Appendix J

Framework Paleontological Resources Protection Plan

Gateway West Transmission Line Project

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1.0 INTRODUCTION

Rocky Mountain Power and Idaho Power Company (Companies) are proposing to construct and operate approximately 1,000 miles of new 230-kilovolt (kV), 345-kV and 500-kV alternating current electric transmission system, called the Gateway West Transmission Line Project (Project), consisting of 10 segments between the Windstar Substation at Glenrock, Wyoming, and the Hemingway Substation approximately 30 miles southwest of Boise, Idaho. The proposed transmission line is 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 includes ground-disturbing activities associated with the construction of above-ground, single-circuit transmission lines involving towers, access roads, multiuse areas, fly yards, and pulling sites as well as associated substations, communication sites, and electrical supply distribution lines. The Project crosses private land and public lands administered by the Bureau of Land Management (BLM), U.S. Forest Service (Forest Service), and the states of Idaho and Wyoming.

Paleontological resources (i.e., fossils) are the remains or traces of ancient life (DOI 2000). Fossil remains may include bones, teeth, shells, leaves, and wood found in geological deposits within which they were originally buried (DOI 2000). Paleontological resources include not only the actual fossils, but also the collecting localities and the geological deposits that contain the fossils (DOI 2000).

The purpose of the framework Paleontological Resources Protection Plan (PRPP) is to assist the BLM in planning and design efforts for the proposed Project as it relates to paleontological resource issues. The framework PRPP 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. The logistics, procedures, and methods outlined in this framework PRPP ensure compliance with federal and state regulations (BLM 1998, 2008, 2009).

The framework PRPP is a work plan for all of the paleontological-related activities that may ensue during the course of development of the Project. It is not the intent of the PRPP to present a comprehensive list of sites with discussions of all significant taxa found from the vicinity of the Project area. The PRPP offers a research-oriented framework and accompanying logistical guidelines to ensure significant non-renewable paleontological resources unearthed by development of the Project will be managed appropriately and in a timely manner, thereby effectively mitigating adverse impacts to these fossil resources.

As part of the environmental impact statement (EIS) process, a review was conducted of relevant published geological and paleontological reports, unpublished geological and paleontological reports, and museum paleontological site records. This approach was followed in recognition of the direct relationship that exists between paleontological resources and the geological units within which fossils are entombed. By knowing the

geology of a particular area and the fossil productivity of geological units that occur in the area, it is possible to predict where fossils will likely be found.

The proposed Project crosses bedrock units of varying fossil potential. Environmental protection measures (EPMs) to protect fossil resources are presented in Appendix Z of the Plan of Development (POD).

2.0 REGULATORY FRAMEWORK

The following provides a brief overview of federal and state legislation, regulatory compliance, and professional standards applicable to paleontological resources in the Project area considered in the development of this Plan.

2.1 National Environmental Policy Act of 1969 (P.L. 91-190, 83 Stat. 852, 42 USC 4321-4327)

The National Environmental Policy Act of 1969 (NEPA) mandates policies to “preserve important historic, cultural, and natural aspects of our national heritage.” NEPA further provides for reports regarding the environmental impacts of federal actions on public lands.

2.2 Federal Land Policy and Management Act of 1976 (P.L. 94-579)

The Federal Land Policy and Management Act of 1976 (FLPMA) was enacted “to establish public land policy; to establish guidelines for its administration; to provide for the management, protection, development, and enhancement of the public lands; and for other purposes,” and requires that important historic, cultural, and natural aspects of our natural history be preserved. As such, paleontological resources on federal lands have been determined to be property of the United States and must be protected under FLPMA.

2.3 Paleontological Resources Preservation, Omnibus Public Lands Act, Public Law 111-011, Title VI, Subtitle D 16 USC (OPLA-PRP 2009)

The purpose of the Paleontological Resources Preservation Act of 2009 is to “manage and protect paleontological resources on federal land using scientific principles and expertise.” It directs the DOI and the Forest Service to “develop appropriate plans for inventory, monitoring, and the scientific and educational use of paleontological resources, in accordance with applicable agency laws, regulations, and policies.”

3.0 PALEONTOLOGICAL POTENTIAL

3.1 Determination of Paleontological Potential

The Potential Fossil Yield Classification (PFYC) system is a measure of the likelihood of impacting fossil resources in a given area based on the occurrence of fossil-bearing geological units. This system predicts the probability of finding paleontological resources in a given area using geological maps of sufficient scale and detail. The numerical nature of the PFYC system also allows for ease of importation into a geographic information system, further facilitating the planning and management

decision-making process. The five-part PFYC system, as defined by the BLM (2008), is explained below:

Class 1 – Very low potential: Geological units not likely to contain recognizable fossil remains such as:

- Units that are igneous or metamorphic, excluding reworked volcanic-ash units
- Units that are Precambrian in age

The probability for impacting any fossils is negligible. Assessment or mitigation of paleontological resources is usually unnecessary. The occurrence of significant fossils is nonexistent or extremely rare.

Class 2 – Low potential: Sedimentary geological units not likely to contain vertebrate fossils or scientifically significant non-vertebrate fossils such as:

- Vertebrate or significant invertebrate or plant fossils not present or very rare
- Units that are generally younger than 10,000 years before present
- Recent eolian deposits
- Sediments that exhibit significant physical and chemical changes (i.e., diagenetic alteration)

The probability for the project toimpact vertebrate fossils or scientifically significant invertebrate or plant fossils is low. Assessment or mitigation of paleontological resources is not likely to be necessary. Localities containing important resources may exist, but would be rare and would not influence the classification. These important localities will be managed on a case-by-case basis and assessment or mitigation may be unnecessary except in rare or isolated circumstances.

Class 3 – Moderate or unknown potential: Fossiliferous sedimentary geological units where fossil content varies in significance, abundance, and predictable occurrence, or sedimentary units of unknown fossil potential such as:

- Often marine in origin with sporadic known occurrences of vertebrate fossils
- Vertebrate fossils and scientifically significant invertebrate and plant fossils known to occur intermittently and are predictably known to be low
- Poorly studied and/or poorly documented. Potential yield cannot be assigned without ground reconnaissance

Class 3, 4, and 5 units are divided into subclasses, as described below.

<u>Class 3a – Moderate potential</u>: Units are known to contain vertebrate fossils or scientifically significant invertebrate or plant fossils, but these occurrences are widely scattered. Common invertebrate or plant fossils may be found in the area and opportunities may exist for hobby collecting. The potential for a project to be sited on or impact a significant fossil locality is low, but the potential is somewhat higher for common fossils.

<u>Class 3b – Unknown potential</u>: Units exhibit geological features and preservational conditions that suggest significant fossils could be present, but little information about

the paleontological resources of the unit or the area is known. This may indicate the unit or area is poorly studied, and field surveys may uncover significant fossils. The units in this class may eventually be placed in another class when sufficient surveying and research is performed. The unknown potential of the units in this class should be carefully considered when developing any mitigation or management plans.

This classification includes a broad range of paleontological potential. It includes geological units of unknown potential, as well as units of moderate or infrequent occurrence of fossil resources. Management considerations cover a broad range of options as well and could include pre-disturbance surveys, monitoring, or avoidance. Ground-disturbing activities will require sufficient assessment to determine where significant paleontological resources occur in the area of the proposed action and whether the action could affect the paleontological resources. These units may contain areas that would be appropriate to designate as hobby-collecting areas due to the higher occurrence of common fossils and lower concern about affecting significant paleontological resources.

Class 4 – High potential: Geological units containing a high occurrence of significant fossils. Vertebrate fossils or scientifically significant invertebrate or plant fossils are known to occur and have been documented, but may vary in occurrence and predictability. Ground-disturbing activities may adversely affect paleontological resources in many cases.

<u>Class 4a – High potential</u>: Units exposed with little or no soil or vegetative cover. Outcrop areas are extensive, with exposed bedrock areas often larger than two acres. Paleontological resources may be susceptible to adverse impacts from ground-disturbing actions. Illegal collecting activities may impact some areas.

<u>Class 4b – High potential</u>: These are areas underlain by geological units with high potential, but have lowered risks of human-caused adverse impacts and/or lowered risk of natural degradation due to moderating circumstances. The bedrock unit has high potential, but a protective layer of soil, thin alluvial material, or other conditions may lessen or prevent potential impacts to the bedrock resulting from the activity There include areas such as:

- Extensive soil or vegetative cover; bedrock exposures are limited or not expected to be impacted
- Exposed outcrop are smaller than two contiguous acres
- Outcrops form cliffs of sufficient height and slope so impacts are minimized by topographic conditions
- Where other characteristics are present that lower the vulnerability of both known and unidentified paleontological resources

The probability for impacting significant paleontological resources is moderate to high, and is dependent on the proposed action. Mitigation considerations must include assessment of the disturbance, which may include removal or penetration of the protective surface alluvium or soils, potential for future accelerated erosion, or increased ease of access resulting in greater looting potential. If impacts to significant fossils can be anticipated, on-the-ground surveys prior to authorizing the ground-disturbing action

usually will be necessary. On-site monitoring or spot-checking may be necessary during construction activities. Management prescriptions for resource preservation and conservation through controlled access or special management designation should be considered. Class 4 and 5 units may be combined as Class 5 for broad applications, such as planning efforts or preliminary assessments, when geological mapping at the appropriate scale is not available. Resource assessment, mitigation, and other management considerations are similar at this level of analysis, and impacts and alternatives can be addressed at a level appropriate to the application.

Class 5 – Very high potential: Highly fossiliferous geological units that consistently and predictably produce vertebrate fossils or scientifically significant invertebrate or plant fossils and are at risk of human-caused adverse impacts or natural degradation.

<u>Class 5a – Very high potential</u>: Units are exposed with little or no soil or vegetative cover. Outcrop areas are extensive with exposed bedrock areas often larger than two contiguous acres. Paleontological resources are highly susceptible to adverse impacts from ground-disturbing activities. Unit is frequently the focus of illegal collecting activities.

<u>Class 5b – Very high potential</u>: These are areas underlain by geological units with very high potential but have lowered risks of human-caused adverse impacts and/or lowered risk of natural degradation due to moderating circumstances. The bedrock unit has very high potential, but a protective layer of soil, thin alluvial material, or other conditions may lessen or prevent potential impacts to the bedrock resulting from ground-disturbing activity. These include areas such as:

- Extensive soil or vegetative cover; bedrock exposures are limited or not expected to be impacted.
- Exposed outcrop are smaller than two contiguous acres.
- Outcrops form cliffs of sufficient height and slope so impacts are minimized by topographic conditions.
- Where characteristics are present that lower the vulnerability of both known and unidentified paleontological resources

The probability of impacting significant fossils is high to very high. Vertebrate fossils or scientifically significant invertebrate fossils are known or can be reasonably expected to occur in the impact area. On-the-ground surveys prior to authorizing any ground-disturbing activities or land-use adjustments will usually be necessary. On-site monitoring may be necessary during construction activities. Mitigation will often be necessary before and/or during these actions. Official designation of areas of avoidance, special interest, and concern may be appropriate.

3.2 Potential Fossil Yield Classification and Condition Classification

The PFYC system replaces the Condition Classification system previously used by the BLM and defined in the *Handbook for Paleontological Resource Management* (BLM 1998). The three levels of the Condition Classification system correspond to the five levels of the PFYC as such:

- **Class 1** – PFYC 4 or 5

- **Class 2** – PFYC 3, 4, or 5 (based upon the geological unit)
- **Class 3** – PFYC 1 or 2

The shift from the Condition Classification system to the PFYC is the result of an effort to increase interagency cooperation and consistency by bringing the methodologies of the BLM and Forest Service in line with one another. The five-part PFYC system is an excellent tool during the planning stages of a given project, whereas a three-part system, similar to the Condition Classification system, may be used both in the field and the office for the purpose of assigning placement of paleontology monitors along the project corridor. This system consists of high, moderate/unknown, and low sensitivities that determine areas that will require on-site paleontological monitors during construction activities. Construction activities impacting high and moderate/unknown potential geological units are generally assigned paleontology monitors; whereas low potential units will not be monitored, unless fossil resources are discovered during the course of construction activity.

The Companies will use the PFYC in assigning fossil potential to Project bedrock units. Attachment A presents a summary of bedrock units and estimates of PFYC for the Proposed Route.

4.0 PALEONTOLOGICAL STIPULATIONS AND METHODS

The following stipulations and methods to be employed if paleontological resources are discovered during construction and development of the Project. The specifics of the efforts are described in greater detail in Appendix Z of the POD.

4.1 Stipulations and Methods

Before Construction: An orientation workshop shall be prepared, reviewed by the BLM, and presented by a professional paleontologist to explain paleontological mitigation guidelines and procedures to the contractor and construction workers. This workshop can be presented in conjunction with any pre-construction meetings conducted prior to excavation. The workshop will review the PRTP and will endeavor to explain the nature, appearance, and importance of fossil vertebrates, invertebrates, and plants. The responsibilities of construction personnel in a paleontological mitigation context will also be explained. Construction workers shall not collect any fossils found during construction before their significance can be assessed by a qualified paleontologist.

During Construction: If paleontological resources (fossils) are found at any time during construction, work shall be redirected to another area nearby and the authorized BLM officer contacted so the scientific significance of the discovery may be assessed. If warranted, a qualified professional paleontologist with regional experience appointed by the BLM may then assess the significance of the discovery and recommend additional mitigation measures, as necessary. The paleontologist may be retained to perform inspection of the excavation and to salvage exposed fossils. A standard sample of fossiliferous sediment may be collected for the collection and identification of terrestrial microvertebrates (e.g., rodents, birds, rabbits). The paleontologist may also determine whether the fossil is part of an archaeological deposit. If so, it shall then be considered a cultural resource discovery and treated according to the procedures specified in the Historic Properties Treatment Plan prepared prior to construction.

After Construction: For any fossils (vertebrate, invertebrate, and/or plant) collected during construction, a data collection program shall be undertaken that includes preparation of collected specimens to a point of identification and permanent preservation (including screen washing of fossiliferous sediment samples to collect small to microscopic vertebrate fossils); preparation of large vertebrate fossils collected in plaster jackets; long-term stabilization of all collected significant fossils; and analysis. The paleontological salvage team shall include an expert in vertebrate paleontology. A final report, including an itemized and accessioned inventory of collected specimens, shall be prepared by a professional vertebrate paleontologist and distributed to the BLM, Oregon Department of Geology and Mineral Industries, and Idaho Geological Survey. All fossils collected during construction shall be curated at a qualified research facility, such as the paleontology museum at College of Idaho (Idaho) or Eastern Oregon College (Oregon). A repository agreement for curation would be reviewed and approved by the third-party contractor on behalf of the Companies, BLM, and the repository, which would provide guaranteed future research access to the fossils. Fossils discovered on private land would be considered property of the landowner. The landowner would have the option to keep the fossils or donate them to a federally approved, professional repository, preferably the same repository receiving fossils discovered on federal and state lands

4.2 Construction Personnel Procedures

Crews and supervisors should be on the lookout at all times for fossils, bones, animal trackways, charcoal, ash, or other paleontological resources exposed during excavation or ground-disturbing activities. Upon encountering an exposed fossil or other paleontological resource, the construction crew will stake-off and flag an area of approximately 2 meters on all sides of the discovery to alert equipment operators to the presence of the potential resource. Construction crews must avoid these staked-off/flagged areas by a minimum of 6 meters until the authorized BLM officer has been contacted and has authorized continued excavation.

4.3 Collection/Replication of Fossil Trackways

Unique fossil trackways may occur within the area of potential effect of the Project, or adjacent to the Project area. Trackways are highly visible and are subject to removal by unauthorized collection. In the event that trackways cannot be avoided, overburden will be removed to expose the trackways, which will then either be removed (preferred) or replicated for curation. Collected specimens will be curated at an approved repository in accordance with appropriate federal, state, and county permits.

4.4 Curation Plan

Curation of fossil specimens collected during the paleontological mitigation program includes the preparation of collected specimens to a point of identification and permanent preservation, including the screen washing of fossiliferous sediment samples to collect small to microscopic vertebrate fossils. Large specimens encased in plaster jackets taken from the site will be prepared in the paleontology laboratory.

The curation plan calls for laboratory preparation of collected fossil remains to a point of identification and permanent preservation (*not* exhibition). This preparation generally

requires exposure of the collected resource(s) by removal of the surrounding sedimentary matrix from the jacket. This matrix may be saved for later microfossil processing. Once the matrix has been removed and the specimen has been cleaned, the fossil is hardened with Vinac, a modified polyvinyl acetate homopolymer, which has been thinned with acetone to enable the hardener to more fully penetrate the fossil. Vinac may be applied several times before the fossil is deemed to be sufficiently sturdy for permanent storage. Excess plaster from the jacket is then trimmed to reduce the amount of storage space required by the specimen.

The curation plan also includes the processing of standard samples of fossiliferous matrix. The sedimentary matrix will be washed with water through stacked sets of 20- and 30-mesh screens and sun dried. Where appropriate, some sediment samples may be washed through more finely meshed screens to enable the collection of microscopic ostracodes or fossil pollen. To accelerate the breakdown of the fossiliferous matrix, sediments will be oven-roasted to promote drying and then re-submerged in water to facilitate disaggregation of clays and fine silts. Subsequent screen washing will remove these fine sediments and leave fossil specimens in a clean concentrate. This concentrate will be visually examined with a binocular microscope and hand-sorted to remove fossil specimens.

The curation plan further includes sampling for fossil pollen. In those cases where pollen is identified from bulk samples in the field, additional sampling should be initiated where warranted in a series of more precise (e.g., 2 centimeters) sampling horizons. This will potentially enable determination of changes in plant distributions and microclimate through time.

Should plant macrofossils be exposed or identified during a mitigation program, such fossils should be collected and prepared to a point of identification and permanent preservation (*not* exhibition). Preparation generally requires full exposure of the collected resource(s) by splitting of thin sedimentary layers along their bedding planes, followed by application of a hardening agent. Misting with a 10:1 water/white glue mixture is usually sufficient for preserving such fossils. Application of nitrocellulose thinned with acetone is also recommended in some instances (LePage and Basinger 1993). In some cases, select rock slabs thought to contain fossilized plant remains will be left intact for future researchers.

Other curatorial tasks will include the identification, curation, and accessioning of all collected specimens into the retrievable storage collections of an approved, accredited curation facility. All data pertaining to the specimens will be recorded in the collections database of the repository. Resource locality information will also be plotted on topographic maps and entered into a computerized locality database. Card stock printouts of all pertinent faunal, floral, locational, and lithologic data pertaining to each resource locality will be produced and filed. Card stock files from the locality database will also be printed and kept on file.

Following preparation, fossils will be stored in steel cabinets with steel geological specimen trays. Accession and locality data will be printed in archival ink on acid-free paper tags associated with each specimen, generated from the specimen database. Accession numbers of large fossils will be written on the bone in permanent ink. Large fossils will be stored in their plaster jackets where necessary to help retain the integrity

of the bone. Excess plaster will be cut away prior to storage to maximize storage space. Microfossils will be stored in glass vials with cork stoppers. Extremely small specimens (e.g., ostracodes) will be placed in gelatin capsules within the glass vials. Accession data slips, also generated from the computer database, will be placed inside each of the glass vials to prevent accidental shuffling of the collection, and provide a means of "earthquake-proofing" the collection. The glass vials will be placed in cardboard jewelers' boxes with their data slips, then permanently stored in the geological specimen trays. Labels bearing accession number data will be glued to rock slabs bearing marine invertebrates or fossil plant remains, in such a manner so as not to damage or obscure the fossil(s).

Specimens collected during the course of the mitigation program will be identified by professional paleontologists who have appropriate expertise in vertebrate and invertebrate paleontology and paleobotany.

The fossils will be curated, stored, and accessioned into the permanent retrievable collections of a recognized, accredited repository. All paleontological resources will be catalogued and accessioned under a unique number, which will identify the appropriate property and/or development project as the source of the fossils.

A final report of methods and results of the paleontological mitigation plan will be provided at the cessation of the mitigation program. The report will include a detailed discussion of how the research goals of the project have been met, in addition to descriptions of significant discoveries, discussion of the curation of the resources, and results of sampling and analysis, as well as an itemized accession inventory of all specimens collected. A discussion of the significance of each taxon discovered will be provided, where feasible. All resource locality information will be presented as a confidential appendix and a printout of all locality data, as well as pull-out maps with all paleontological resource localities plotted.

5.0 LITERATURE CITED

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LePage, B.A., and J.F. Basinger. 1993. The Use of Lacquer (nitrocellulose) for the Coating and Preservation of Fossil Leaf Impressions. *Journal of Paleontology* 67: 128-134.

ATTACHMENT A
BEDROCK AND FOSSIL POTENTIAL SUMMARY

Attachment A Paleontological Sensitivity Rankings for Proposed Routes

Segment Number	Segment Length (miles)	Formation Name	Miles Crossed	Sensitivity Rating
1W(a)	**76.5**	Chugwater Formation or group	5.3	3
		Goose egg Formation	5.5	2
		Cody shale	2.6	3
		Frontier Formation	0.4	3
		Fox Hills sandstone sandstone	1.1	3
		Cloverly, Morrison, and Sundance Formations	1.8	3
		Lance Formation	3.8	3
		Mowry and Thermopolis shales	0.9	3
		Mesaverde group	8.5	3
		Niobrara Formation	1.0	5
		Steele shale	3.1	3
		Casper Formation	2.4	3
		Tensleep sandstone and Amsden Formation	0.1	2
		Madison limestone, Darby Formation, Bighorn dolomite, Gallatin Limestone, GrosVentre Formation and Flathead sandstone	0.5	3
		Alluvium and colluvium	3.8	2
		Dune sand and loess	4.4	2
		Upper Miocene Rocks	3.3	5
		Wind River Formation - at base locally includes equivalent of Indian Meadows Formation	8.4	5
		White River Formation, upper conglomerate member	7.9	5
		Archean Granitic Rocks	5.2	1
		Granite Gneiss	2.1	1
		Paleontological Sensitivity Ranking	**250.8**	
1W(c)	**70.6**	Chugwater Formation or group	7.7	3
		Goose egg Formation	3.8	2
		Cody shale	4.0	3
		Frontier Formation	0.6	3
		Fox Hills sandstone	1.0	3
		Cloverly, Morrison, and Sundance Formations	0.5	3
		Lance Formation	5.0	3
		Mowry and Thermopolis shales	0.7	3
		Mesaverde group	0.6	3
		Niobrara Formation	1.2	5
		Steele shale	2.2	3
		Casper Formation	2.5	3
		Madison limestone, Darby Formation, Bighorn dolomite, Gallatin Limestone, GrosVentre Formation and Flathead sandstone	0.7	3
		Alluvium and colluvium	7.7	2

Attachment A Paleontological Sensitivity Rankings for Proposed Routes

Segment Number	Segment Length (miles)	Formation Name	Miles Crossed	Sensitivity Rating
		Upper Miocene Rocks	2.5	5
		Wind River Formation - at base locally includes equivalent of Indian Meadows Formation	9.3	5
		White River Formation, upper conglomerate member	7.8	5
		Whiter River Formation	4.5	5
		Archean Granitic Rocks	5.9	1
		Granite Gneiss	2.3	1
		Paleontological Sensitivity Ranking	**234.2**	
2	**96.7**	Lance Formation	4.2	3
		Lewis shale	4.4	3
		Medicine Bow Formation	0.8	3
		Mesaverde group	8.4	3
		Niobrara Formation	0.5	5
		Steele shale	2.9	3
		Steele shale and Niobrara Formation	8.5	5
		Alluvium and colluvium	8.1	2
		Playa lake and other lacustrine deposits	4.4	2
		Gravel, pediment, and fan deposits	0.7	2
		Fort Union Formation	12.5	3
		Hanna Formation	21.7	5
		Ferris Formation	1.1	5
		Miocene Rocks	8.5	3
		Wasatch Formation	10.0	5
		Paleontological Sensitivity Ranking	**360.3**	
3	**56.5**	Almond Formation	4.7	3
		Fox Hills sandstone and Lewis shale	7.6	3
		Lance Formation	2.3	3
		Alluvium and colluvium	1.9	2
		Playa lake and other lacustrine deposits	2.3	2
		Dune sand and loess	5.0	2
		Fort Union Formation	5.0	3
		Green River Formation	11.2	5
		Wasatch Formation	16.4	5
		Paleontological Sensitivity Ranking	**215.3**	
4	**203.0**	Ankareh Formation, Thaynes limestone, Woodside shale, and Dinwoody Formation	2.4	3
		Nugget sandstone	2.1	3
		Stump Formation, Preuss sandstone or redbeds, and Twin Creek limestone	5.3	3
		Aspen shale	0.6	3

Attachment A Paleontological Sensitivity Rankings for Proposed Routes

Segment Number	Segment Length (miles)	Formation Name	Miles Crossed	Sensitivity Rating
		Almond Formation	4.7	3
		Baxter shale	3.2	3
		Blair Formation	4.0	3
		Bear River Formation	0.4	3
		Ericson sandstone	2.5	3
		Frontier Formation	0.8	3
		Fox Hills sandstone and Lewis shale	1.7	3
		Gannett group	0.7	3
		Hilliard shale	1.0	3
		Rock Springs Formation	8.5	3
		Sage Junction, Quely, Cokeville, Thomas Fork, and Smiths Formations	1.0	3
		Sage Junction, Quely, Cokeville, Thomas Fork, and Smiths Formations	0.2	3
		Wells and Amsden Formations	1.2	3
		Phosphoria Formation and related rocks	0.6	3
		Alluvium and colluvium	7.6	2
		Landslide deposits	0.2	1
		Dune sand and loess	2.9	2
		Gravel, pediment, and fan deposits	6.6	2
		Terrace gravel (Pleistocene and/or Pliocene)	1.5	2
		Bridger Formation	34.5	5
		Fowkes Formation (Pliocene? and Eocene)	0.6	3
		Fort Union Formation	1.3	3
		Green River Formation	22.1	5
		Evanston Formation	0.3	3
		Salt Lake Formation	0.4	3
		Wasatch Formation	17.0	5
		Alluvium, Eolian Loess	11.6	3
		Alluvial-fan deposits	0.2	3
		Bonneville and Alpine Formations	4.7	3
		Alluvium		
		Main Canyon Formation of Bright		
		Tufa and Travertine		
		Salt Lake Formation		
		Alluvium	1.1	3
		Formation of Marsh Valley		
		Salt Lake Formation	3.0	3
		Salt Lake Formation, Upper Conglomerate Unit	17.4	5
		Salt Lake Formation, Skyline Member		
		Salt Lake Formation, Cache Valley Member		

Attachment A Paleontological Sensitivity Rankings for Proposed Routes

Segment Number	Segment Length (miles)	Formation Name	Miles Crossed	Sensitivity Rating
		Colluvium (Pleistocene)		
		Eolian Loess	3.6	3
		Salt Lake Formation	0.2	3
		Nugget Sandstone		
		Thaynes Limestone	3.7	5
		Twin Creek Limestone	5.2	3
		Alluvium		
		Nugget Sandstone	0.5	3
		Swan Peak Quartzite	4.6	3
		Garden City Limestone		
		St. Charles Limestone		
		Nounan Limestone	5.5	4
		St. Charles Limestone		
		Worm Creek Quartzite Member		
		Brigham Quartzite	0.3	3
		Diamicton	5.7	3
		Brigham Quartzite		
		Paleontological Sensitivity Ranking	**785.1**	
5	54.6	Great Blue Limestone, lower limestone member	3.1	3
		Floodplain sediments	1.9	3
		Formation of Marsh Valley		
		Loess		
		Alluvial-fan deposits	12.7	3
		Eolian Loess		
		Alluvial deposits		
		Loess		
		Alluvial fan gravel		
		Alluvial fan gravel	0.6	3
		Dune sand	0.0	3
		Alluvial fan gravel		
		Bonneville flood gravel	4.8	3
		Formation of Marsh Valley		
		Starlight and Salt Lake Formations, undifferentiated	0.7	4
		Sunbeam Formation	2.0	3
		Alluvium		
		Loess	1.8	4
		Starlight and Salt Lake Formations, upper member		
		Starlight and Salt Lake Formations, undifferentiated	2.2	4
		Starlight and Salt Lake Formations, upper member		
		Oquirrh Formation, Unit D	1.7	3

Attachment A Paleontological Sensitivity Rankings for Proposed Routes

Segment Number	Segment Length (miles)	Formation Name	Miles Crossed	Sensitivity Rating
		Oquirrh Formation, Unit B	12.2	3
		Oquirrh Formation, Unit A, lower limestone		
		St. Charles Formation, upper member	0.8	3
		Garden City Formation		
		Garden City Formation	4.4	3
		Swan Peak Quartzite		
		Fish Haven Dolomite		
		St. Charles Formation, upper member		
		Alluvium (Holocene and Pleistocene)	0.7	2
		American Falls Lake Beds (upper Pleistocene)	0.4	3
		Raft Formation (upper or middle Pleistocene)	0.7	2
		Dune sand and loess	0.4	2
		Sun Beam Formation (Upper Pleistocene)	2.8	2
		Terrace gravel (Pleistocene)	0.4	2
		Massacre Volcanics (Pliocene and upper Miocene)	0.1	3
		Walcott Tuff (upper Miocene)	0.0	3
		Water	0.2	0
		Paleontological Sensitivity Ranking	**162.9**	
6	**0.5**	Dune sand and loess	0.2	2
		Basalt of Notch Butte	0.3	2
		Mixed alluvial and lacustrine deposits		
		Basalt of Bacon Butte		
		Paleontological Sensitivity Ranking	**1.0**	
7	**118.1**	Floodplain sediments	3.2	3
		Formation of Marsh Valley		
		Loess		
		Alluvial-fan deposits	40.1	3
		Eolian Loess		
		Alluvial deposits		
		Loess		
		Alluvial fan gravel		
		Alluvial fan gravel	13.3	3
		No detail	9.4	3
		Bonneville flood gravel	8.5	3
		Formation of Marsh Valley		
		Starlight and Salt Lake Formations, undifferentiated	12.5	4
		Sunbeam Formation	5.3	3
		Alluvium		
		Loess	2.2	4
		Starlight and Salt Lake Formations, upper member		

Attachment A Paleontological Sensitivity Rankings for Proposed Routes

Segment Number	Segment Length (miles)	Formation Name	Miles Crossed	Sensitivity Rating
		No detail - possilby rhyolite	2.0	3
		Salt Lake Formation, undifferentiated	2.1	3
		Oquirrh Formation, Unit D	5.8	3
		Oquirrh Formation, Unit B	6.4	3
		Oquirrh Formation, Unit A, lower limestone		
		St. Charles Formation, upper member	0.9	3
		No detail - Mississippian sedimentary units	0.9	3
		No detail - Devonian sedimentary units	0.4	3
		Garden City Formation	5.0	3
		Fish Haven Dolomite		
		St. Charles Formation, upper member		
		Paleontological Sensitivity Ranking	**368.9**	
8	**131.0**	Alluvium	3.1	3
		No-Detail gravel deposits	1.3	3
		Alluvium	1.3	3
		Cold Springs Creek lava flow	0.1	2
		Bonneville Flood Deposits	1.3	3
		Pebble gravel in conspicuous iron-stained beds as much as 25 feet thick in lake deposits	1.4	3
		Black Mesa Gravel	2.7	3
		Basalt of Higby Cave	4.1	2
		Basalt of Sand Creek	5.1	2
		Sedimentary material dominated by massive lake beds of white-weathering fine silt, clay, and diatom	0.1	3
		Dune Sand	0.2	3
		Upper Basalt of Halverson Lake	0.4	2
		Basalt of Initial Point	5.8	2
		Pleistocene waterlaid detritus; may be distal deposits of glacial floods and outwash	14.7	3
		Middle Pleistocene plateau and canyon-filling basalt in and near the Snake Plain	20.6	2
		Middle Pleistocene plateau and canyon-filling basalt in and near the Snake Plain	3.9	3
		Pleistocene outwash, fanglomerate, flood and terrace gravels	2.5	3
		Upper Pleistocene Snake Plain lava flows	2.7	2
		Upper Pleistocene Snake Plain lava flows	16.7	2
		Recent relatively un weathered Snake Plain Basalt flows and cinder cones	8.2	2
		Basalt of Swan Falls Road Hill	0.9	2

Attachment A Paleontological Sensitivity Rankings for Proposed Routes

Segment Number	Segment Length (miles)	Formation Name	Miles Crossed	Sensitivity Rating
		Undifferentiated basalt flows on the periphyry of the Birds of Prey area whose sources are unknown	0.8	2
		Lower Pleistocene to Pliocene basalts with associated tuffs and volcanic detritus	4.6	3
		Glenns Ferry Formation of the Idaho Group, includes some younger lacustrine and fluvial sediments	4.9	5
		Gravel and associated clastic materials from southern sources, includes materials transported from the Owyhee Mountains	3.3	5
		Basalt of Orchard Ranch	2.6	2
		Basalt of the Tombstone Patch Rapids	1.4	2
		Idaho Group and other fluvial, lacustrine, and eolian sediments in the northeast part of the Murphy Quadrangle	12.9	5
		Basalt flows associated with the Chalk Hills and Poison Creek Formations	0.3	5
		Poison Creek and Chalk Hill Formations, undivided	1.7	5
		Water	0.1	0
		Basaltic tuff of Waldvogel Canal	0.0	2
		Basaltic tuff of McDermott Road	0.0	2
		Middle basalt of Halverson Lake	0.1	2
		Chalky volcanic field	1.2	3
		Paleontological Sensitivity Ranking	**369.4**	
9	**162.2**	Fan alluvium 2 (upper Pleistocene)	0.1	3
		Colluvium derived from hard rocks (Holocene to Lower Pleistocene)	0.9	3
		Loess Unit 2: thin loess overlying basalt (Upper and Middle Pleistocene)	2.4	3
		Loess Unit 3, Moderately thick loess overlying basalt (upper to lower? Pleistocene)	22.8	3
		Deposits of Playas (Holocene and Upper Pleistocene)	0.4	3
		Alluvium	0.6	3
		Alluvium	7.1	3
		Alluvium of sidestreams (Holocene)	0.2	3
		Deadman Canyon Lava flow	0.1	2
		Black Mesa Gravel	6.8	3
		Sedimentary material dominated by massive lake beds of white-weathering fine silt, clay, and diatom	6.1	3
		Basalt of Hub Butte (Pleistocene)	4.5	2
		Pleistocene outwash, fanglomerate, flood and terrace gravels	1.3	3
		Lower Pleistocene outwash, fanglomerate, flood and terrace gravels	8.2	3

Attachment A Paleontological Sensitivity Rankings for Proposed Routes

Segment Number	Segment Length (miles)	Formation Name	Miles Crossed	Sensitivity Rating
		Middle Pleistocene plateau and canyon-filling basalt in and near the Snake Plain	0.3	2
		Middle Pleistocene plateau and canyon-filling basalt in and near the Snake Plain	5.2	3
		Tuana Gravel	0.6	3
		Glenns Ferry Formation	7.5	5
		Idaho Group and other fluvial, lacustrine, and eolian sediments in the northeast part of the Murphy Quadrangle	5.8	5
		Rhyolite of castleford Crossing (Miocene)	3.5	2
		Basalt of Devil Creek Butte or Tuana Butte (Pliocene or Miocene)	0.6	2
		Pliocene silicic welded tuff, ash and flow rock; most common in southwestern Idaho	5.0	2
		Tuff of McMullen Creek	3.9	2
		Basalt of the Murphy Area	6.2	2
		Pliocene olivine basalt flows and associated tuff and detritus of southern Idaho	1.6	3
		Poison Creek and Chalk Hill Formations, undivided	6.0	5
		Rhyolite lava flows of Reynolds Creek	0.4	2
		Teapot volcanic field	1.5	3
		Upper Member of Tuff of Wooden Shoe Butte	0.4	3
		Alluvial fan deposits (Holocene and Pleistocene)	3.8	3
		Landslide deposits (Holocene to Middle Pleistocene)	0.2	3
		Pebble gravel in conspicuous iron-stained beds as much as 25 feet thick in lake deposits	0.2	3
		Talus	0.1	3
		Gravel surface, abundant Eocene volcanics (Quaternary or Tertiary)	0.3	3
		Gravel surface, abundant quartzite (Quaternary and Tertiary)	0.7	3
		Gravel lens or surface, abundant quartzite (Tertiary)	1.1	3
		Clay to sand sized sediments (Miocene or Pliocene)	25.3	3
		Chalky volcanic field	0.7	3
		Basalt of Sinker Creek	0.4	2
		Glenns Ferry Formation of the Idaho Group, includes some younger lacustrine and fluvial sediments	10.0	5
		Idaho Group and other fluvial, lacustrine, and eolian sediments in the northeast part of the Murphy Quadrangle	8.7	5
		Chalk Hills Formation of the Idaho Group	0.7	5
		Paleontological Sensitivity Ranking	**539.0**	
10	**33.6**	Open Water	0.3	N/A
		Alluvium of side streams	0.4	3

Attachment A Paleontological Sensitivity Rankings for Proposed Routes

Segment Number	Segment Length (miles)	Formation Name	Miles Crossed	Sensitivity Rating
		Alluvial-fan deposits	1.7	3
		Basalt of Skelaton Butte	4.2	2
		Basalt of Rocky Butte	15.3	2
		Basalt of Wilson Butte		2
		Basalt of Notch Butte	2.9	3
		Mixed alluvial and lacustrine deposits		
		Basalt of Bacon Butte		
		Basalt of Hansen Butte	8.8	2
		Younger Tertiary basalt flows, undivided		
		Paleontological Sensitivity Ranking	**71.5**	

Note: Mileages have been rounded to the nearest tenth of a mile; therefore, numbers are inexact and columns/rows may not sum exactly