favorable for use of outsloped roads with no ditch:

- Short back slopes.
- Terrain slope less than 20 percent.
- Road grades steeper than 3 percent.
- Seasonal road use.
- Light traffic.
- Fast re-vegetation of cut and fill slopes.

Outslopes become a problem if roads are not maintained when ruts begin to form. The ruts will then act as channels.

The following conditions are unfavorable for outsloping:

- Long back slopes.

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- Terrain steeper than 20 percent.
- Steep, continuous road grade.
- Where ruts occur and allow water to concentrate and run along the road.
- Where winter hauling is required.

To minimize rutting and erosion of the right-of-way, road construction shall be completed during predominantly dry conditions. Fills, which will essentially consist of native soils, shall not be made when the moisture content of the soils will not permit adequate compaction.

As a minimum level of compaction, common fill shall be placed in 12″-thick, loose lifts and each lift compacted by walking or tracking in with a heavy dozer or rubber-tired (pneumatic) equipment. Each lift shall be compacted by at least four passes with the equipment.

In areas of dense vegetation, the surface organic material shall be stripped from the ground within the roadway and cut and fill areas. Stripping to a maximum depth of 6″ will be adequate unless otherwise directed by the company or its representative. Stripped and disturbed areas shall be compacted as specified above or as shown in the drawings or access road charts.

Personnel constructing the access road system shall be aware of the definition of a wetland such that potential wetlands may be identified before work is begun. In some cases where wetlands have been identified, road construction personnel shall comply with requirements as directed by the company or its representative.

Ditches, installed culverts, and/or installed surface drains to drain wet areas resulting from springs, seeps, or poor surface drainage may be required to construct the road. Drainage ditches shall be shallow, not to exceed 18″ in depth. The ditch bottom shall have a width of approximately 1′ and side slopes shall not exceed 1.5 to 1 (see Figure 5).

All earthwork and grading, cut and fill slopes, and other disturbed areas shall be re-vegetated with seed. Unless otherwise specified, the seed mix shall consist of 45 percent rye grass, 45 percent orchard or fescue grass, and 10 percent clover. The seed shall be applied at a minimum of 60 pounds per acre. At locations where the ground slope is greater than 10 percent, the seeds shall be covered with straw- or wood-fiber mulch applied at a rate of one ton of mulch per acre. The seed shall be spread in early fall when weather permits.

All phases of operation, including the construction of truck and tractor roads, shall be conducted to minimize as much as practical the damage to the soil and to prevent gullies and creation of other conditions conducive to soil erosion. Repair of all erosion damage shall be accomplished as soon as it occurs to prevent further loss of material into existing drainages. Cut slopes shall be stabilized. Care shall be taken to avoid creation of wet land conditions.

Crew movement on the right-of-way, including access routes, shall be limited so as to minimize damage to land or property. Crews shall endeavor to avoid marring the lands. Ruts and scars shall be obliterated, damage to ditches, terraces, roads and other features of the land shall be corrected, and the disturbed land beyond the access roads and structure landings shall be restored, as nearly as practical, to its original condition before final acceptance of the work.

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Erosion control measures shall be installed to minimize the transport of eroded sediments to streams and other waterways. Erosion control measures may include, but are not necessarily limited to, straw bales and silt fences.

E. Road Cross Sections

This section provides road cross sections, including required dimensions, cleared right-of-way width, and other information. See general road construction notes in Section G and references in Section H.

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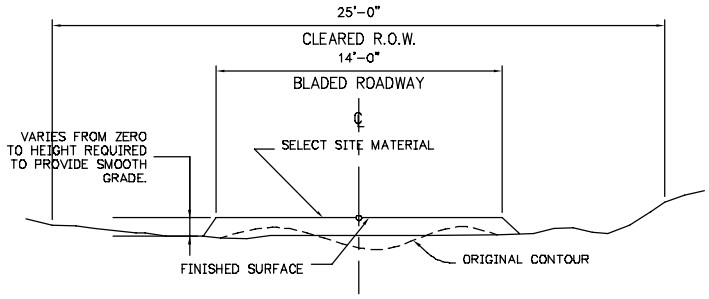
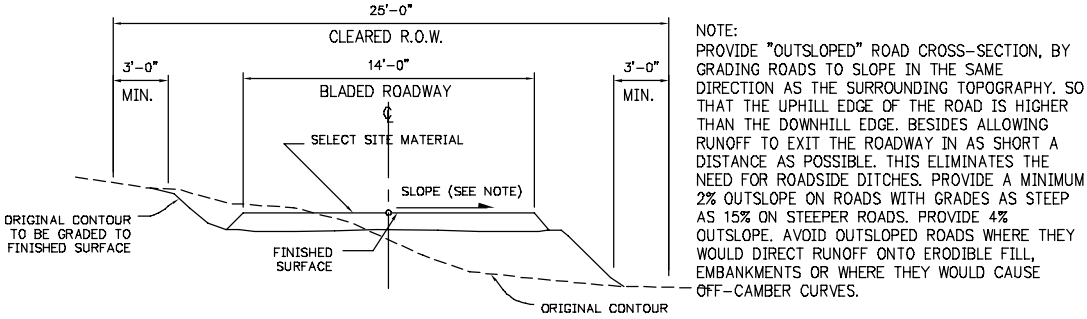
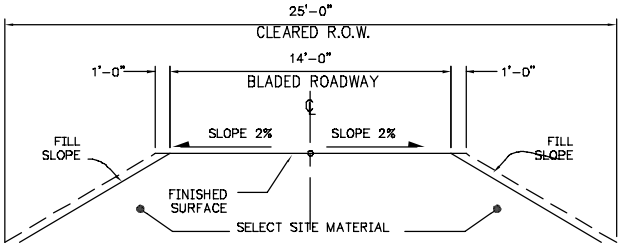


TYPICAL SECTION ON FLAT GROUND

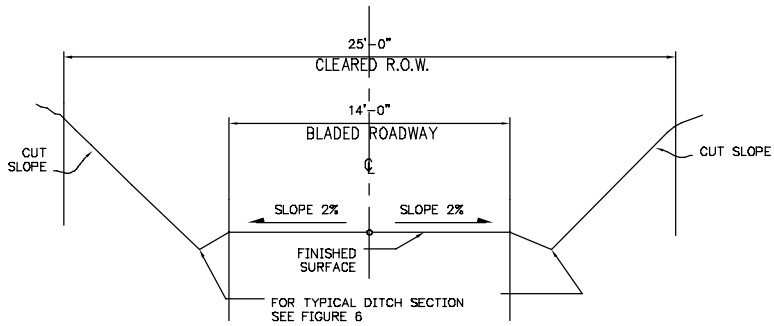


NOTE:
PROVIDE "OUTSLOPED" ROAD CROSS-SECTION, BY GRADING ROADS TO SLOPE IN THE SAME DIRECTION AS THE SURROUNDING TOPOGRAPHY. SO THAT THE UPHILL EDGE OF THE ROAD IS HIGHER THAN THE DOWNHILL EDGE. BESIDES ALLOWING RUNOFF TO EXIT THE ROADWAY IN AS SHORT A DISTANCE AS POSSIBLE. THIS ELIMINATES THE NEED FOR ROADSIDE DITCHES. PROVIDE A MINIMUM 2% OUTSLOPE ON ROADS WITH GRADES AS STEEP AS 15% ON STEEPER ROADS. PROVIDE 4% OUTSLOPE. AVOID OUTSLOPED ROADS WHERE THEY WOULD DIRECT RUNOFF ONTO ERODIBLE FILL, EMBANKMENTS OR WHERE THEY WOULD CAUSE OFF-CAMBER CURVES.

TYPICAL "OUTSLOPE" SECTION



TYPICAL FILL SECTION



TYPICAL THROUGH CUT SECTION

Figure 1—Typical Road Sections for Different Terrains

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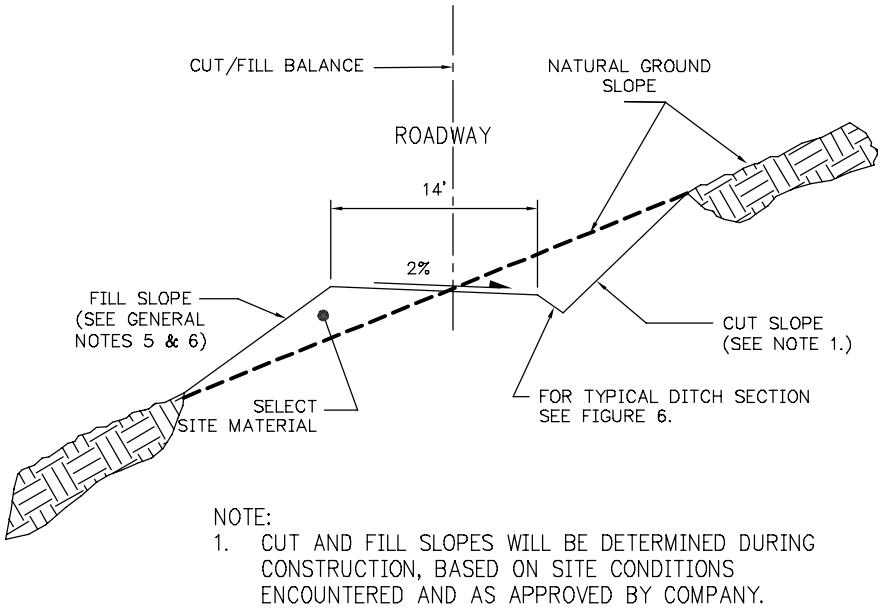

Figure 2—Typical Cut and Fill Insloped Road Section
for Natural Side Slopes Less Than 30 Percent (15)

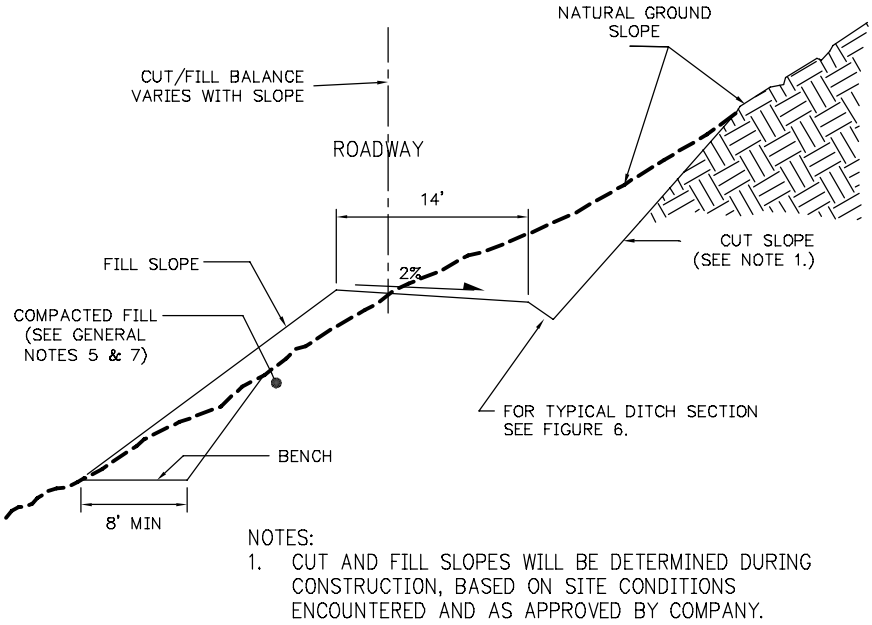

Figure 3—Typical Cut and Fill Insloped Road Section
for Natural Side Slopes Greater Than 30 Percent (15) and Less Than 60 Percent (30).

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Engineer (C. Wright): CLW
Standards Manager (G. Lyons): GL

Roads—Construction

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7 Apr 08

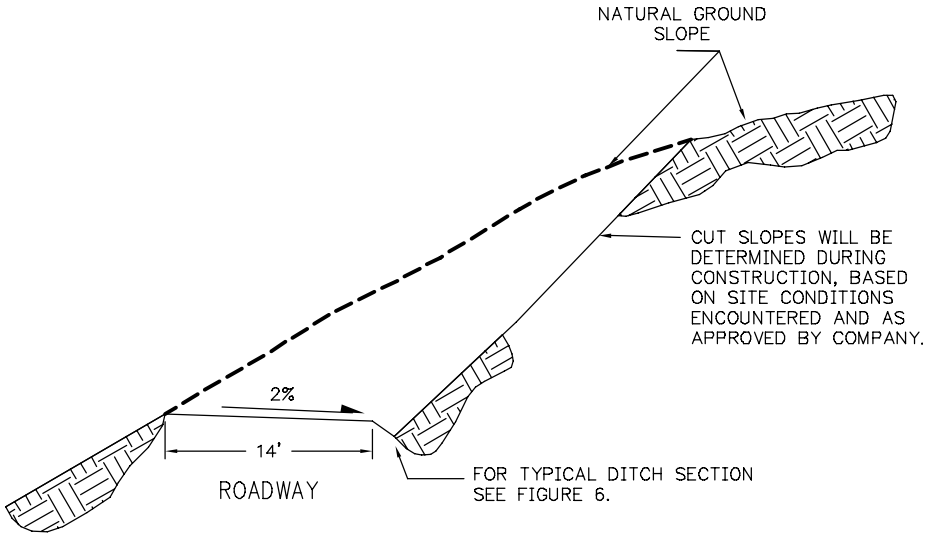

Figure 4—Typical Cut and Fill Section
for Natural Side Slopes Greater than 60 Percent (30).

F. Typical Ditch Section

Typical ditch construction is depicted in Figure 6. Many of the road cross sections shown above use this ditch construction.

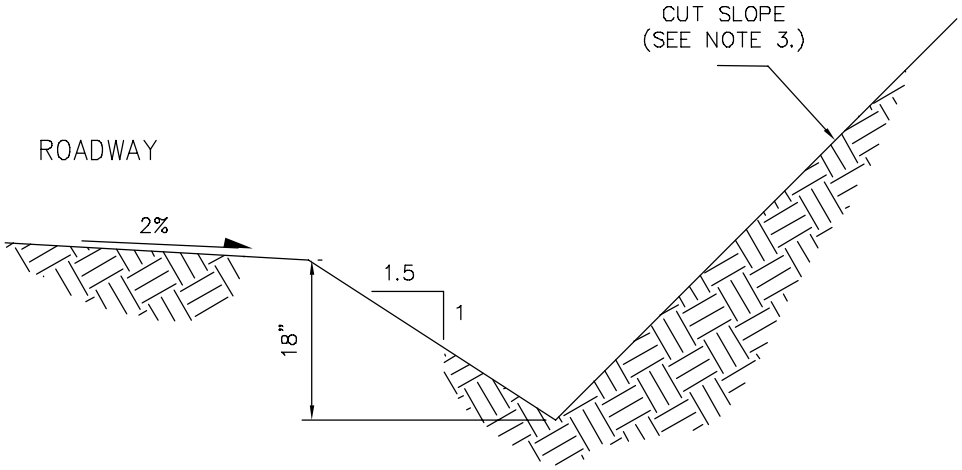

Figure 5—Ditch Section

Notes:

1. Slope the ditch so that it will drain; ditch shall have a minimum slope of 1 percent and not to exceed 3 percent.
2. Remove all soil, rock, and other material loosened by grading from ditch.
3. Cut slopes will be determined during construction based on site conditions and as approved by the company representative.

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G. General Road Construction Notes

1. Roads shall follow natural contours as much as practical.
2. Maximum grade for roads shall be 10 percent. Grades up to 20 percent will be allowed for a distance of 1000 feet where unavoidable and approved by the company.
3. Radius of curves shall be 200 feet, with a minimum of 80 feet when approved by company. When curves are less than 200 feet, roadbed shall be widened as shown in Table 1.
4. Cut and fill slopes will be determined during construction based on site conditions encountered and as approved by the company.
5. Unless specified otherwise by the company, fill material shall consist of site material excavated from RG-1 cuts. Fill material shall have a maximum particle size of 12″.
6. Fills placed on side slopes of 30 percent or less shall be placed in nominal 9″ lifts and compacted by walking in with at least four passes of earthwork equipment.
7. Fills placed on side slopes greater than 30 percent shall be placed in nominal 12″-thick lifts and compacted to at least 90 percent of the maximum dry density as determined by the ASTM D 696 method of compaction.
8. Allow 1′ additional road width on fill slopes for sloughing. When fills are over 6′ high at shoulder, allow 2′ additional road width.
9. Road construction across wetland areas may require placement of fragmented 6″ minus rock. Rock shall be placed in 8″-thick lifts and compacted by a heavy dozer or vibratory roller until well keyed. RB-(1) rock will be provided and installed by the contractor. Proper construction shall be use in wetlands so conditions as shown in Figure 7 do not develop.
10. Geotextile fabric material shall consist of MIRAF1212 OHP or equivalent, as approved by the company.

Figure 6—Poor Road Construction in Wetland Area

Table 1—Road Width for Different Road Curves

Curve Radius (feet)	Roadbed Width (feet)
200 or >	14
150 to 200	16
100 to 150	18
80 to 100	20

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H. References

1. *Handbook for Forest and Ranch Roads*, William E. Weaver, PHD. and Danny K. Hagans, 1994.

2 *A Landowner's Guide to Building Forest Access Roads,* United States Department of Agriculture, Forest Service, Northeastern Area State and Private Forestry, July 1998.

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Roads—Culvert Installation

A. Scope

This standard provides information about the construction of surface drainage and the installation of culverts. It is impossible to over-emphasize the importance of drainage in maintaining stable roads and protecting water quality. Roads should be designed and constructed to cause minimal disruption of natural drainage patterns. Provisions for two components of road drainage should be included in every road project: 1) road-surface drainage (including drainage which *originates* from the cutbank, road surface, and fill-slope), and 2) hill-slope drainage (including drainage from large springs, gullies, and streams which *cross* the road alignment).

B. Determining Culvert Diameter

Use pipe no smaller than 24″ in diameter. A drainage table provides help in determining the proper size culvert (see Table 1 and Table 2). The following example illustrates how to choose pipe size (Table 1) using the drainage table (Table 2). To use this method, you will need information on slope, soils, and cover.

Example: The area to be drained is 70 acres on steep slopes with heavy soils and moderate cover. In Table 2 under C opposite 70, find area required: 10.3 square feet. Under the area table for round pipe (Table 1), the pipe size should fall between 42″ and 48″. Use 42″ pipe with an area of 9.6 square feet. If a wood or other type of box culvert is planned, one 3′ by 3.5′ pipe would furnish the required area.

Table 1—Size of Round Pipe Needed for Area of Waterway

Area (square feet)	Pipe diameter (inches)
1.25	24
1.80	24
3.10	24
4.90	30
7.10	36
9.60	42
12.60	48
15.90	54
19.60	60
23.80	66
28.30	72
33.20	78
38.50	84
44.20	90

Source: Figure 45, Haussman and Pruett 1978, p. 36

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Table 2—Drainage Table Based on Talbot's Formula for Rainfall
1-1/4″ per Hour

Area required for waterway								
Acres	**Impervious 100% runoff** †C=1.00	**Steep slopes Heavy soils Moderate cover** C=0.80	C=0.70	**Moderate slopes Heavy to light soils Dense cover** C=0.60	C=0.50	**Gentle slopes Agricultural soil & cover** C=0.40	C=0.30	**Flatland Previous soils** C=0.20
Square Feet								
2	0.5	0.4	0.4	0.3				
4	0.9	0.7	0.6	0.5				
6	1.2	1.0	0.8	0.7	0.6	0.5		
8	1.5	1.2	1.0	0.9	0.7	0.6		
10	1.7	1.4	1.2	1.0	0.9	0.7	0.3	
20	2.9	2.3	2.0	1.8	1.5	1.2	0.5	
30	4.0	3.2	2.7	2.4	2.0	1.6	0.5	0.3
40	4.9	3.9	3.4	3.0	2.5	2.0	0.9	0.4
50	5.8	4.7	4.0	3.5	2.9	2.3	1.2	0.6
60	6.7	5.4	4.6	4.0	3.4	2.7	1.5	0.8
70	7.5	6.0	5.2	4.5	3.8	3.0	1.8	1.0
80	8.3	6.7	5.8	5.0	4.2	3.3	2.0	1.2
90	9.1	7.3	6.3	5.5	4.6	3.6	2.3	1.4
100	9.9	7.9	6.8	5.9	4.9	3.9	2.5	1.5
150	13.5	10.6	9.3	8.0	6.7	5.4	2.7	1.7
200	16.6	13.4	11.5	10.0	8.4	6.7	2.9	1.8
250	19.8	15.8	13.6	11.9	9.9	7.9	4.0	2.0
300	22.9	18.1	15.5	13.6	13.5	9.0	5.0	2.7
350	25.5	20.3	17.5	15.3	12.7	10.1	5.9	3.3
400	28.0	22.5	19.5	17.0	14.0	11.1	6.8	4.0
450	30.9	24.9	21.0	18.5	15.3	12.1	7.5	5.1
500	33.4	26.4	23.0	20.0	16.6	13.3	8.4	5.6
600	38.5	30.8	26.3	23.0	19.0	15.2	9.0	6.2
700	43.0	34.2	29.8	26.0	21.5	17.0	9.9	6.6
800	48.0	38.1	32.9	28.5	23.8	19.0	11.4	7.7
900	52.0	41.5	35.9	31.1	26.0	20.8	12.9	8.6
1000	56.5	45.0	38.9	34.0	28.3	22.5	14.3	9.5

* See Table 1 for size of pipe needed.

† C is the constant factor based on a combination of how much water the soil can hold, slope, and cover. C = .70 is adequate for most conditions prevailing in the Northeast. C = 1.00 represents complete runoff of precipitation (e.g., rock surfaces).

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Table 3 provides a simplified method for determining culvert size. To use this table, determine the size of the drainage area (in acres) above the stream crossing as well as the expected life of the culvert. A private consultant may provide assistance determining the size of a culvert. Make sure they do not size the culverts for a 50- or 100-year storm, unless that is what is required. For low-traffic or temporary roads, a flood frequency of 20 years can be used.

Table 3—Culvert Sizes by Drainage Area

	Recurrence interval (years)		
	10	20	50
Area (acres)	**Culvert diameter (inches)**		
10	24	24	18
20	24	24	20
30	24	24	24
40	24	24	26
50	24	24	28
60	24	24	28
70	24	26	30
80	24	26	30
90	24	28	32
100	26	28	34
125	28	30	36
150	28	32	38
175	30	34	40
200	32	36	42

Source: Table 3, Helvey and Kochenderfer 1988, p. 125

C. Determining Culvert Lengths

The following simplified procedure can be used to determine culvert lengths needed for new stream crossings or ditch-relief drains. Refer to Figure 1 for specific locations and distances described in the step-by-step procedure. A complete example follows these instructions.

1. Estimate the depth of the fill (F) at the running surface on the inside of the road above the culvert inlet (point “a”).
2. Additional width (C) due to fill is then estimated as 1.5 times the fill depth (F) (that is, all fill slopes are assumed to be 1.5:1 in steepness).
3. Add half the road width (1/2 W) and the fill width (C). Measure this distance horizontally upstream from the center line of the road, and place stake at location A. The horizontal

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distance must be converted to slope distance before you can tape it off on the ground. Use Table 4 to convert horizontal distance to slope distance (on-the-ground distance).

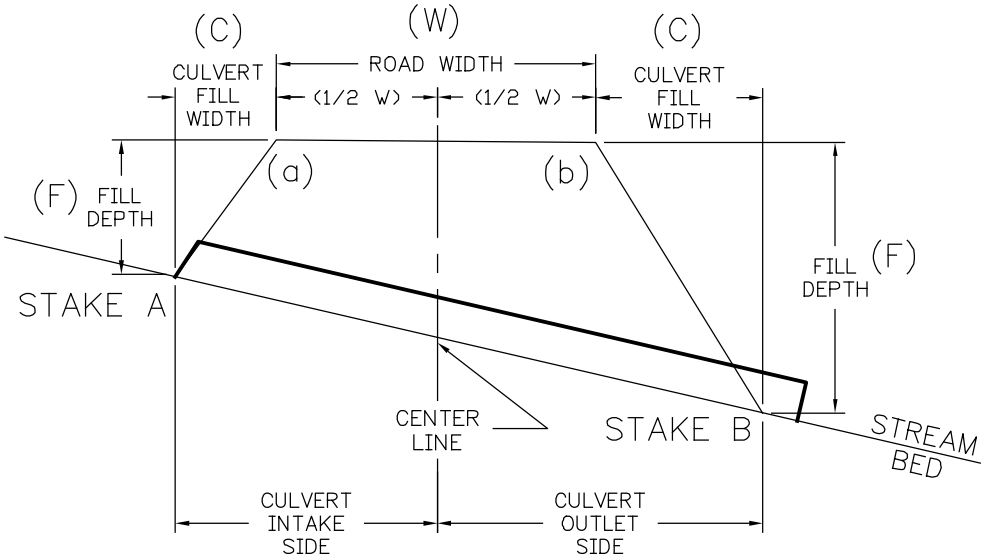

Figure 1—Culvert Length

4. Repeat steps 1 through 3 for the culvert outlet side of the crossing and place stake at location B.
5. Measure the slope length between stakes A and B. This measurement, plus two to four extra feet, is the length of culvert needed for the installation. The extra several feet are added to extend the inlet and outlet beyond the edge of the fill.

   Forty-four feet horizontal distance equals 52.4 feet slope distance on a 65 percent slope.

   horizontal distance × correction factor = slope distance

   (44ft) × (1.19) = 52.4′

   Example: What culvert length is needed for a 14′ wide road crossing a stream with a 55 percent gradient? The estimated inside fill-depth, above the culvert inlet, will be 6′ and the fill-depth above the outlet will be 13′.

   Step 1: Estimated depth of fill (F) at culvert inlet = 6′

   Step 2: (C) = 1.5 × 6′ = 9′

   Step 3: 14′ wide road (W), so 1/2 × 14′ = 7′

   Stake A (the location of the culvert inlet) should be placed on the ground a distance of (9′ + 7′) = 16 horizontal feet up the stream channel from the flagged centerline of the road. According to the correction table, 16 feet horizontally on a 55 percent slope is 18.2′ slope distance (16′ × 1.14 = 18.2′).

   Place the inlet stake (A) 18.2′ up the channel from the centerline of the road.

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Step 4: Estimated depth of fill (F) at culvert outlet =13′

Step 5: (C) = 1.5 ×13′ = 20′

Step 6: 14′ wide road (W), so 1/2 × 14 = 7′

Stake B (the location of the culvert outlet) should be placed on the ground a distance of (13′ + 20′) = 33 horizontal feet down the stream channel from the flagged centerline of the road. According to the correction table, 33 feet horizontally on a 55 percent slope is 37.6′ slope distance (33′ × 1.14 = 37.6′0.

Place the outlet stake (B) 37.6 ′down the channel from the centerline of the road.

Step 7: Length of culvert needed = 18.2′ + 37.6′ = 55.8′ or about 56′.

Approximately 2′–4′ should be added to this length to make sure the culvert inlet and outlet extend sufficiently beyond the base of the fill.

Final culvert length to be ordered and delivered to the site = 56 ′+ 4 ′= 60 ′.

Table 4—Slope Correction Factors to (C) on Vertical-Horizontal Distance to Slope Distance

Hill slope or stream channel gradient (%)	Correction factor (multiplier)	Hill slope or stream channel gradient (%)	Correction factor (multiplier)
10	1.00[1]	45	1.10
15	1.01	50	1.12
20	1.02	55	1.14
25	1.03	60	1.17
30	1.04	65	1.19
35	1.06	70	1.22
40	1.08	75	1.25

[1] For a slope of 10 percent or less, no correction factor is needed.

D. Culvert Installation for Ditch Relief

Insloped roads should be constructed: 1) where road-surface drainage discharged over the fillslope would cause unacceptable erosion or discharge directly into stream channels, 2) where fillslopes are unstable, or 3) where outsloping would create unsafe conditions for use. It is generally preferable to outslope road surfaces in order to disperse road-surface runoff before it has a chance to concentrate.

Insloped roads should be built with an inside drainage ditch to collect and remove road surface runoff (TA 501, *Roads—Construction*). Roads steeper than about 8 percent may be too steep for an inside ditch because of the potential for gullying in the ditch. Inside ditches should also be drained at intervals sufficient to prevent ditch erosion or

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outlet gullying, and at locations where water and sediment can be filtered before entering a watercourse. Filtering can be accomplished with thick vegetation, gentle slopes, settling basins, or filter windrows of woody debris and mulches secured to the slope.

As with outsloped roads, steep insloped road surfaces may be difficult to drain. Rolling dips (for permanent, surfaced roads and seasonal roads) or waterbars (for seasonal or temporary, unsurfaced roads) should be constructed at intervals sufficient to disperse road surface runoff from steep road segments. See TA 503, *Roads—Water Bars and Water Dips* for more information.

Ditches and culverts need occasional maintenance to maintain proper flow. Annual and storm-period inspection can prevent small problems from growing into large failures. When ditches become blocked by cutbank slumps, they need to be cleaned and the spoil deposited in a stable location. However, excessive maintenance (i.e., grading) can cause continuing and persistent erosion, sediment transport, and sediment pollution to local streams. It may also remove rock surfacing.

Ditch relief culverts should be designed and installed along the road at intervals close enough to prevent erosion of the ditch and at the culvert outfall, and at locations where collected water and sediment is not discharged directly into watercourses (Table 5).

Table 5—Maximum Suggested Spacing for Ditch Relief Culverts (ft)

Road grade	**Soil Credibility**				
(%)	**Very High**	**High**	**Moderate**	**Slight**	**Very Low**
2	600–800				
4	530	600–800			
6	355	585	600–800		
8	265	425	525	600–800	
10	160	340	420	555	
12	180	285	350	460	600–800
14	155	245	300	365	560
16	135	215	270	345	490
18	118	190	240	310	435

On new roads, ditch flow should be directed into a culvert and discharged into buffer areas and filter strips before it reaches a watercourse crossing. Ditches should neither be discharged directly into the inlet of a watercourse crossing culvert, nor should ditch relief culverts discharge into a watercourse without first directing flow through an adequate filter strip. In addition to installing ditch relief culverts on either approach to watercourse crossings, it is advisable to consider installing ditch drains before curves, above and below through-cut road sections, and before and after steep sections of the road.

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If a ditch is capable of transporting and delivering sediment to a Class I or Class II watercourse during a flood event, it can be said to function the same as a Class III watercourse. It has a bed and a bank, and it can transport sediment. Ditches which drain directly into watercourse-crossing culverts should be treated and protected from disturbance and erosion, just as is a Class III watercourse. Ditch relief culverts should be installed across ditched roads before water course crossings so that water and sediment can be filtered before reaching the stream.

Ditch relief culverts do not need to be large, since they carry flow only from the cutbank, springs, and a limited length of road surface. In areas of high erosion and/or storm runoff, nominal ditch relief culvert sizes should be 18″, but ditch relief culverts should never be less than 15″ diameter. Smaller culverts are too easily blocked (Figure 2). Generally, culverts should have a grade at least 2 percent greater than the ditch which feeds it to prevent sediment buildup and blockage. Where possible, ditch relief culverts should be installed at the gradient of the original ground slope, so it will emerge on the ground surface beyond the base of the fill. If this is not possible, the fill below the culvert outlet should be armored with rock or the culvert fitted with an anchored downspout to carry erosive flow past the base of the fill. Culverts should never be “shot-gunned” out of the fill, thereby creating highly erosive road drainage waterfalls (Figure 3).

Figure 2—Undersized Culvert

Figure 3—Culvert Not Installed at the Existing Stream Gradient

A 10 percent grade to the culvert will usually be self-cleaning. The culvert should be placed at a 30° angle to the ditch to improve inlet efficiency and prevent plugging and erosion at the inlet. The pipe should be covered by a minimum of 18″ of compacted soil, or to a depth of 1.5 times the culvert diameter, whichever is greater. Finally, inlet protection such as rock armoring or drop structures can be used to help minimize erosion, slow flow velocity, and settle sediment before it is discharged through the pipe.

E. Culvert Installation for Stream Crossings

The importance of proper planning for stream crossings cannot be overstated. If stream crossings are not planned and located before road construction begins, serious problems may arise, including unintended damage to natural resources. Requirements for stream crossings vary from state to state. Often, a permit is required; check with the water division of the local natural resources agency.

Culverts can be considered dams that are designed to fail. The risk of culvert failure is substantial for most crossings, so *how* they fail is critical. In the upper sketch in

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Figure 4, the crossing has failed and the road grade has diverted the stream down the road, resulting in severe erosion and downstream sedimentation. Such damage to aquatic habitats can persist for many years. Stream diversions are easy to prevent, as illustrated by the lower sketch, in which the road grade was such that a failed crossing caused only some loss of road fill.

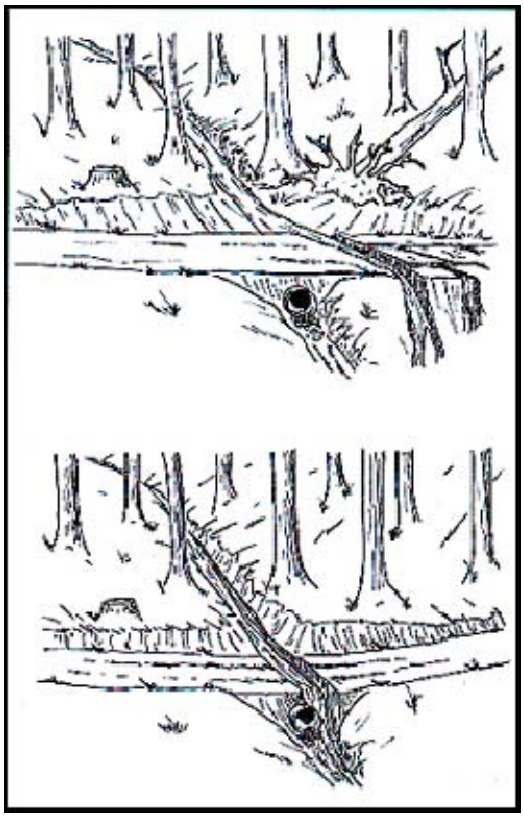

Figure 4—Stream Crossing Failures

Culverts should be installed as road work progresses. The culvert and its related drainage features should be installed via the following steps:

1. Place debris and slash to be used as a filter system, if needed.
2. Construct sediment ponds, if needed.
3. Complete downstream work first, such as energy dissipating devices and large rock riprap.
4. Route stream around work area until pipe is installed.
5. Construct pipe inlet structure.
6. Install culvert pipe.

A culvert inlet should be placed on the same level as the stream bottom. Where the culvert inlet has to be lower than the drainage gradient, a drop box can be constructed. The box provides a place for sediment to settle before water enters the culvert. Drop boxes require frequent maintenance.

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Install culvert pipes as near as possible to the gradient of the natural channel and so there is no change in the stream bottom elevation (Figure 5). Culverts should not cause damming or pooling. Seat the culvert on firm ground and compact the earth at least halfway up the side of the pipe to prevent water from leaking. Pipe culverts must be adequately covered with fill; the rule is a minimum of 30″ or 1.5 times the culvert diameter, whichever is greater.

Figure 5—Culvert Installed at Channel Gradient

If adequate cover cannot be achieved, an arch pipe or two small culverts should be installed. The cover must also be compacted to prevent settling in the road. Debris-laden material should not be used to cover pipe culverts.

The following are additional guidelines for installing culverts in streams:

- Limit construction activity in the water to periods of low or normal flow.
- Minimize use of equipment in streams.
- Use soil stabilization practices on exposed soil at stream crossings. Seed/mulch and install temporary sediment control structures, such as silt fences made of straw bales or geotextiles, immediately after road construction. Maintain these practices until the soil is permanently stabilized.
- Use materials that are clean, non-toxic, and which do not erode.

To prevent erosion and under-cutting of the inlet end of the culvert, provide a headwall. Sandbags containing some cement mixed with the sand, durable logs, concrete, or hand-placed riprap are suitable.

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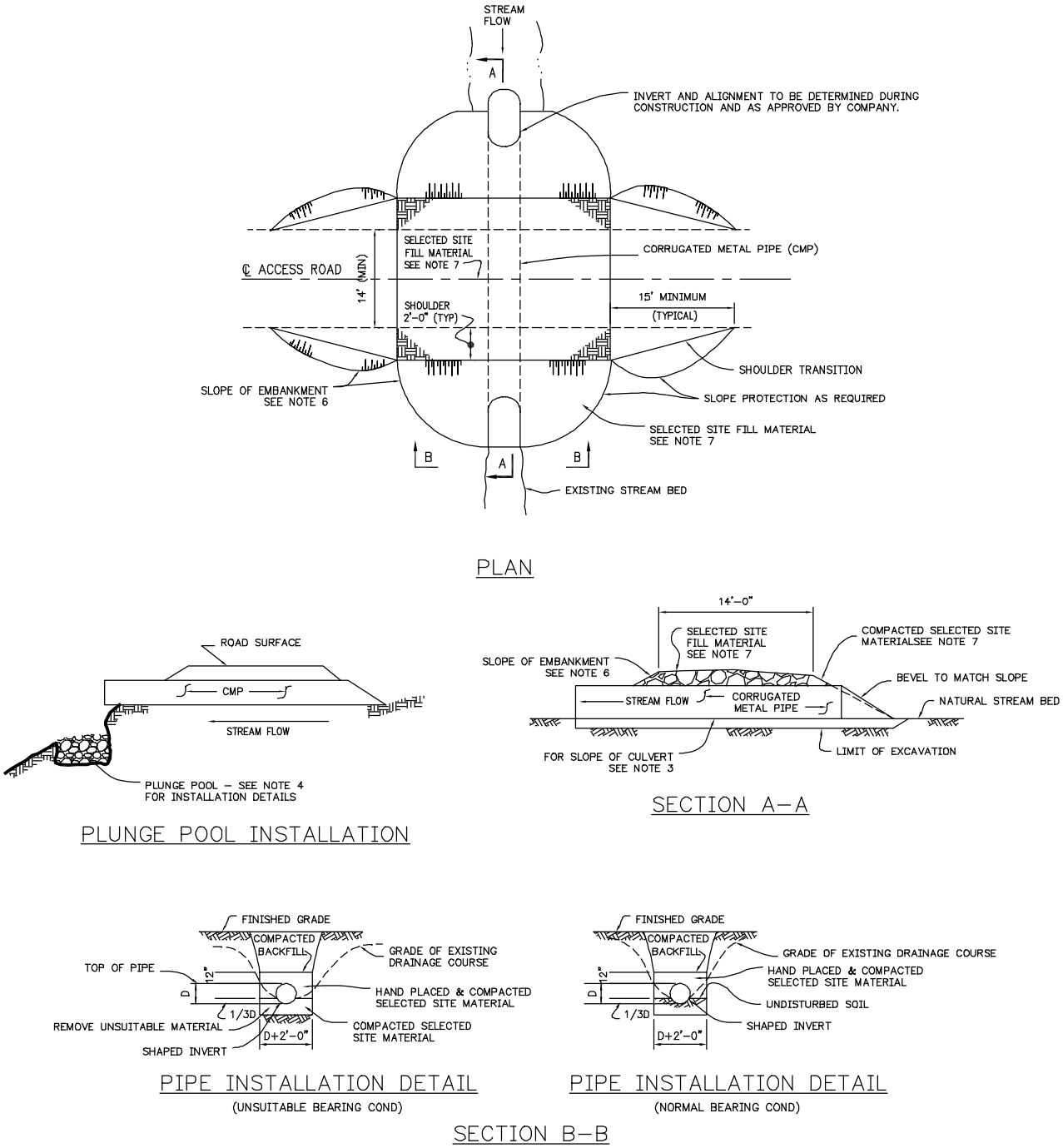

Figure 6—Stream Crossing Culverts

Installation Notes for Figure 6:

1. Culverts for existing drainage shall be aligned with the drainage.

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2. Culverts for roadway and ditch drainage shall be oriented at an angle of 30° to 45° to the roadway. See TA 503, *Roads—Water Bars and Water Dips*, for installation instructions.
3. Culverts shall be sloped a minimum of 1 percent or at least 1 percent steeper than the existing drainage.
4. When the culvert outlet is above grade, a plunge pool shall be constructed with length and width equal to two pipe diameters and a depth of one pipe diameter. Line plunge pool with geotextile fabric filled with 2″ to 8″ rock.
5. Culvert clogging debris located within 50′ of a culvert inlet shall be removed.
6. Cut and fill slopes will be determined during construction based on site conditions and as approved by the company.
7. See TA 501, *Roads—Construction*, for general road construction information.
8. Cover over culverts shall be 18″ or 1.5 times the culvert diameter, whichever is greater. To minimize damage from culvert failure, height of fill over culverts shall be as close to minimum as practical.
9. Outlets on culverts with pipe slopes greater than 3 percent shall be protected with a 30′ × 10′ strip of geotextile fabric fastened to culvert as a bib. Fabric shall be weighted down with 6″to 8″ rock to slow runoff.
10. Bottom of culvert shall be cushioned with fine-grain site material when installed over large rocks.

F. Fords

A ford is an alternative way to cross a water course where the streambed has a firm rock or coarse gravel bottom; the approaches are low and stable enough to support traffic; the stream is small to medium-sized, with water depth less than three feet and stream flows not exceeding 6 fps; and vehicle traffic is light. Dry fords can often be installed and used with minimal impact to the channel system.

The following standards apply when constructing a ford:

1. Install wing ditches, water-bars, dips, and level spreaders before the crossing. These structures should disperse runoff into an established and stable stream buffer.
2. If corduroy, coarse gravel, or gabion is used to create a driving surface, it should be installed flush with the streambed to minimize erosion and to allow fish passage.
3. Crossings should be at right angles to the stream.
4. Stabilize the approaches by using non-erodible material. The material should extend at least 50 feet on both sides of the crossing.
5. Requirements for stream crossings vary from state to state. Often a permit is required; check with the water division of the local natural resources agency.
6. Fords shall be designed for a low-maintenance long-term life. Rock size and grading, depth of rock, fabric underlayment, etc. and approaches shall be designed for the equipment expected to use the road.

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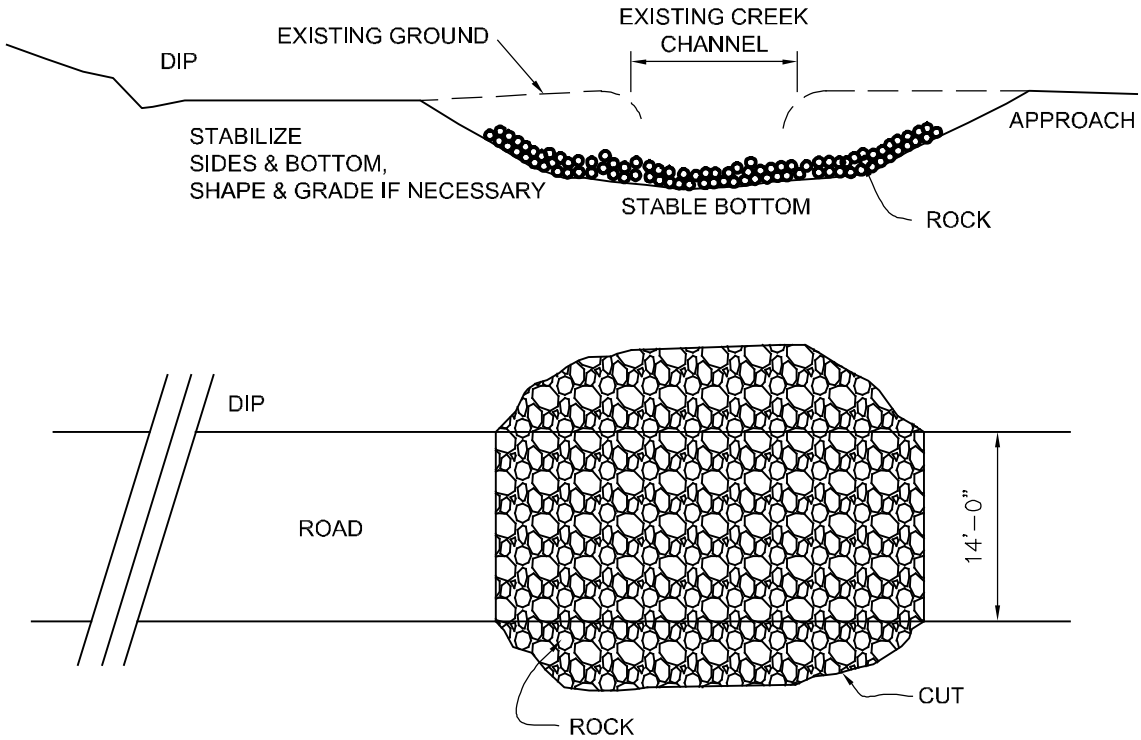

Figure 7 – Ford Stream Crossing

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