PALEOSERVICES
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Paleontological Monitoring and Discovery Plan

Digital 299 Broadband Project
Humboldt, Trinity, and Shasta Counties, California

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Prepared for:
Transcon Environmental, Inc.
1942 University Avenue, Suite 206
Berkeley, CA 94704

Prepared by:
Department of PaleoServices
San Diego Natural History Museum
P.O. Box 121390
San Diego, California 92112-1390

Katie M. McComas, M.S., Paleontological Report Writer & GIS Specialist
Thomas A. Deméré, Ph.D., Principal Paleontologist

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Executive Summary

This Paleontological Monitoring and Discovery Plan (PMDP) was prepared for the Digital 299 (D299) Broadband project (Proposed Action), a proposed regional telecommunications network that will provide broadband infrastructure to portions of Humboldt, Trinity, and Shasta counties, California. The plan provides a summary of paleontological resources along the proposed route, outlines potential construction-related impacts to paleontological resources, and provides step-by-step guidance for implementing the recommended paleontological mitigation program.

The Proposed Action is to install approximately 300 miles of fiber optic cable, mostly buried along existing roads. New road construction is not proposed. Construction of the Proposed Action would be in two phases, the first phase including construction of the middle-mile fiber optic facilities and vaults, which would be entirely buried. During the second phase of the project, Vero will partner with last-mile providers to build out last-mile connections, planned to be attached to existing utility poles. Wireless facilities (e.g., cellular towers or equipment) are not proposed as part of this Action. The Proposed Action also includes the construction of up to six prefabricated buildings to support signal regeneration, distribution, and interconnection (also referred to as "node" buildings). These buildings would be installed during the first phase of the project and are sited off public land.

Following the Potential Fossil Yield Classification (PFYC) system developed by the United States Forest Service and Bureau of Land Management, the paleontological resources technical report and addendum previously prepared for the Proposed Action identified six geologic units underlying the proposed main route and alternative segments that are assigned a high potential (PFYC 4)—unnamed Pleistocene-age marine and nonmarine overlap deposits, and the Falor, Modesto, Riverbank, Tehama, and Weaverville formations—and an additional four geologic units underlying the proposed main route and alternative segments that are assigned a moderate potential (PFYC 3)—unnamed Pleistocene-age nonmarine terrace deposits, and the Red Bluff, Galice, and Bragdon formations.

Construction-related excavations that will disturb geologic units with a PFYC ranking of 3 or 4 are recommended for paleontological mitigation, with the exception of certain types of earthwork that cannot be feasibly monitored for paleontological resources. Types of earthwork that are recommended for paleontological monitoring include: excavation of HDD sending and receiving bore pits, installation of buried fiber optic cable and conduit via the cut-and-cover trenching method, excavation for the installation of barrel/access vaults, excavation to bring buried conduit above ground at either end of bridge attachments, and grading for the installation of prefabricated node buildings. Types of earthwork that cannot be feasibly monitored for paleontological resources include: horizontal directional drilling and installation of buried fiber optic cable and conduit via the plowing method. Construction activities not anticipated to require significant earthwork include: placement of buried fiber optic cable, use of existing conduit or overhead attachment of new conduit for bridge attachments, installation of overhead fiber optic cable via attachment to existing utility poles, construction operations (e.g., use of staging and laydown areas), and operation and maintenance. As construction details are made available (e.g., locations of access vaults, segments of buried conduit to be installed by the trenching method, HDD sending and receiving bore pits, bridge crossing end points, and node buildings), the included GIS database may be used to determine whether impacts to paleontological resources are likely to occur at a given location along the alignment. The analysis of project components provided here should not be considered exhaustive, and additional project components arising prior to and during construction should be evaluated for monitoring requirements and monitoring feasibility on an ongoing basis.

The PMDP contains steps that are consistent with the recommendations of the paleontological resource technical report and addendum prepared for the Proposed Action, and are in accordance with current industry standards and the requirements of government agencies. The PMDP is broken down into three stages:

- **Before Earthwork:** retention of a Qualified Project Paleontologist; designation of a professional repository to receive any salvaged fossils; securing of any required federal and state agency permits; attendance at pre-construction meetings, as appropriate; development and presentation of a worker environmental awareness program to all excavation personnel; and development of a research design.
- **During Earthwork:** excavation monitoring by a paleontological monitor; salvage of any unearthed, significant fossil remains; and preparation of annual reports, as required.
- **After Earthwork**: preparation, curation, and storage of salvaged fossils (if any); and completion of a final paleontological monitoring report.

Contents

1.0 Introduction

This Paleontological Monitoring and Discovery Plan (PMDP) was prepared for the Digital 299 (D299) Broadband project (Proposed Action), a proposed regional telecommunications network that will provide broadband infrastructure to portions of Humboldt, Trinity, and Shasta counties, California. The following current Proposed Action description was provided by Transcon Environmental, Inc.

1.1 Proposed Action Description

The Proposed Action is to install approximately 300 miles of fiber optic cable, mostly buried along existing roads. New road construction is not proposed. Construction of the Proposed Action would be in two phases, the first phase including construction of the middle-mile fiber optic facilities and vaults, which would be entirely buried. During the second phase of the project, Vero will partner with last-mile providers to build out last-mile connections, planned to be attached to existing utility poles. Wireless facilities (e.g., cellular towers or equipment) are not proposed as part of this Action.

The Proposed Action also includes the construction of up to six prefabricated buildings to support signal regeneration, distribution, and interconnection (also referred to as "node" buildings). These buildings would be installed during the first phase of the project and are sited off public land.

The Proposed Action area extends through three counties in northern California: Humboldt, Trinity, and Shasta. The route has been chosen to include alternative segments in case field conditions prove constructability of the main route difficult. The main route and alternative segments are described below, following the route from west to east.

The main route begins along the coast with terminus points in Samoa and Eureka. The alignment follows two routes north around Humboldt Bay, including a crossing of Samoa Bridge from the Peninsula to Eureka, with the two routes connecting Arcata. From Arcata, the main route heads north to its junction with SR 299. From here, it follows two routes: one north for 16 miles through McKinleyville and Clam Beach to a terminus point in Trinidad, and the other continuing eastward as the main route following SR 299 to Blue Lake where it departs from SR 299 through residential Blue Lake, then for 16 miles following Maple Creek Road, Bald Mountain Road, and Snow Camp Road, connecting back to SR 299 at the intersection of Old Highway 200. The main route follows SR 299 for 5 miles to Saber Tooth Road, with an alternative segment continuing on SR 299 and the main route following the Saber Tooth Road and County Route 7K1000 for 6 miles where it reconnects and continues along SR 299 for about 50 miles through Willow Creek, Salyer, Burnt Ranch, Big Bar, to Junction City. At Willow Creek, an aerial spur breaks off from the main route north to serve Hoopa.

Between Salyer and Junction City, three alternative segments are proposed in case the main route along SR 299 is not able to be constructed. One alternative segment departs SR 299 just west of Salyer following Route 447 and Hennessey Road southeast for 15 miles. Another alternative segment departs the main route from Burnt Ranch and follows Route 16, Forest Route 5N09, 5N25, and Eagle Rock Road for 20 miles, including a 5-mile spur up to Eagle Rock Peak. This alternative reconnects with the main route along SR 299 in Big Bar. The third alternative in this area departs the main route west of Helena, breaking into alternate paths around Junction City, the main route heading south along Wintu Pass Road, Forest Route 33N41, Red Hill Road, and Dutch Creek Road, and the alternative segment running north from Valdor Road, an unnamed Forest Road, PowerHouse Road, and Canyon Creek Road; both alternatives reconvene at SR 299 in Junction City.

From Junction City, the main route follows SR 299 to Slattery Pond with an alternative segment continuing on SR 299 and the main route following La Grange Road and Castle Road for 2 miles back to

SR 299 to Weaverville. In Weaverville, the main route breaks from SR 299 to follow Trinity Lake Boulevard, Lance Gulch Road, and Route 3 for 4 miles. An aerial route continues following Route 3 south to Douglas City, while the main route continues east along Browns Mountain Road for 10 miles into Lewiston. Within Lewiston, it follows Lewiston Road, Trinity Dam Boulevard, and other residential roads. It continues east for 17 miles following Deadwood Road, French Gulch Road, and Trinity Mountain Road before the route connects back to SR 299 south of French Gulch.

Connected again with SR 299 south of French Gulch, the main route continues for 14 miles through Whiskeytown and Shasta, breaking south in Redding to follow Buenaventura Boulevard, Placer Street, and other residential roads. It follows Route 273/South Market Street south for 9 miles to Anderson where it follows Barney Road and Locust Street, with an alternative segment following South Barney Road and Industry Road, and the main route following Locust Road to Trefoil Lane, terminating on Trefoil Lane northeast of Cottonwood.

A Proposed Action overview map is included as Figure 1. Additional detailed location maps are included in Appendix A.

1.1.1 Project Facilities and Construction

The backbone consists of four underground conduits housing the fiber optic cable. Barrel vaults are installed underground adjacent to the line to splice the cable and provide access to the conduit. Aerial attachments would extend from the backbone, attaching to existing utility poles to connect communities. Up to six prefabricated buildings (nodes) would be placed to facilitate signal regeneration. These facilities and associated construction methods are described in further detail below.

1.1.1.1 Buried conduit and vaults

Four 1.25-inch conduits would house the fiber optic cable. Cable would be installed in one conduit, while two others would be left empty for maintenance work or future capacity. The conduit would be placed along the road shoulder or through the roadway if shoulders are narrow. Three construction methods are proposed to account for variations in geology and terrain or environmental sensitivities: horizontal directional drilling (HDD); plowing, and trenching with either a trencher, backhoe, or rock saw, all described below.

- Horizontal directional drilling (HDD) – Most of the project (approximately 90%) will be constructed using the HDD method. HDD is a steerable, trenchless method of installing underground conduits along a prescribed bore path by using a surface drilling rig. HDD causes minimal impacts; ground disturbance occurs only at each entry/exit point, referred to as “bore pits.” Bore pits would be sized up to 10 feet by 10 feet, to a maximum depth of 4.5 feet. Bore pits would be sited outside sensitive areas and within the 25-foot-wide temporary construction corridor.

  An HDD bore normally installs conduit in 500- to 700-foot ranges, and in some cases over 2,500-foot ranges can be obtained, depending on the substrate. The bore diameter to house the conduit would 4 inches and would be buried between 36-42 inches deep, with a maximum depth of 10 feet achievable when necessary.

  The HDD process involves drilling a hole with guidance equipment and continuous drill bit position monitoring. Once drilling is complete, the conduit is pulled through the bore hole. HDD uses a clay/water mixture that is pumped down the drill stem to lubricate the drill head and drill pipe, maintain the bore hole opening, and remove bore cuttings.

  Vero will employ a Contingency Plan in case of frac-outs during the HDD operation. The Plan will include overarching best management practices as well as site-specific measures and requirements. Agencies will have an opportunity to review and discuss the Plan with Vero prior to issuing permits. General best management practices include but are not limited to installing temporary sediment barriers and storing spoils away from riparian boundaries when boring under waterways; monitoring fluid pressure and bore paths for the duration of drilling operations; keeping a vacuum and spill kit on-site.

- Plowing and trenching – In areas where HDD is not feasible (terrain, environmentally sensitive areas), the plow or trench construction method would be used. A plow machine has a 2- to 3-inch-wide stationary or vibrating blade that cuts a narrow slit for the conduit to be inserted below ground. As the ground is cut, the conduit is installed at the desired depth by feeding it down a chute located on the back of the blade. As the tractor passes the insertion point, the ground is packed behind it, restoring it to its original condition. This allows soil compaction to simultaneously take place as the conduit is being installed as one single action. After the conduits are installed, the furrow is compacted back in place by the back end of the plow or a following compaction vehicle. Plowing creates minimal temporary disruption to the soil; soil disturbance from the plow blade is anticipated to occur within a 4- to 6-inch width. Equipment for this operation include tracked vehicles 10 to 12 feet long.

  Areas of fractured rock or that are otherwise unsuitable for plowing or HDD would be constructed through using trenching machines, excavators, backhoes, or rock saws. The trenches are opened and material is stacked to the side within the 25-foot-wide construction corridor. Conduit is placed and stacked material is returned to the trench and compacted. Temporary soil disturbance from trenching is anticipated to be approximately 6 feet wide. The typical bucket size on a backhoe used for trenching would be 18 inches, up to a maximum of 24 inches.

  Rock sawing is used to dig trenches in rock or extremely compacted soil conditions. The trenching component of the rock saw consists of a large rotating cutting wheel with blades or teeth that cut up/crush the ground as it rotates, breaking rocks or compacted soil. Rock saws are placed along the trench line with the blade lowered to the desired depth. Then the vehicle cuts along the trench line. Spoils from the trench are fine 0.25-inch to 0.5-inch gravel which is deposited adjacent to the trench for backfill. In shallow trenches, spoils are removed, and a slurry backfill is used. The slurry protects the conduit and cable from inadvertent dig ups or damage.

- Barrel/access vaults – Underground vaults are necessary along the alignment to splice cables and provide access to the buried conduit. Vaults are excavated and placed at the same time as conduit installation; they would be sized 4 feet by 4 feet by 4 feet deep, spaced approximately every 2,500 feet. Specific vault locations are unknown but would be placed along the centerline of the conduit within the proposed temporary disturbance area (i.e., 25-foot-wide corridor). Vaults are covered with metal access lids flush with the ground.

- Fiber optic cable placement – Once the conduit and vaults are installed, the conduit is tested and then the fiber optic cable is placed. Fiber optic cable is placed using two primary methods: 1) pulling cable using Kevlar tape or 2) pneumatically using compressed air, colloquially known as “blowing” or “jetting.”

  For both methods, a reel of cable is transported via flat-bed truck to access vaults along the alignment. For cable pulling, Kevlar tape is attached to the fiber line and fed into the conduit. Once the fiber/tape reaches the next vault location, it is retrieved and spliced to the next section of fiber. To use compressed air, a truck- or trailer-based compressor and a 3-foot by 2-

foot "blowing machine" channels the cable and compressed air along a tube and into the conduit. The fiber line flows through the conduit with the compressed air, is retrieved at the next vault location, and is spliced to the next section of cable.

1.1.1.2 Overhead conduit

- Bridge attachments – For perennial and intermittent waterways that have bridges, conduit would be attached to the existing bridge, or the fiber cable would be installed in existing conduit already attached to the bridge, if available. All bridge attachments would be certified by a professional civil engineer registered in the State of California. Conduit would be affixed on the side or underside of the bridge to meet visual needs of the particular structure and location. Bolts, clips, or anchors would be used to secure the conduit to the bridge in such a way that it would not impact the structural integrity of the bridge. Typically, a standard drill is used to install hardware on bridges. Conduit would be housed in a single 6-inch steel pipe installed by crews using a "reach around" boom that operates on a trailer that sits on the roadway, with an extension that reaches out from the railing of the bridge and extends below the bridge surface to the work platform.

  At either end of bridge crossings, an area 3 feet wide by 10 feet long (the same size as a bore pit) would be disturbed to bring the buried conduit above ground to attach to bridges. This area would generally be in line with the bridge alignment and up to 50 feet from where the bridge and conduit attachments begin. These areas would be sited outside sensitive areas.

  For water crossings that do not have bridges suitable for conduit attachment but do have culverts, the conduit would be installed using HDD under the waterway or culvert.

- Pole attachments – Fiber cable would be attached to existing utility poles during the second phase of the project. Pole attachments would be utilized only for last-mile attachments to serve communities and CAIs. Additionally, Digital 299 would support the provision of last-mile services in the community of Lewiston, which would be delivered via aerial utility poles within Lewiston. This Proposed Action includes building out the fiber line to strategic pole locations for future connections to homes and businesses within Lewiston; specific connections in Lewiston would be determined between Vero Networks and interested parties.

  Aerial attachments would be installed on existing poles using existing access. New poles or access roads are not proposed as part of this Proposed Action. Although unlikely, it is possible that existing poles would have to be replaced if loading calculations indicate pole structures need to be reinforced to handle increased loads. Vero Networks would coordinate with the pole and landowners regarding any needed pole replacements.

  Existing poles would be accessed using bucket trucks, or crew members would climb the poles to manually attach the cable. Cable would be pulled through rollers from the uphill end of the route. Once the cable is pulled through the rollers, the linemen would return to the poles, detach the rollers, and permanently affix the cable to the pole.

1.1.1.3 Node buildings

The Proposed Action includes installation of up to six prefabricated buildings (nodes) to regenerate transmission signals and serve as points of interconnection to other service providers. Node buildings measure up to 20 feet by 25 feet, depending on location, and would be enclosed in 50-foot by 50-foot secured compounds and secured by locked gates.

The prefabricated buildings would have finished concrete walls, composite or metal roofs, metal doors, and no windows. They are manufactured off-site and placed on-site with equipment. The buildings are secured to concrete slabs, which would likely require grading to create a level surface prior to installation. The proposed node locations are in the communities of Eureka, Arcata, Willow Creek, Big Bar, Weaverville, Redding, Anderson, and Cottonwood. The buildings require electricity, which would be provided primarily by existing commercial power. Each building's commercial power system would be backed up by battery (a minimum of 8-hour capacity) and a 75-kilowatt or 125-kilowatt propane- or natural gas-powered generator. These buildings also may be supported by solar power, and all buildings would have an air conditioning system, similar to large, window-mounted units. These buildings would not be occupied but can accommodate one to two persons to work on equipment. Typically, visits to check on equipment would occur monthly.

Node buildings will be located off public land. Specific locations have not been determined.

1.1.1.4 Construction operations

Equipment needed to construct the Proposed Action would include a Caterpillar D8, backhoe, 10-wheeler truck, semi-trailer truck, three-quarter-ton pickup truck, excavator, trencher, dozer/plow, loader, cable reel trailer, air blower device, air compressor, mechanical pusher/puller, and water truck. All equipment would stay within the 25-foot construction area or staging areas. Multiple crews would be working concurrently along the route, all in a generally linear fashion. Construction pace is between 500 feet and 2 miles per day, depending on construction method and terrain. Access and egress to and from construction sites would occur along existing roadways.

Staging and laydown areas are used to store vehicles, equipment, and materials during construction. Temporary parking of vehicles overnight would occur within these areas or as permitted along remote unpaved back roads. Areas potentially used for staging or laydown have been pre-determined, included in this environmental analysis, and are depicted on maps in Appendix A. It is expected that more staging/laydown areas are identified than will be needed.

Staging/laydown areas have been previously disturbed, and grading is not anticipated prior to use.

- Construction schedule – The total duration of construction for the Proposed Action is estimated up to 24 months, estimated to begin in the fourth quarter of 2020. Construction crews generally work 8 to 10 hours a day, 5 days a week, during daylight hours. Saturday work may be required in some areas as needed; approval from the proper agency would be obtained prior to construction on weekends. No work is anticipated to occur on major holidays.

  Digital 299 would avoid lane closures during times of inclement weather, including but not limited to rain, snow, and ice.

  Phase 2 of the project (last-mile connections) would begin construction as soon as last-mile providers and Vero finalize interconnection points and locations of service drops.

- Traffic control – This Proposed Action would follow federal, state, and local guidelines for temporary traffic control in construction zones. Guidelines include signage, cones, barricades, flagging, and pilot cars. Traffic control plans would be submitted for encroachment approval from state and local agencies, based on the specific conditions of the roadways and construction sites involved. Active flagging and the use of pilot cars would likely be used along SR 299 and on city streets, while a combination of signage and flagging would be used in more remote areas. Advanced notification of traffic control measures would be given to the community under certain conditions. The Proponent will develop Traffic Control Plans prior to the start of construction and as required by city and county agencies.

- Subsurface warning tape and cable locating technology – A continuous ribbon of warning tape would be placed along and above the new conduit during construction. The warning tape would be imprinted with a warning message to excavators that fiber optic cable is buried below. The subsurface tape may be magnetic, which would allow engineers to locate the fiber optic cable conduit.
- Fiber optic cable marker posts – Aboveground warning marker posts would be placed along the entire cable route at intervals of approximately 700 feet. The posts would be contained within the ROW directly above or offset of the conduit. These 4-foot-tall metal, poly-vinyl, or fiberglass posts are installed to provide visible evidence of the presence of buried cable, identify the owner of the cable, and provide a telephone number for emergency notifications. The location of the marker post may be adjusted to accommodate sensitive environments (e.g., sensitive vegetation communities) or physical limitations (e.g., rocks). Land management agencies would be consulted on preference for marker posts regarding color, placement, or other features.

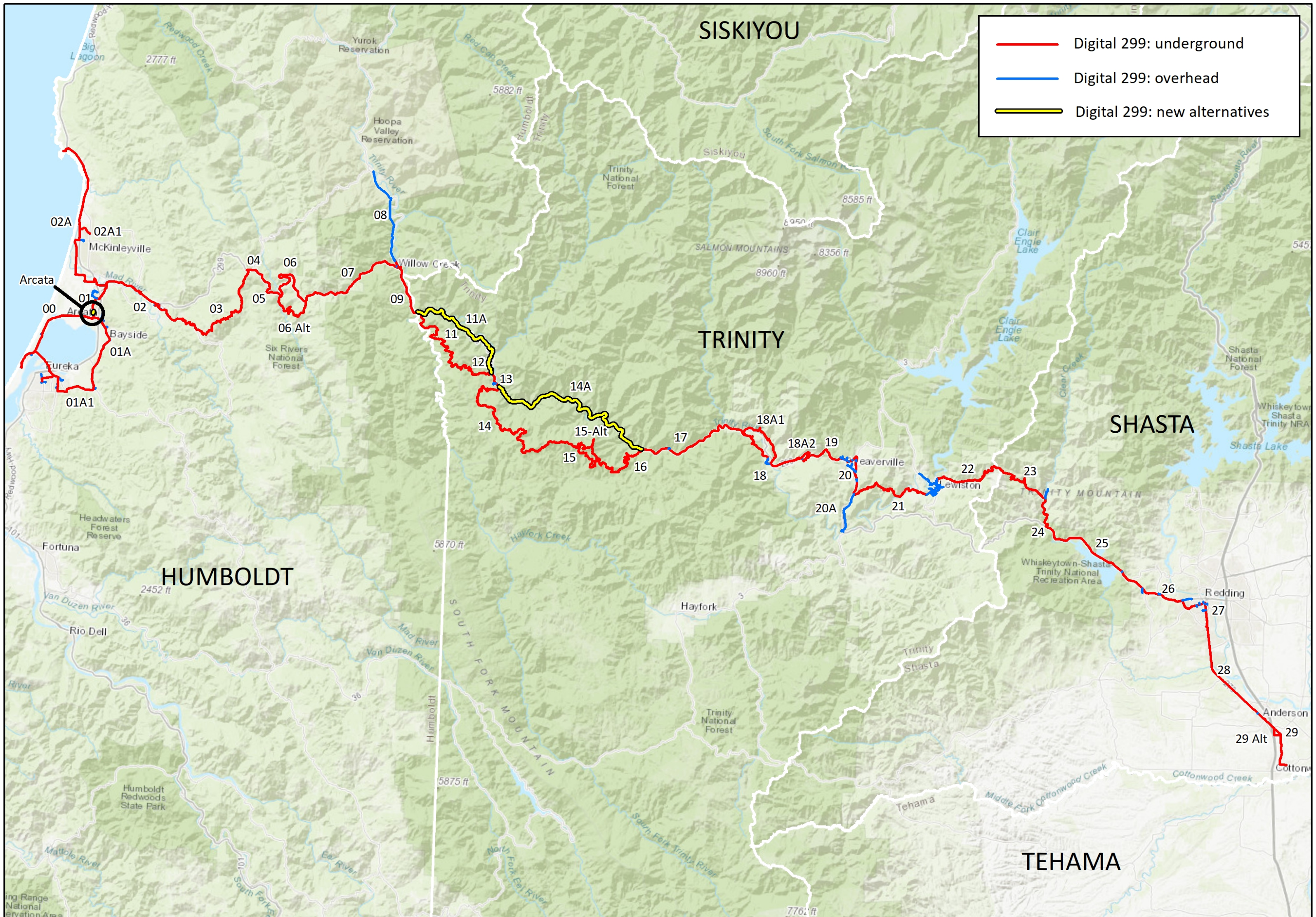
1.1.1.5 Operation and maintenance

Operation and maintenance needs for fiber optic networks are generally minimal, but they are required when a risk is identified or damage to the cable is discovered. The fiber line would be electronically monitored continuously for such risk or damage. Surveyors may also drive along the existing roads to inspect the line after a significant weather or seismic event; existing roads would be utilized for operation and maintenance activities. If the conduit requires access, the barrel vaults installed as part of the Proposed Action would be utilized to inspect or repair the line. Ground-disturbing activities associated with on-going operation and maintenance procedures are typically minor and would only occur as a result of erosion control repair in the event of storm damage, landslides, or other emergencies. The scope of this analysis assumes maintenance activities would be confined to the existing roadway and the 10-foot fiber optic ROW.

1.2 Scope of Work

The primary purpose of this PMDP is to describe the measures that will be implemented to mitigate (via monitoring and treatment) potential impacts to paleontological resources that may occur during construction of the Proposed Action. The PMDP provides a summary of paleontological resources along the main route and proposed alternatives, outlines potential construction-related impacts to paleontological resources, and provides step-by-step guidance for implementing the paleontological mitigation program. These steps are organized into three phases, to be implemented prior to the start of earthwork (contracting a Project Paleontologist, designating a professional repository, obtaining the appropriate agency permits, attendance at pre-construction meetings, development of a worker environmental awareness program, and development of a research design), during earthwork (paleontological monitoring of designated earthwork, salvage of discovered fossils, and submission of annual reports, as required), and after earthwork (preparation and curation of any salvaged fossils, fossil storage, and completion of a final paleontological mitigation report). Implementation of the PMDP will reduce potential impacts to paleontological resources to less than significant levels.

The PMDP was prepared in accordance with the recommendations of the paleontological resources technical report and addendum previously prepared for the Proposed Action (PaleoServices, 2020, 2021). All steps recommended in the plan are in line with current industry standards (e.g., Murphey et al., 2019; Society of Vertebrate Paleontology [SVP], 2010) and the requirements of government agencies (e.g., Bureau of Land Management [BLM], 2007, 2016; United States Department of Agriculture, Forest Service [USFS], 1996).



Sources: County boundaries, California Department of Forestry and Fire Protection, 2015; World Topographic Map, Esri et al., 2021

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FIGURE 1

Overview Map
Digital 299 Broadband
Humboldt, Shasta, and Trinity counties, California

0 30
scale in miles

2.0 Paleontological Resources

2.1 Definition of Paleontological Resources

As defined here, paleontological resources (i.e., fossils) are the buried remains and/or traces of prehistoric organisms (i.e., animals, plants, and microbes). Body fossils such as bones, teeth, shells, leaves, and wood, as well as trace fossils such as tracks, trails, burrows, and footprints, are found in the geologic units/formations within which they were originally buried. The primary factor determining whether an object is a fossil or not is not how the organic remain or trace is preserved (e.g., "petrified"), but rather the age of the organic remain or trace. Although typically it is assumed that fossils must be older than ~11,700 years (i.e., the generally accepted end of the last glacial period of the Pleistocene Epoch), organic remains older than recorded human history and/or older than middle Holocene (about 5,000 radiocarbon years) can also be considered to represent fossils (SVP, 2010).

Fossils are considered important scientific and educational resources because they serve as direct and indirect evidence of prehistoric life and are used to understand the history of life on Earth, the nature of past environments and climates, the membership and structure of ancient ecosystems, and the pattern and process of organic evolution and extinction. In addition, fossils are considered to be non-renewable resources because typically the organisms they represent no longer exist. Thus, once destroyed, a particular fossil can never be replaced.

Finally, paleontological resources can be thought of as including not only the actual fossil remains and traces, but also the fossil collection localities and the geologic units containing those localities. The collection locality includes both the geographic and stratigraphic context of fossils—the place on the earth and the stratum (deposited during a particular time in earth's history) from which the fossils were collected. Localities themselves may persist for decades, in the case of a fossil-bearing outcrop that is protected from natural or human impacts, or may be temporarily exposed and ultimately destroyed, as in the case of fossil-bearing strata uncovered by erosion or construction. Localities are documented with a set of coordinates and a measured stratigraphic section tied to elevation detailing the lithology of the fossil-bearing stratum as well as overlying and underlying strata. This information provides essential context for any future scientific study of the recovered fossils.

2.1.1 Definition of Significant Paleontological Resources

The California Environmental Quality Act (CEQA, Public Resources Code Section 21000 et seq.) dictates that a paleontological resource is considered significant if it "has yielded, or may be likely to yield, information important in prehistory or history" (Section 15064.5, [a][3][D]). The Society of Vertebrate Paleontology (SVP) has further defined significant paleontological resources as consisting of "fossils and fossiliferous deposits[…]consisting of identifiable vertebrate fossils, large or small, uncommon invertebrate, plant, and trace fossils, and other data that provide taphonomic, taxonomic, phylogenetic, paleoecologic, stratigraphic, and/or biochronologic information" (SVP, 2010).

2.2 Regulatory Framework

Paleontological resources are considered scientifically and educationally significant nonrenewable resources; they are protected under a variety of laws, regulations, and ordinances. The Proposed Action is located within Humboldt, Shasta, and Trinity counties, California, and crosses land managed by the Bureau of Land Management (BLM), Bureau of Reclamation (USBR), United States Forest Service (USFS), National Park Service (NPS), and the State of California, as well as tribal and private land. Pertinent laws, regulations, and ordinances are summarized below.

2.2.1 Federal

Notable Federal legislative protection for paleontological resources includes the Antiquities Act of 1906, the Mineral Leasing Act of 1920, the National Environmental Policy Act of 1969, the Federal Land Policy Management Act of 1976, and the Paleontological Resources Preservation Act of 2009.

The **American Antiquities Act of 1906 (P.L. 59–209, 34 Stat. 225, 16 U.S.C. 431–433)** establishes a penalty for disturbing or excavating any historic or prehistoric ruin or monument or object of antiquity on federal lands. The act also establishes a permit requirement for collection of antiquities on federal lands. Although not specifically addressing paleontological resources, the act is considered relevant to such resources by number of federal agencies that consider fossils to be objects of antiquity.

The **Mineral Leasing Act (MLA) of 1920 (30 U.S.C. § 181 et seq.)** mandates the protection of significant paleontological resources as both federal property (on public surface lands) and as private property (on private surface lands). On split estate lands (private surface/public mineral lands), paleontological resources are defined as part of the surface estate, and therefore belong to the private landowner. While the BLM must account for possible impacts to paleontological resources located on private surface lands, the landowner has the ultimate right to determine the disposition of said paleontological resources.

The **National Environmental Policy Act (NEPA) of 1969 (P.L. 91–190, 83 Stat. 852, 42 U.S.C. 4321–4347)** recognizes the continuing responsibility of the Federal Government to "preserve important historic, cultural, and natural aspects of our national heritage..." (Sec. 101 [42 U.S.C. § 4321]) (#382). As with the American Antiquities Act, NEPA does not specifically address paleontological resources but is interpreted by many federal agencies to be applicable to such resources. For example, the BLM and the USFS both view NEPA as one of the major laws protecting paleontological resources on public lands.

The **Federal Land Policy and Management Act (FLPMA) of 1976 (P.L. 94–579, 90 Stat. 2744, 43 U.S.C. 1701–1785)** defines significant fossils as: unique, rare or particularly well-preserved; an unusual assemblage of common fossils; being of high scientific interest; or providing important new data concerning [1] evolutionary trends, [2] development of biological communities, [3] interaction between or among organisms, [4] unusual or spectacular circumstances in the history of life, [5] or anatomical structure.

The **Paleontological Resources Preservation Act (PRPA) of 2009 (P.L. 111–11, 123 Stat. 991, H.R. 146)** is the first statute to directly address the management and protection of paleontological resources on federal lands. This law essentially codifies collecting polices of federal land management agencies. It allows reasonable amounts of common invertebrate and plant fossils to be casually collected with negligible disturbance. In addition, it requires protection and preservation of uncommon invertebrate and plants and all vertebrate fossils, including imprints, molds, casts, etc. The PRPA further describes requirements for permitting collection on federal lands, stipulations regarding the use of paleontological resources in education, continued federal ownership of recovered paleontological resources, and standards for acceptable repositories of collected specimens and associated data. The PRPA also provides for criminal and civil penalties for unauthorized removal of paleontological resources from federal lands.

To implement the policies of the PRPA, the **United States Department of Agriculture (USDA) adopted regulations (Title 36 C.F.R. Part 291)** in April 2015 to manage, protect, and preserve paleontological resources on National Forest System lands. These regulations provide for management of paleontological resources by establishing fossil collection permitting procedures, setting curation standards, establishing civil and criminal penalties, prohibiting fossil collection for commercial purposes, and developing procedures for allowing the casual collection of some of these resources on certain lands and under specific conditions.

The **Department of the Interior (DOI) proposed its own set of regulations (81 F.R. 88173)** in December 2016 for the implementation of PRPA on lands administered by the Bureau of Land Management, the Bureau of Reclamation, the National Park Service, and the U.S. Fish and Wildlife Service. While not yet adopted, these proposed regulations address the management, collection, and curation of paleontological resources—including fossil collection permitting procedures, curation and repository standards, and confidentiality of paleontological locality data—and details civil penalty procedures for illegal collecting, damaging, altering or defacing, or selling of paleontological resources from DOI-administered lands.

2.2.2 Tribal

The **Bureau of Indian Affairs (BIA) provides guidance (Indian Affairs Manual Part 59, Chapter 7)** regarding the protection and management of paleontological resources, which are considered to be trust resources on tribal lands. As trust resources, the landowner has the right to determine the fate of any discovered fossils, including retaining ownership and/or determining if fossils should be preserved in place. Prior to the excavation of any "imbedded" fossils, written consent to excavate must be received from the landowner and/or tribe. If the landowner and/or tribe consents to fossil excavation, a permit may be required from the BIA, operating under the authority of the Secretary of the Interior, which adheres to the above listed federal legislative protection. The permitting process allows the BIA to ensure that applicants are qualified to complete the excavation, have written consent to salvage the fossils, and have developed a plan for the eventual fate of salvaged fossils.

No permit is required for exploration or surface collecting of "non-imbedded" fossils, but are subject to tribal jurisdiction and/or landowner consent.

2.2.3 State

Notable State legislative protection for paleontological resources includes the California Environmental Quality Act and the Public Resources Code.

The **California Environmental Quality Act (CEQA, Public Resources Code Section 21000 et seq.)** protects paleontological resources on both state and private lands in California. This act requires the identification of environmental impacts of a Project, the determination of significance of the impacts, and the identification of alternative and/or mitigation measures to reduce adverse environmental impacts. The Guidelines for the Implementation of CEQA (Title 14, Chapter 3, California Code of Regulations: 15000 et seq.) outlines these necessary procedures for complying with CEQA. Paleontological resources are specifically included as a question in the CEQA Environmental Checklist (Section 15023, Appendix G): "Will the proposed project directly or indirectly destroy a unique paleontological resource or site or unique geologic feature." Also applicable to paleontological resources is the checklist question: "Does the project have the potential to… eliminate important examples of major periods of California history or pre-history."

Other state requirements for paleontological resource management are included in the **Public Resources Code (Chapter 1.7), Section 5097.5 and 30244**. These statutes prohibit the removal of any paleontological site or feature on public lands without permission of the jurisdictional agency, defines the removal of paleontological sites or features as a misdemeanor, and requires reasonable mitigation of adverse impacts to paleontological resources from developments on public (state) lands.

Sections within the California Code of Regulations (Title 14, Division 3, Chapter 1), are applicable to paleontological resources on lands administered by the **California Department of Parks and Recreation** (DPR). Section 4307 includes indicates a person shall not destroy, disturb, or remove a geological feature, and defines a geological feature as including paleontological resources. Section 4309 indicates that a person must require a special permit from the DPR in order to collect paleontological resources in order to not be liable for violating Section 4307.

Section 0309 within the California Department of Parks and Recreation Operations Manual specifically outlines policies for site development and the protection of paleontological resources on DPR-managed land (DPR, 2004). Policy 0309.1 Site Development Policy states that planning for site development will include an evaluation of paleontological resources and stabilization of existing paleontological sites. Policy 0309.2 Paleontological Resource Protection Policy states that "paleontological resources will be protected, preserved, and managed for public education, interpretation, and scientific research," through the following steps: a. inventory and systematically monitor for exposed paleontological resources, and protection of fossils through site stabilization, physical protection, collection, or documentation; b. encourage academic field research and scientific study under approved permits (DPR 412P); c. interpret paleontological resources for park visitors; d. prohibit general classroom collection activities; and e. protect known fossil localities and prevent damage to and unauthorized collection of fossils, including by keeping the locations of significant fossil localities confidential.

2.2.4 Local: Humboldt, Trinity, and Shasta Counties

The Humboldt County General Plan (adopted October 2017) does not specify any requirements for paleontological resources. Paleontological resources, however, are often considered a sub-category of cultural resources. The Conservation and Open Space Element of the General Plan contains requirements for cultural resources that involve the identification and documentation of significant historic and prehistoric resources and the mitigation of impacts to significant cultural resources.

Trinity County last updated the Open Space and Conservation Element of its General Plan in 1973, and it does not contain any reference to paleontological or "prehistoric" resources.

The Shasta County General Plan (amended through September 2004) briefly discusses paleontological resources in the mineral resources group. While the General Plan notes the presence of scientifically significant paleontological resources in the county that are protected under Federal, State, and local environmental laws, it does not specifically outline any requirements for the protection of paleontological resources.

2.3 Summary of Paleontological Resources Technical Report

A paleontological resources technical report was previously completed for the Proposed Action (PaleoServices, 2020). More recently, an addendum to the technical report covering newly added alternatives was completed (PaleoServices, 2021). This section summarizes the results and recommendations of those reports.

The Proposed Action transects a region of complex geology that encompasses portions of three California geomorphic provinces, including (from west to east) the Coast Ranges Geomorphic Province, the Klamath Mountains Geomorphic Province, and the Great Valley Geomorphic Province. In the Coast Ranges Geomorphic Province, relatively young (late Cenozoic), locally fossil-rich sedimentary rocks in the Eel River Basin overlie faulted and metamorphosed Mesozoic-age rocks of the sparsely fossil-bearing Franciscan Complex and non-fossil-bearing Coast Range Ophiolite. In the Klamath Mountains Geomorphic Province, a complex amalgamation of numerous tectonostratigraphic terranes has been intruded by a patchwork of plutonic rocks. Individual terranes typically represent exotic tectonic fragments composed of ancient ocean crust, volcanic island arcs, and subduction-accumulated mélange that sequentially (east to west) collided with and accreted to the western edge of North America during early Paleozoic, late Paleozoic, Triassic, and Jurassic time. Several of these exotic terranes also include weakly to strongly metamorphosed marine sedimentary rocks that locally contain geologic age-significant fossils. At a few locations in this province are smaller fault-bounded basins containing erosional remnants of Cretaceous marine and Cenozoic nonmarine fossil-bearing sedimentary rocks. In the Great Valley Geomorphic Province, a localized sequence of fossil-bearing late Cenozoic fluvial and alluvial fan sedimentary rocks overlap the eastern margin of the Klamath Mountains and document regional environmental and biotic changes of the last 5 million years.

Following the Potential Fossil Yield Classification (PFYC) system developed by the USFS (USFS, 1996) and BLM (BLM, 2007, 2016), PFYC rankings were assigned to all 29 of the geologic units individually mapped as occurring along the main route and alternative segments of the Proposed Action, and are included in the GIS database. Of these, only six geologic units were assigned a high potential (PFYC 4): unnamed Pleistocene-age marine and nonmarine overlap deposits, and the Falor, Modesto, Riverbank, Tehama, and Weaverville formations. An additional four geologic units were assigned a moderate potential (PFYC 3): unnamed Pleistocene-age nonmarine terrace deposits, and the Red Bluff, Galice, and Bragdon formations.

Table 1. Summary of geologic units underlying the main route and alternative segments of the Proposed Action with PFYC rankings of 3 or 4, listed in approximate stratigraphic order from youngest to oldest.

Geologic Unit	Age	PFYC	PFYC Justification
nonmarine terrace deposits	Pleistocene-early Holocene	PFYC 3: Moderate	Significant fossils widely scattered; common invertebrates/plants intermittent
marine and nonmarine overlap deposits	Pleistocene	PFYC 4: High	Significant fossils documented
Falor Formation	early-middle Pleistocene	PFYC 4: High	Significant fossils documented
Modesto Formation	late Pleistocene-early Holocene	PFYC 4: High	Significant fossils documented
Riverbank Formation	middle-late Pleistocene	PFYC 4: High	Significant fossils documented
Red Bluff Formation	early-middle Pleistocene	PFYC 3: Moderate	Significant fossils widely scattered
Tehama Formation	Pliocene	PFYC 4: High	Significant fossils documented
Weaverville Formation	Oligocene-Miocene	PFYC 4: High	Significant fossils documented
Galice Formation	late Jurassic	PFYC 3: Moderate	Significant fossils widely scattered
Bragdon Formation	early Mississippian	PFYC 3: Moderate	Significant fossils widely scattered

Earthwork that occurs within geologic units with a PFYC ranking of 3 or 4 is typically mitigated for impacts to paleontological resources, with the exception of certain types of earthwork that for various reasons cannot be feasibly monitored for paleontological resources (e.g., horizontal directional drilling methods, small diameter augering). Recommended mitigation measures were provided to address possible impacts, and included a measure to prepare a paleontological monitoring plan (PMDP).

2.4 Analysis of Potential Impacts to Paleontological Resources

As currently understood, approximately 90% of the buried optic cable and conduit will be installed using the **horizontal directional drilling (HDD) method**. This hydraulic drilling method typically produces spoils of pulverized sedimentary rock in a slurry of lubricant and water, and thus destroys most, if not all, macrofossil remains that may have been present. In addition, the precise stratigraphic context of any encountered fossils (including microfossils) is impossible to document with this construction method, eliminating their research value. Therefore, sections where the HDD method will be used are not recommended for paleontological monitoring. However, excavation of the sending and receiving bore pits (measuring 10 feet by 10 feet, excavated to a maximum depth of 4.5 feet) at either end of HDD segments can be successfully monitored for paleontological resources.

In areas where HDD methods cannot be used, **plowing or trenching construction methods** are proposed. The plowing method uses a 2- to 3-inch wide stationary or vibrating blade to cut a narrow slit for the installation of conduit to a desired depth, resulting in disturbance measuring 4 to 6 inches wide. Backfill of the slit occurs as the plow machine passes, eliminating the ability for monitors to view any of the minimal spoils expected to be produced by this method. Therefore, sections where the plowing method will be used are not recommended for paleontological monitoring. The cut-and-cover trenching method uses trenching machines, excavators, backhoes, or rock saws to excavate an open trench measuring approximately 6 feet wide. Spoils are placed alongside the trench before being used as backfill, and can result in the successful discovery and recovery of paleontological resources. Therefore, trenching construction methods can be successfully monitored for paleontological resources.

Barrel/access vaults will be placed approximately every 2,500 feet along the alignment, and will measure 4 feet by 4 feet, excavated to a depth of 4 feet. Excavation of access vaults is typically accomplished using excavators or backhoes, which produce spoils often consisting of large blocks of rock or sedimentary matrix that can contain relatively intact fossil remains. Therefore, excavation of access vaults can be successfully monitored for paleontological resources.

The **placement of fiber optic cable** is achieved by pulling or “blowing”/”jetting” the cable through the conduit between adjacent vault locations. This work does not require any additional excavations, as it utilizes the existing vaults and installed conduit and, therefore, is not recommended for paleontological monitoring.

Bridge attachments may be necessary where the alignment crosses waterways. Conduit will either be attached to the existing bridge or the fiber optic cable will be installed in existing conduit already attached to the bridge, where available. The only anticipated earthwork related to bridge attachments will occur at either end of the bridge crossing, where excavations measuring 3 feet wide by 10 feet long will be required to bring buried conduit above ground to attach to the bridge. Where bridge attachment is not possible, HDD methods will be used to install conduit under the waterway. Both the excavation of pits for bridge crossings and HDD sending and receiving bore pits can be successfully monitored for paleontological resources. In contrast, the actual bridge attachment work does not require earthwork and the HDD drilling cannot be successfully monitored.

The installation of last-mile fiber cable using **pole attachments** will utilize existing utility poles. This method does not require any ground disturbance and, therefore, is not recommended for paleontological monitoring.

The installation of up to six prefabricated **node buildings** will require grading of a level building pad prior to pouring of a concrete slab on which to site each structure. Grading typically produces spoils that can contain intact fossils remains and, therefore, can be successfully monitored for paleontological resources.

Construction operations, including the use of laydown/staging areas, placement of subsurface warning tape with the buried conduit, and installation of fiber optic cable marker posts, are not anticipated to require significant excavations into previously undisturbed strata. The proposed laydown/staging areas are located along existing roads in previously disturbed areas, and further grading is not anticipated prior to their use. Placement of subsurface warning tape and marker posts is anticipated to occur within strata that were disturbed during installation of the buried cable and conduit, and therefore will not result in additional impacts to paleontological resources and will not require paleontological monitoring.

Operations and maintenance activities associated with the installed fiber optic network are generally not anticipated to require ground disturbance (i.e., use of existing access roads, and access to buried fiber optic cable via existing barrel vaults). Some minor earthwork may be associated with erosion control repairs that result from storm damage or landslides, but this work is anticipated to be superficial and unlikely to impact previous undisturbed strata. Therefore, work associated with operations and maintenance is not recommended for paleontological monitoring.

As construction details are made available (e.g., locations of access vaults, segments of buried conduit to be installed by the trenching method, HDD sending and receiving bore pits, bridge crossing end points, and node buildings), the included GIS database may be used to determine whether impacts to paleontological resources are likely to occur at a given location.

The analysis provided here and summarized in Table 2 should not be considered exhaustive, and additional Proposed Action components arising during construction should be evaluated for monitoring requirements and monitoring feasibility on an ongoing basis.

Table 2. Summary of paleontological impact analysis of Proposed Action components, and monitoring recommendations for each where underlain by geologic units outlined in Table 1.

Proposed Action Component (Construction Method)	Monitoring Recommended?
Installation of buried fiber optic cable & conduit (via HDD method)	Yes – excavation of sending and receiving bore pits; No – horizontal directional drilling
Installation of buried fiber optic cable & conduit (via plowing method)	No – minimal earthwork involved, and cut is immediately backfilled, making monitoring impossible
Installation of buried fiber optic cable & conduit (via trenching method)	Yes – significant earthwork anticipated
Installation of barrel/access vaults	Yes – significant earthwork anticipated
Placement of fiber optic cable	No – no significant earthwork anticipated
Installation of overhead fiber optic cable (via bridge attachments)	Yes – excavation to bring buried conduit above ground at either end of the bridge attachment; No – use of existing conduit or overhead attachment of new conduit to existing bridge
Installation of overhead fiber optic cable (via pole attachments)	No – no significant earthwork anticipated

Proposed Action Component (Construction Method)	Monitoring Recommended?
Installation of node buildings	Yes – grading of level building pad
Construction operations (e.g., use of staging/laydown areas, fiber optic cable marker posts)	No – no significant earthwork anticipated
Operation and maintenance activities (e.g., inspection or repair of fiber optic line, erosion control repair)	No – no significant earthwork anticipated

3.0 Plan Implementation

For the Proposed Action, paleontological monitoring shall be implemented during mitigable earthwork operations that will impact geologic units assigned a PFYC ranking of 3 (Moderate) or 4 (High), as described in Sections 2.3 and 2.4, summarized in Tables 1 and 2, and depicted in Appendix A.

The following PMDP includes a series of steps to be implemented in phases: 1.) before the commencement of construction-related earthwork, 2.) during construction-related earthwork, and 3.) after the completion of construction-related earthwork in the event that fossils either are, or are not, discovered and salvaged. All steps described in the PMDP have been formulated in accordance with industry standards (e.g., Murphey et al., 2019; SVP, 2010) and the requirements of government agencies (e.g., Bureau of Land Management [BLM], 2007, 2016; United States Department of Agriculture, Forest Service [USFS], 1996). Adopting the measures outlined in this PMDP will reduce impacts to paleontological resources from ground disturbance to less than significant levels.

3.1 Before Earthwork

Prior to commencement of earthwork activities, some or all of the following actions will be necessary.

3.1.1 Retention of Qualified Project Paleontologist

Prior to the start of earthwork, a qualified Project Paleontologist (as defined below) shall be retained to monitor ground disturbance. The Project Paleontologist will oversee implementation of the PMDP, including serving as supervisor to any retained qualified paleontological monitors (as defined below).

The qualified Project Paleontologist will have a Master's Degree or Ph.D. in paleontology and will have proven knowledge of local paleontology and geology, as well as professional experience with paleontological procedures and techniques. In turn, the qualified paleontological monitor(s) will have a B.A. or B.S. in Geology or Paleontology and a minimum of 1 year of monitoring experience.

3.1.2 Designation of Repository

A professional repository shall be contracted prior to the start of earthwork to curate and store any discovered fossils. Such an institution shall be a recognized paleontological specimen repository with a permanent curator, such as an AAM-accredited museum or university (e.g., University of California Museum of Paleontology, or Natural History Museum of Los Angeles County). The repository shall be capable of storing fossils in a facility with adequate security against theft, loss, damage, fire, pests, and adverse climate conditions.

For paleontological resources recovered from federally- or state-managed lands, the designated repository will understand that, though they will assume the professional and financial responsibilities associated with curation and storage in perpetuity, ownership of the fossils will be retained by the federal government or state. A curation agreement outlining this relationship shall be submitted to the appropriate federal or state agency. The funds required for initial curation and storage needs shall be provided to the designated repository. Reasonable costs may include necessary curatorial supplies (e.g., archival specimen trays, glass vials, foam), as well as a one-time fee for initial specimen storage, which is generally calculated based on the actual or prorated purchase price of steel drawers and cabinets, and a prorated cubic foot volume charge for the collection room.

3.1.3 Permit Requirements

Since the Proposed Action route crosses land managed by multiple federal and state agencies, the Project Paleontologist must obtain the required permits to conduct paleontological mitigation prior to the start of earthwork in these areas. Specifically, areas where paleontological monitoring may be required are located on land managed by the BLM (Redding Field Office area), USBR, USFS (Shasta-Trinity National Forest, Six Rivers National Forest), NPS (Whiskeytown-Shasta-Trinity National Recreation Area), and California DPR (Little River State Beach). The Project Paleontologist must ensure that the conditions of each approved permit (e.g., field work and collecting requirements, treatment and repositing of any collected fossils, reporting requirements) are followed. The required permits for each involved federal and state agency are outlined below.

3.1.3.1 Bureau of Land Management (BLM)

The Project Paleontologist must have a current Paleontological Resources Use Permit (PRUP) obtained from the California State Office that will remain active for the duration of the Project. These permits are typically renewed every three years, as needed. The application should be requested from the California State Office directly. In addition, a Fieldwork Authorization (FWA) specific to construction of the Proposed Action should be obtained from the Redding Field Office. This form should be requested from the Redding Field Office.

3.1.3.2 United States Bureau of Reclamation (USBR)

The Project Paleontologist should contact the Regional Archaeologist for the California-Great Basin Regional Office directly (listed at https://www.usbr.gov/cultural/crmstaff.html) to obtain the appropriate permit application forms and requirements for conducting paleontological monitoring on USBR lands in the Lewiston area.

3.1.3.3 United States Forest Service (USFS)

The Project Paleontologist should obtain an Authorization to Conduct Paleontological Resources Research or Collection by submitting form FS-2800-22A to the Shasta-Trinity National Forest Headquarters and Six Rivers National Forest Headquarters. The form is available at the link below:

https://www.fs.usda.gov/sites/default/files/media_wysiwyg/fs_2800_22a-form-508.pdf

3.1.3.4 National Park Service (NPS)

The Project Paleontologist should obtain a Scientific Research and Collecting Permit. The application is available online through the "Research Permit and Reporting System" at https://irma.nps.gov/RPRS/ or may be obtained by contacting the Whiskeytown-Shasta-Trinity National Recreation Area directly.

3.1.3.5 California Department of Parks & Recreation (DPR)

The Project Paleontologist should obtain a Scientific Research and Collecting Permit by submitting form DPR 065, "Application and Permit to Conduct Scientific Research and Collections," to the Natural Resources Division. The duration of the permit is up to one year. The form is available at the link below:

https://www.parks.ca.gov/?page_id=21557#paleo

3.1.4 Attendance at Relevant Meetings

The Project Paleontologist shall attend any relevant meetings or conference calls prior to the start of project earthwork to consult with project manager(s) and/or any excavation contractors concerning excavation schedules, paleontological field techniques, and safety issues.

3.1.5 Worker Environmental Awareness Program

Prior to the start of earthwork, the Project Paleontologist shall coordinate and help to develop the paleontological resources section of the worker environmental awareness program (WEAP) to ensure that all construction personnel understand paleontological monitoring requirements, the roles and responsibilities of paleontological monitors, and the appropriate action to be taken in the event of a discovery of paleontological resources. The penalties associated with the unauthorized collection or intentional disturbance of any paleontological resources, as well as the penalties for noncompliance with paleontological mitigation requirements, shall be clearly communicated. Training shall include a definition of paleontological resources and an overview of potential resources that could be encountered during ground disturbing activities, which will help to facilitate worker recognition and/or avoidance of paleontological resources, and prompt immediate notification of the Project Paleontologist or paleontological monitor.

3.1.6 Research Design

Specific research themes associated with the geologic units present within a given project can help direct the types of data collection made during paleontological mitigation. These research themes shall be applied during the implementation of a research design/discovery phase, as appropriate. Research themes related to the paleontologically sensitive strata located along the Proposed Action route include (but are not limited to):

- Pleistocene stratigraphy and depositional environments of the Eureka-Arcata area;
- Pliocene and Pleistocene land mammal assemblages of the Tehama, Red Bluff, Riverbank, and Modesto formations in the Redding area;
- Miocene paleoenvironmental and paleoclimatic indicators within the fossil flora of the Weaverville Formation; and
- biochronology and paleoenvironments of the Jurassic Galice Formation and Mississippian Bragdon Formation.

3.2 During Earthwork

Commencement of construction-related earthwork operations marks the time when potential impacts to paleontological resources will begin. To mitigate these potential impacts, some or all of the following actions are required.

3.2.1 Excavation Monitoring: Duties and Areas to Be Monitored

A qualified paleontological monitor(s) working under the direction of the Project Paleontologist shall be present full-time during mitigable earthwork operations that will impact geologic units assigned a PFYC ranking of 3 (Moderate) or 4 (High), as described in Sections 2.3 & 2.4, summarized in Tables 1 & 2, and depicted in Appendix A.

It is the Project or Construction Manager's responsibility to keep the Project Paleontologist and paleontological monitor(s) up-to-date with current earthwork plans and any scheduling changes. Typically, the Project or Construction Manager will provide the Project Paleontologist with a 48-hour notice prior to the start of relevant earthwork operations. The monitor(s) will coordinate with Construction Management to determine the timing for monitoring in the identified areas of concern. It will be the paleontological monitor's responsibility to maintain communication and coordination with the earthwork team. Paleontological monitoring may be reduced (e.g., spot-checking) at the discretion of the Project Paleontologist based on the conditions in the field (e.g., only weathered deposits are being impacted by earthwork, or earthwork is taking place entirely within previously disturbed artificial fill).

A paleontological monitor will observe and inspect any temporarily exposed outcrops (e.g., trench and pit sidewalls, graded pad surfaces) for paleontological resources. Spoils produced by excavation activities (e.g., trenching, miscellaneous excavations) may also be inspected. Ideally, inspection involves the examination of every newly exposed surface, but operationally this is often impossible. The pace and quantity of equipment in the cut may determine how often and where paleontological monitors can inspect. When active excavations are too dangerous to enter because of a narrow cut, short haul, and/or heavy equipment traffic, monitoring may be conducted from an elevated vantage point. Paleontological monitors should aim to avoid interference with or delay of earthwork operations.

3.2.1.1 Stratigraphic data recovery

Recording of stratigraphic data will be an on-going aspect of each phase of excavation monitoring to provide context for any eventual fossil discoveries. Outcrops exposed in active cuts and observed geologic features will be recorded in field notes and photo documented, where possible. The goal of this work is to delimit the nature of fossil-bearing geologic units along the construction route, determine their areal distribution and depositional contacts, and record any evidence of structural deformation that may affect determination of the stratigraphic position of recovered fossils.

Standard geologic and stratigraphic data collected include lithologic descriptions (color, sorting, texture, structures, and grain size), stratigraphic relationships (bedding type, thickness, and contacts), and topographic position. Measurement of stratigraphic sections will be performed routinely, where feasible. Areas containing exposures of fossil-bearing sedimentary deposits will be studied in greater detail and fossil localities recorded on measured stratigraphic sections.

3.2.1.2 Safety procedures

Safety of paleontological field personnel is of paramount concern during the earthwork phase of construction. Safety procedures to be followed by field personnel will include wearing appropriate gear (e.g., high-visibility safety vests, hard hats, steel-toed boots), carrying large handheld orange flags mounted on poles, securing equipment operators' attention before entering an active cut, notifying grading personnel before beginning a salvage excavation, marking fossil discovery sites with surveyor's flagging, and using caution while driving along the construction route.

Attendance at any meetings prior to the start of each phase of work and/or daily or weekly tailgate meetings is important for discussion of mutual safety issues between paleontological field personnel and earthwork personnel.

3.2.2 Procedures for Paleontological Discoveries

The goal of paleontological monitoring is to observe excavation activities and to be onsite in the event that fossils are unearthed by excavation activities. When fossils are discovered, the procedures outlined below will be followed. Recovery methods, as well as time needed for fossil recovery, may vary depending on the types of fossils discovered (e.g., macrofossils, microvertebrate fossils, or plant fossils) and the nature of the enclosing sedimentary deposits.

3.2.2.1 Discovery process and work stoppage

In the event of a fossil discovery, the qualified paleontological monitor may immediately initiate recovery or choose to temporarily stop excavation activities at the discovery location to consult with the Project Paleontologist. When work is stopped, the Project Paleontologist will notify the appropriate personnel (e.g., Project Manager, Construction Manager) and land management agency representative (e.g., BLM, USBR, USFS, NPS, California DPR). The monitor, under direction of the Project Paleontologist, will divert, direct, or temporarily halt ground disturbing activities in the area of discovery to allow for preliminary evaluation of potentially significant paleontological resources and to determine if additional measures (i.e., collection and curation) are required.

3.2.2.2 Determination of significance

The significance of the discovered paleontological resources will be determined by the Project Paleontologist. For significant paleontological resources, a fossil recovery program will be initiated that will follow the general steps outlined below, with some refinements based on the type and nature of the specific discovery.

The fossil recovery program will largely be driven by the research themes, and will incorporate appropriate field methods for data collection to answer specific questions, as well as develop plans for the preparation, curation, and storage of recovered fossils, and data collection and post-collection phases of fossil recovery.

3.2.2.3 Macrofossil recovery

Many fossil specimens discovered during excavation monitoring are readily visible to the naked eye and large enough to be easily recognized and removed. Upon discovery of such macrofossils, the qualified paleontological monitor will temporarily flag the discovery site for avoidance and evaluation as described above. Actual recovery of unearthed macrofossils can involve several techniques including "pluck-and-run," hand quarrying, plaster-jacketing, and/or large-scale quarrying. The "pluck-and-run" technique will be used when equipment activity in the vicinity of the discovery area is heavy and immediate action is required to remove an isolated specimen so as not to slow the progress of earthwork operations. "Pluck-and-run" recovery involves exploratory probing around a partially exposed fossil specimen to determine its dimensions, the application of consolidants (e.g., Acryloid, Butvar, or Paraloid) to stabilize any damaged or weakened areas of the fossil, and removal of the specimen in a block of matrix. Hand quarrying typically consists of site specific "mining" of fossil-rich sedimentary rock layers without establishment of a geographic grid framework. Fragile fossils are stabilized as described above. Hand quarrying and the "pluck-and-run" techniques can typically be carried out in several minutes, to an hour, thus minimizing the duration of any work stoppage.

Particularly large and/or articulated vertebrate fossils (e.g., mammoth skeleton) require special handling because of their size and/or fragility and are typically recovered in a process called "plaster-jacketing." The process begins by isolating a partially exposed specimen from the temporary exposure in a matrix-supported sedimentary pedestal. The pedestal is then slightly undercut at its base to form an overhanging lip and a layer of damp newsprint or tissue paper is placed on the upper surface of the block. Strips of burlap fabric are then soaked in a mixture of Plaster-of-Paris and laid across the matrix block to dry. Depending upon the volume of the block, one, two, or more layers of plaster-soaked burlap strips are formed on the block. Especially large blocks (over two feet in length) are reinforced with wooden or metal splints. Once the plaster hardens, the supporting pedestal is undercut and the block turned over. Hand tools are then used to remove any excess matrix from the bottom of the block and a plaster and burlap cap constructed on the inverted bottom of the block using the same methods described above. When all layers of plaster are dry and hard, the completed plaster "jacket" is then labeled with a field number and north arrow and removed from the field. Depending on the size, complexity, and number of plaster jackets, recovery may require several hours to several days to complete. The discovery of a concentration of large vertebrate fossils (e.g., a bone bed) would require more time (e.g., weeks) for recovery.

3.2.2.4 Microvertebrate fossil recovery

Many significant fossils often are too small to be readily visible in the field (e.g., small mammal teeth, fish otoliths, lizard limb bones), but are nonetheless significant and worthy of attention because of their potential to provide information concerning paleoenvironments, paleoclimates, and geologic age. If sedimentary horizons are observed that either contain microvertebrate fossils, or appear to have high potential to contain such fossils, these horizons shall be sampled by collecting bulk quantities of sedimentary matrix. These bulk matrix samples then undergo laboratory processing in order to isolate the microfossils. Specific procedures for recovery of microvertebrates are described below. Once a bulk matrix sample has been collected and removed from the Project, earthwork activities can resume.

For microvertebrate fossils (e.g., small mammal, bird, reptile, amphibian, or fish remains) guidelines developed by the Society of Vertebrate Paleontology (SVP, 2010) define an adequate sample as comprising "…4.0 cubic meters (6,000 lbs. or 2,500 kg) of matrix for each site, horizon or paleosol," but note that "...the uniqueness of the microvertebrate fossils recovered may justify screen washing even larger amounts…" as determined by the Project Paleontologist. However, conditions in the field may be such that recovery of a 6,000 lbs. matrix sample is not possible, and a smaller matrix sample may be collected at the discretion of the Project Paleontologist. In some cases, microvertebrate fossil sites will occur within a layered sequence of strata that may yield several individual microvertebrate fossil horizons. A maximum of one bulk matrix sample per fossil horizon shall be collected. This sample shall be assumed to contain a representative assemblage of fossils preserved in that fossil horizon. For each sample collected, it is recommended that a 200 lb. (90 kg) subsample be initially processed to determine the fossil productivity of the larger sample. Generally, if five or more complete mammal teeth are recovered from the subsample, the remainder of the sample shall be processed. If fewer teeth are recovered, processing shall cease.

3.2.2.5 Paleobotanical fossil recovery

Paleobotanical specimens typically occur in fine-grained, laminated strata (e.g., shale) and will require special recovery techniques. When fossil plant sites are discovered, they initially will be evaluated in terms of fossil preservation, specimen abundance, and taxonomic diversity to determine the level of sampling. For sites with well-preserved and relatively complete leaves, an adequate sample shall aim to recover at least 20 specimens of each recognized leaf type (species or morphotypes). Large blocks (>2 feet in diameter) of sedimentary rock typically can be hand quarried from the temporary outcrop and then split along bedding planes to reveal compressed fossil plant material (e.g., leaves, stems, and flowers). Individual slabs are then wrapped in tissue paper or newsprint to minimize destruction of the fossils during desiccation. In some cases, specimens that are delaminating or flaking may need to be coated with special consolidants (e.g., Vinac or Butvar). Once an adequate sample has been collected and removed from a paleobotanical discovery site, excavation activities can resume.

3.2.2.6 Time required for fossil recovery

The vast majority of fossil salvages can be accomplished relatively quickly, requiring a few minutes to a few hours of focused recovery work to complete. However, recovery of large vertebrate fossils or concentrations of vertebrate fossils may require several days to weeks to complete. In many cases, fossil recovery may be expedited through the temporary use of on-site heavy equipment to remove sedimentary "overburden," collect bulk matrix samples, and/or lift plaster jackets. Avoiding or minimizing project delays can be achieved by diverting earthwork operations to other areas of the project while fossil recovery work is under way.

3.2.3 Annual Reporting

Annual reports may be required as a condition of the various federal and state permits held by the Project Paleontologist. The information required in the annual report is typically outlined in detail in the approved permit package, but typically includes a summary of the areas monitored to date, the observed stratigraphy, and preliminary reporting of any fossils that have been collected. Reports should be submitted to the appropriate agency, as required.

3.3 After Earthwork

In the event fossils are discovered and salvaged, the fossils will be prepared, identified, catalogued, and stored in the designated repository, and a final paleontological mitigation report written that summarizes the results and findings of paleontological monitoring. If no fossils are salvaged over the course of monitoring, an abbreviated final paleontological mitigation report will be prepared.

3.3.1 Fossil Preparation

Fossil remains collected during the monitoring and salvage portion of each phase of the project will be cleaned, repaired, and/or screen washed as described below. Fossil preparation may be conducted at the laboratory of the contracted Project Paleontologist or the designated repository, and shall follow the standards of the designated repository. Prior to commencement of work, an estimate of fossil preparation costs will be developed based on the number and type of specimens, preparation labor rates, and preparation supply needs.

3.3.1.1 Manual specimen preparation

Preparation of fossil specimens will involve removal of extraneous and concealing sedimentary matrix from specimens using various mechanical methods including pneumatic air scribes, micro-sandblasters, and simple hand tools (hammers, chisels, X-acto knives, brushes, dental picks, and pin vises). Fossil preparation will also involve consolidation of fragile or porous specimens by the application of specialized media including polyvinyl acetate resins (e.g., Vinac), acrylic resins (e.g., Acryloid), or polyvinyl butyral resins (e.g., Butvar). Repair of broken/damaged specimens will require the use of various adhesives including cyanoacrylate glues (e.g., Zap) polyvinyl acetate emulsions (e.g., carpenter's glue), and polyvinyl butyral resins (e.g., Butvar).

3.3.1.2 Screen washing

Recovery of microvertebrate fossils will be accomplished by screen washing bulk samples of fossil-bearing sedimentary matrix. The process begins by breaking large blocks into 2–3 cm cubes to facilitate air-drying of the matrix. Once dry, the matrix is placed into water-filled 5 gallon plastic buckets to soak for no less than 15 minutes with regular stirring. The slurry is then poured onto nested 20 (0.84 mm openings) and 30 (0.59 mm) mesh stainless steel screens placed in water-filled troughs. Manual agitation of the screens forces the fine clays and silts through the mesh and concentrates the coarser sand and fossil material on the screens. The screens are then placed at a tilt facing the sun to dry. Once dry, the coarse concentrate is transferred into plastic sample bags and labeled with all pertinent site locality data.

3.3.1.3 Heavy liquid floatation

Screen washed concentrates can be further concentrated by the use of heavy liquids (e.g., Lithium Metatungstate) to concentrate particles of equal density. This process involves the use of a heavy plastic container to hold the heavy liquid, which is calibrated to a standard density of ~2.6 g/cm^3 (density at which a quartz crystals begin to float). Measured subsamples of sediment are then poured into the beakers and stirred to create an even distribution of material. The sediment-heavy liquid mixture is allowed to set until complete separation of the heavy minerals (and fossils) from the lighter (and more numerous) quartz and feldspar grains occurs. A fine sieve (30 mesh) is then used to skim off the floating light fraction, and then the remaining solution is poured through a second sieve to recover the heavy concentrate containing the fossil bones and teeth. After rinsing with distilled water, the concentrate is left to dry. This separation process produces a very rich concentration of fossil remains, typically isolated teeth of small vertebrates (e.g., fish, rodents).

Following screen washing and heavy liquid flotation, the fossil concentrate is examined under a microscope for manual “picking” of identifiable microfossils (e.g., teeth and bones of small reptiles and mammals). If necessary, residual amounts of matrix will be removed with a pin vise, and broken fossils repaired under the microscope.

3.3.1.4 Paleobotanical specimen preparation

Preparation of plant fossils will involve carefully splitting slabs of mudstone/siltstone matrix along laminations to reveal individual or composite leaf impressions. Any remaining matrix still obscuring the impressions will then be removed with X-acto knives or other fine-scale preparation tools. The exposed impressions may also require stabilization with specialized media (e.g., Vinac or Butvar).

3.3.2 Fossil Curation

Following preparation of salvaged fossil remains, the specimens will be sorted/picked, identified, and catalogued as described below. Fossil curation may be overseen by the contracted Project Paleontologist, or by the designated repository, and shall follow the standards of the designated repository. Prior to commencement of work, an estimate of fossil curation costs will be developed based on number and type of specimens, curation labor rates, curation supply needs.

3.3.2.1 Sorting

Fossils require sorting to group together specimens of the same taxon (e.g., species and/or genus) into individual taxon lots. For vertebrate microfossils, primarily isolated teeth and jaw fragments, curation may also involve “pinning” specimens by securing individual teeth onto the heads of pins with microcrystalline wax. These pins are inserted into corks that are then placed in glass vials, thereby protecting the fossil tooth.

3.3.2.2 Taxonomic Identification

Once sorted, individual taxon lots will be identified to the lowest taxonomic level practical (e.g., family, genus, and/or species).

3.3.2.3 Cataloguing

Sorted and identified specimens are then assigned unique specimen catalogue numbers and entered into an electronic catalogue database. A specimen number may represent a single fossil specimen or a batch of specimens belonging to a single species. Catalogue numbers are written on individual specimens using India ink on a patch of white acrylic paint. Curation also involves placement of taxon lots into archival specimen trays with labels containing relevant taxonomic, geologic, and geographic information.

3.3.2.4 Locality data

Formal descriptions of fossil collection locality records, including geographic, geologic, taphonomic, and collection data, need to be compiled and stored electronically with the specimen catalogue data.

3.3.3 Fossil Storage

Recovered fossils will be professionally curated and stored in the designated professional repository, as outlined in Section 3.1.3. For any fossils recovered from federally-managed lands, ownership of the fossils will be retained by the appropriate federal or state agency (e.g., BLM, USBR, USFS, NPS, or California DPR).

Adequate storage shall include conservation of specimens in a stable environment away from flammable liquids, corrosive chemicals, organic materials subject to mildew, and sources of potential water damage. Typically, this is accomplished by placing curated specimens in archival quality steel drawers and cabinets, which are housed in climate-controlled collection rooms. Specimens shall be available for study by future researchers, students, and citizen scientists, and thus shall be stored in a fashion that allows for retrieval of individual specimens and associated collection data. Specimen storage shall be accompanied by supporting data (e.g., field notes, GPS data, photographs, geologic maps, stratigraphic reports) and fossil preparation data (e.g., description of preparation techniques and materials used for individual specimens).

3.3.4 Final Paleontological Monitoring Report

After the completion of construction earthwork, a final paleontological monitoring report (PMR) will be completed that presents the results of the implementation of the PMDP. In the event that fossils are recovered, the report will include discussions of the methods used, stratigraphic section(s) exposed, fossils collected, and significance of the recovered fossils relative to the research themes and questions. A complete inventory of salvaged, prepared, and curated fossils will be included. In the event that no fossils are recovered, an abbreviated technical report that summarizes the field methods used and stratigraphy exposed will be completed. Any recommendations for future monitoring along the Project alignment based on observations made during the monitoring program (e.g., the extent of artificial fill, or revisions to the PFYC ranking of underlying geologic units) should be incorporated into the PMR. The PMR will be submitted to appropriate land management agency (e.g., BLM, USBR, USFS, NPS, California DPR) for review and approval. Approval of the PMR will serve as the final step in the program.

4.0 References

Bureau of Land Management (BLM). 2007. Potential Fossil Yield Classification (PFYC) System for Paleontological Resources on Public Lands. Instruction Memorandum No. 2008-009, released October 15, 2007.

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PaleoServices, San Diego Natural History Museum. 2020. Paleontological Resources Technical Report, Digital 299 Broadband, Humboldt, Trinity, and Shasta Counties, California. Prepared for Transcon Environmental, Inc., dated 10 March 2020.

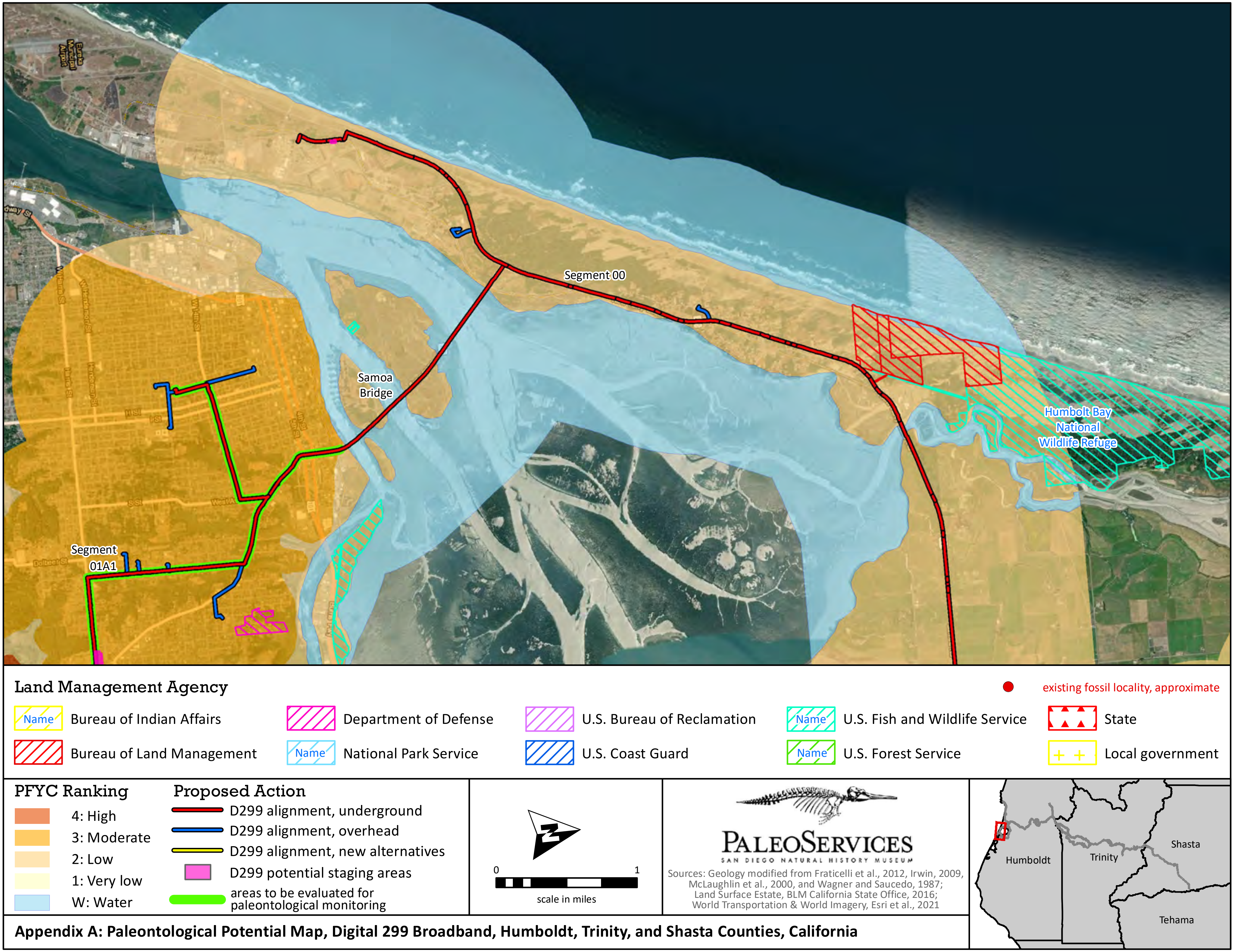
PaleoServices, San Diego Natural History Museum. 2021. Paleontological Resources Technical Report Addendum – Assessment of New Digital 299 Broadband Alternatives. Prepared for Transcon Environmental, Inc., dated 28 April 2021.

Society of Vertebrate Paleontology (SVP). 2010. Standard Procedures for the Assessment and Mitigation of Adverse Impacts to Paleontological Resources. Society of Vertebrate Paleontology, p. 1-11.

United States Department of Agriculture, Forest Service (USFS). 1996. Appendix J. Probable Fossil Yield Classification (PFYC). Developed by the Forest Service's Paleontologic Center of Excellence and the R-2 Paleontology Initiative. J1-J9.

Appendix A

Paleontological potential map, showing locations along the Proposed Action route requiring paleontological monitoring.



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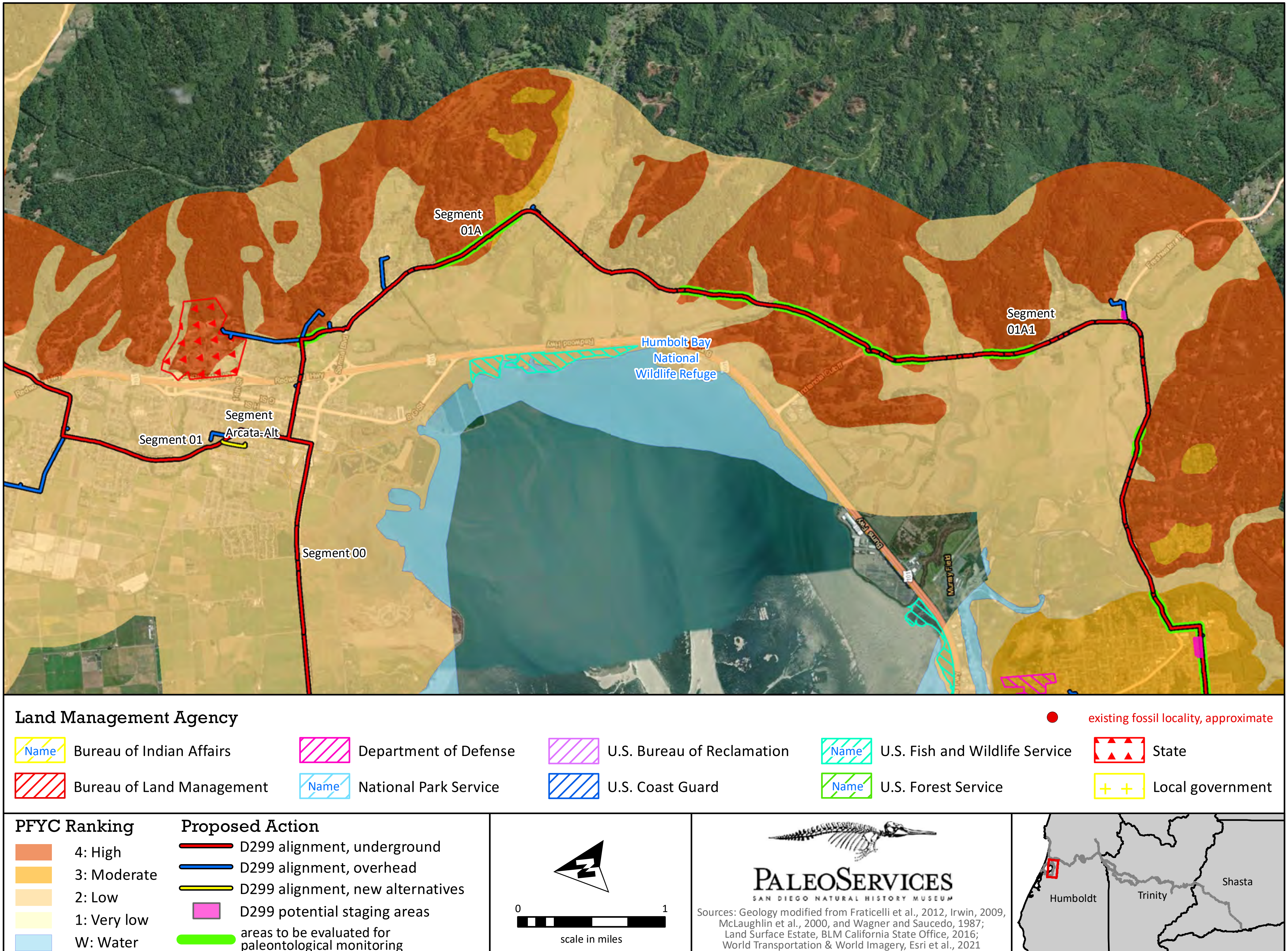

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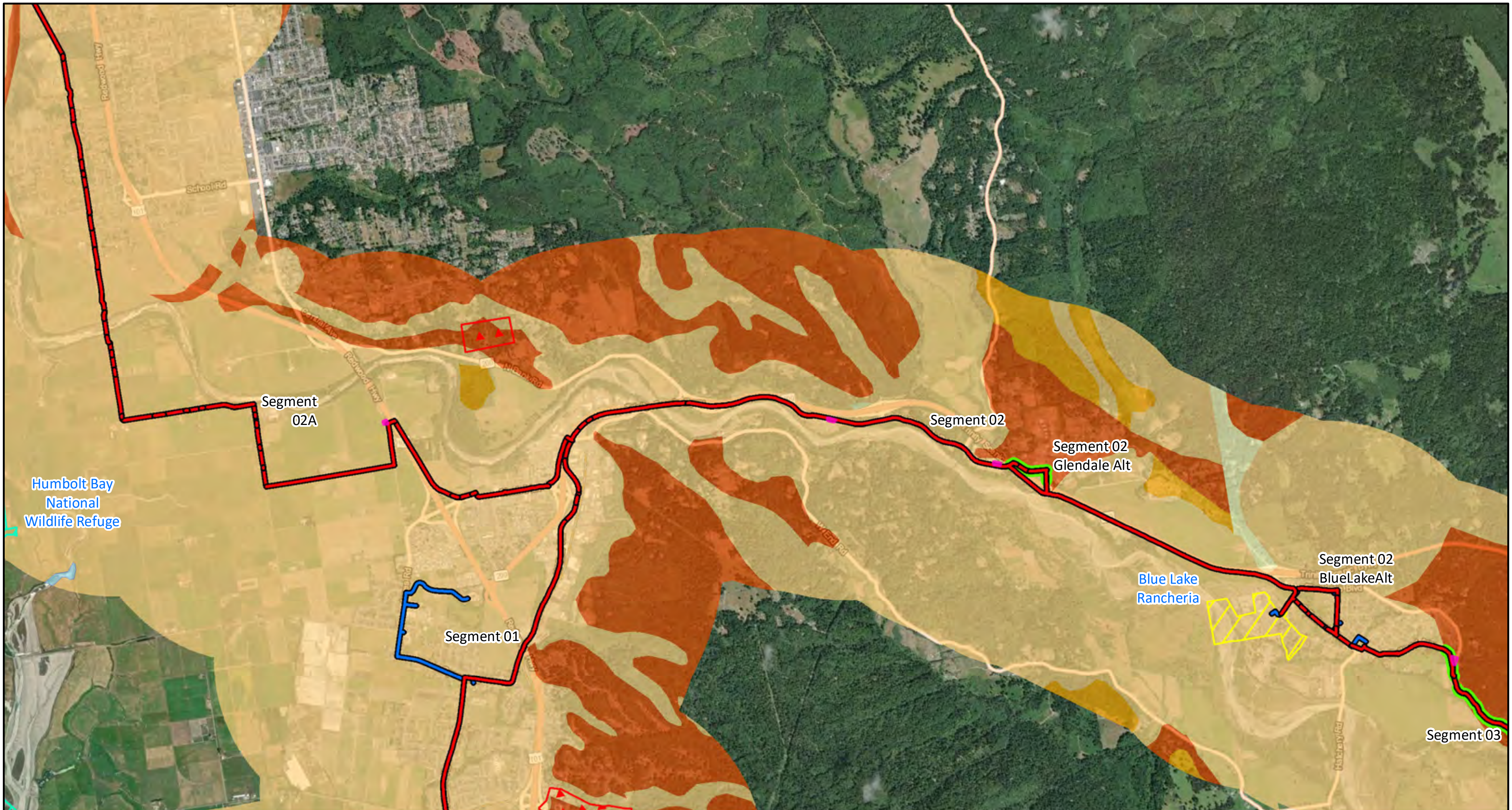

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PFYC Ranking

- 4: High
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- W: Water

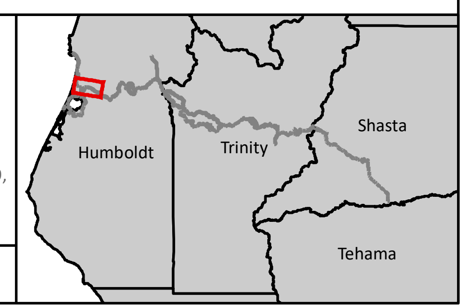
Proposed Action

- D299 alignment, underground
- D299 alignment, overhead
- D299 alignment, new alternatives
- D299 potential staging areas
- areas to be evaluated for paleontological monitoring

0 1
scale in miles

PALEOSERVICES
SAN DIEGO NATURAL HISTORY MUSEUM

Sources: Geology modified from Fraticelli et al., 2012, Irwin, 2009, McLaughlin et al., 2000, and Wagner and Saucedo, 1987; Land Surface Estate, BLM California State Office, 2016; World Transportation & World Imagery, Esri et al., 2021



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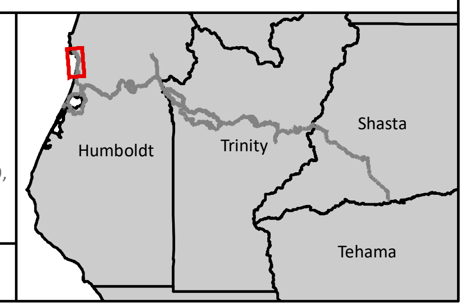

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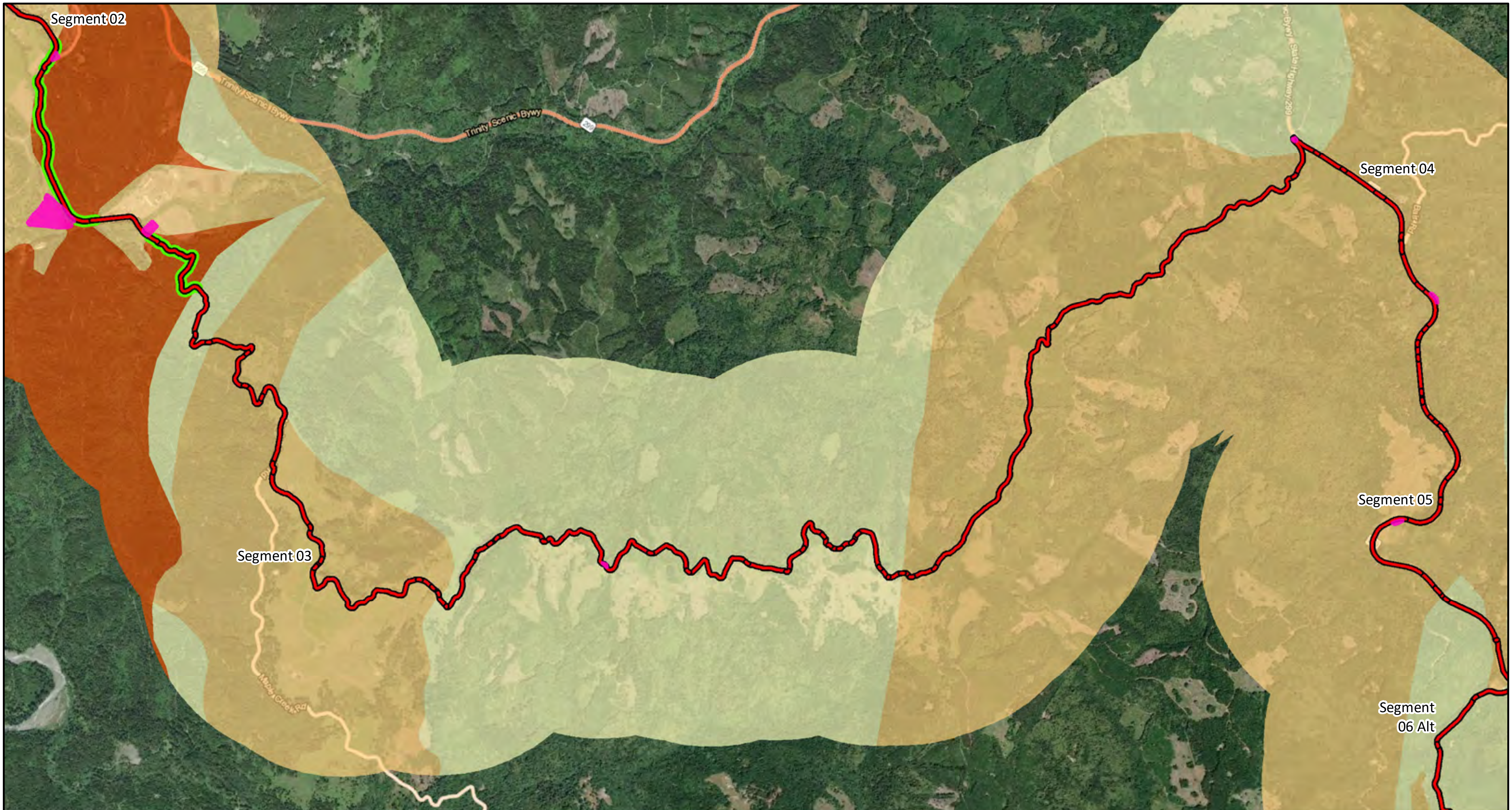

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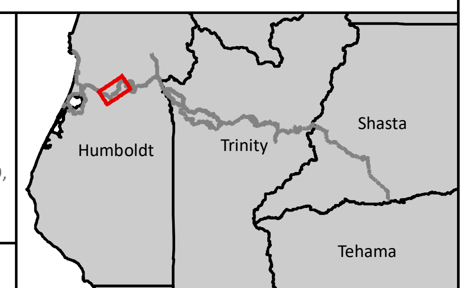

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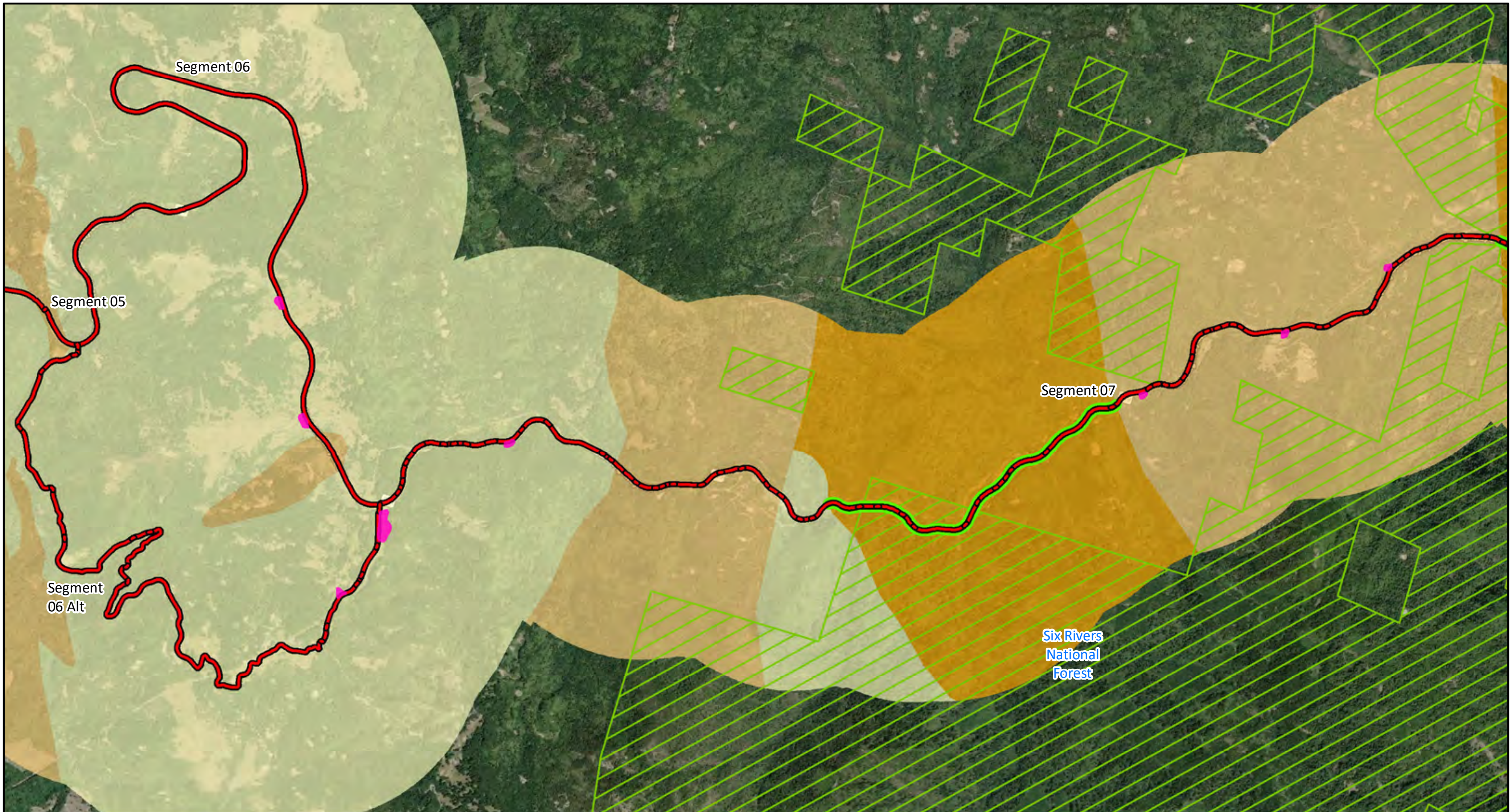

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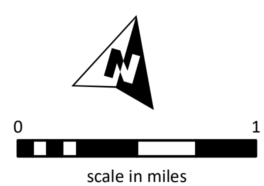

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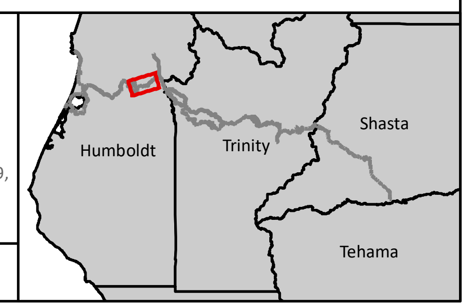

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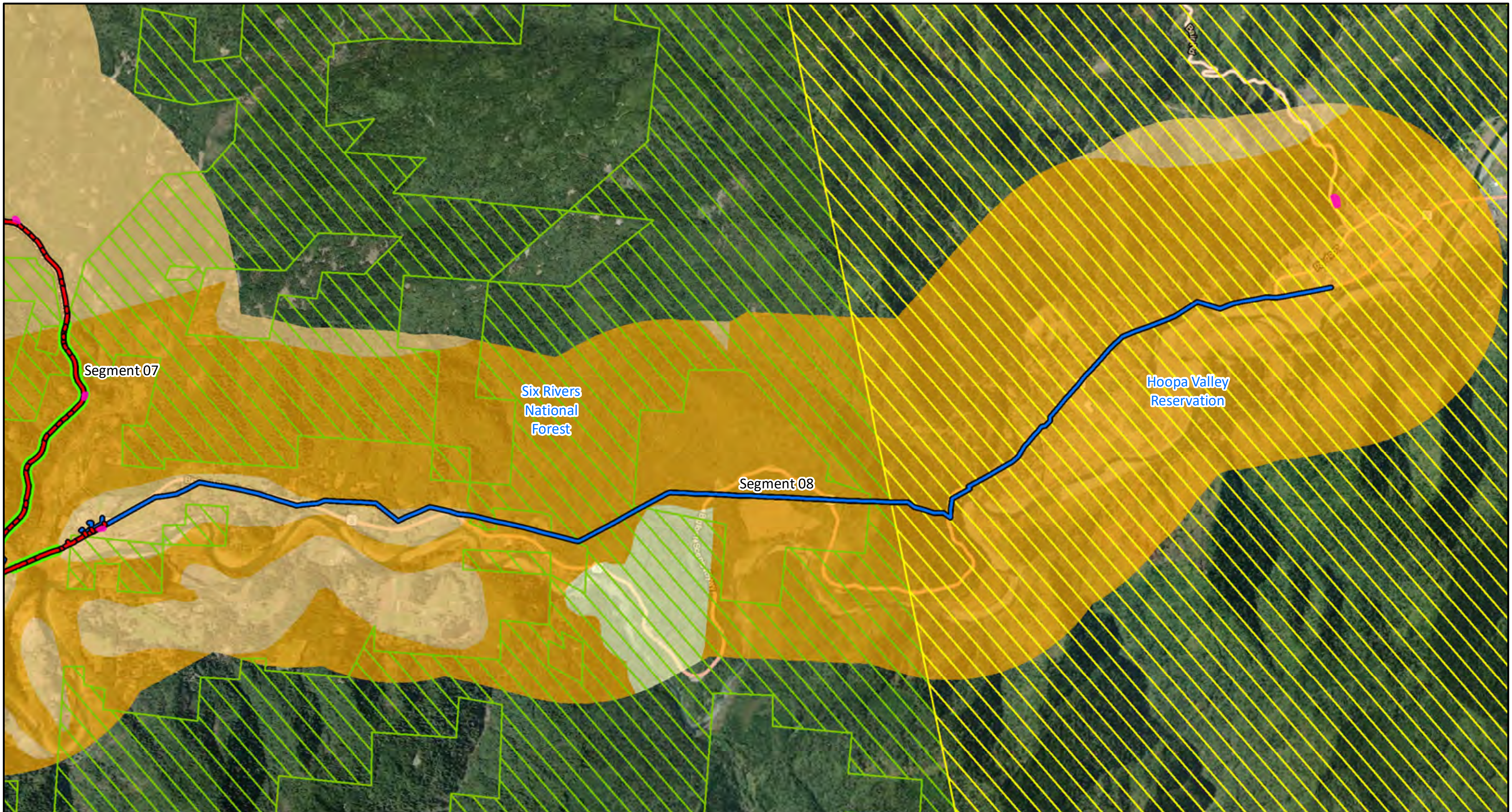

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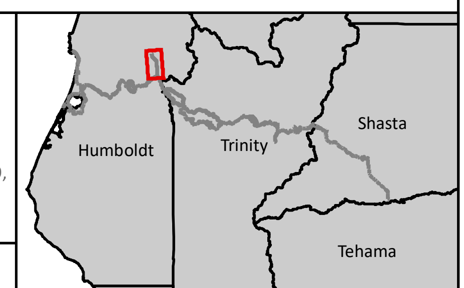

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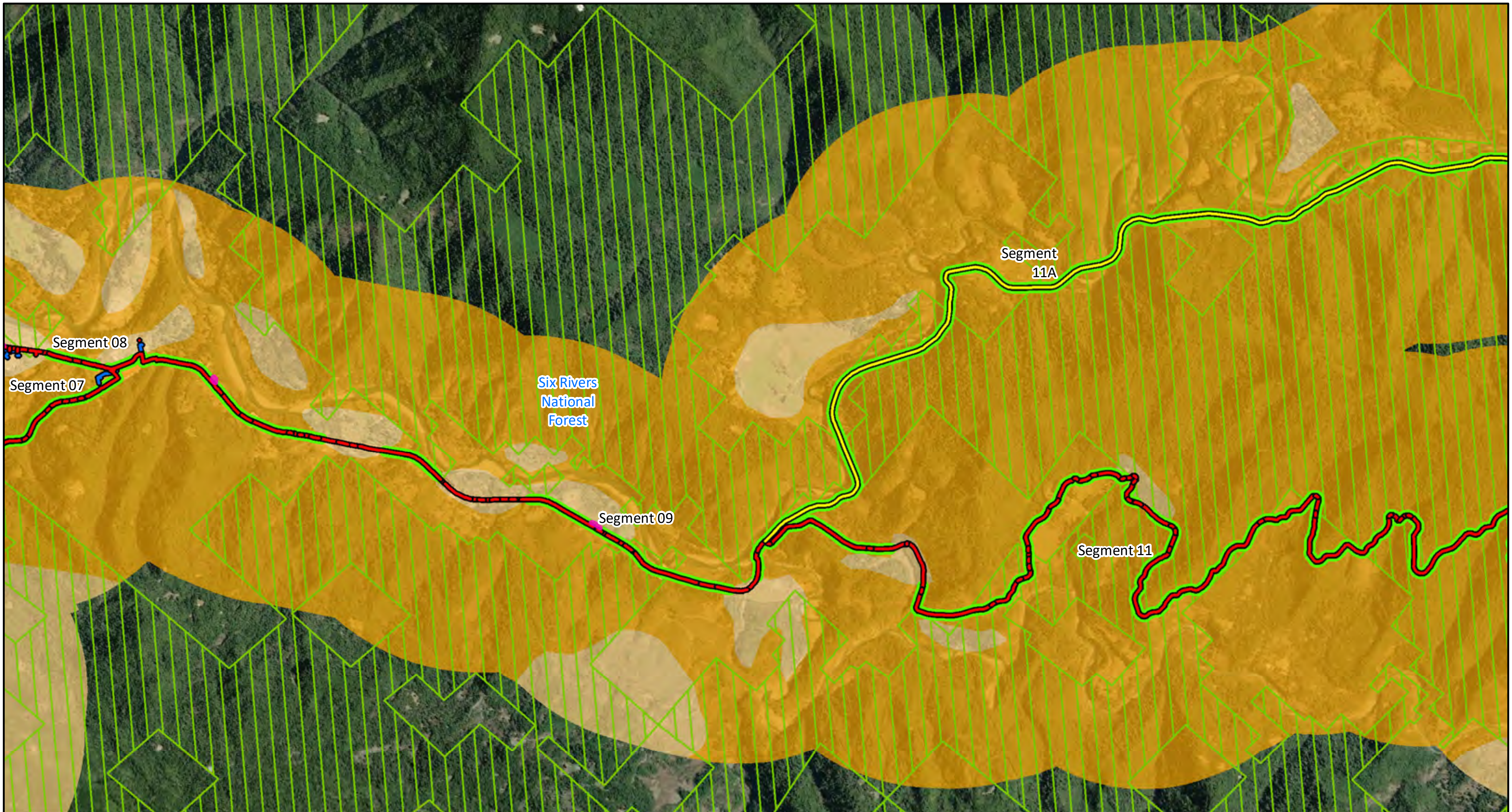

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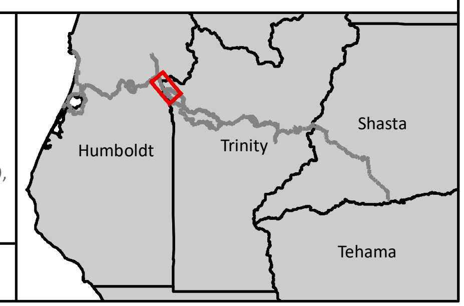

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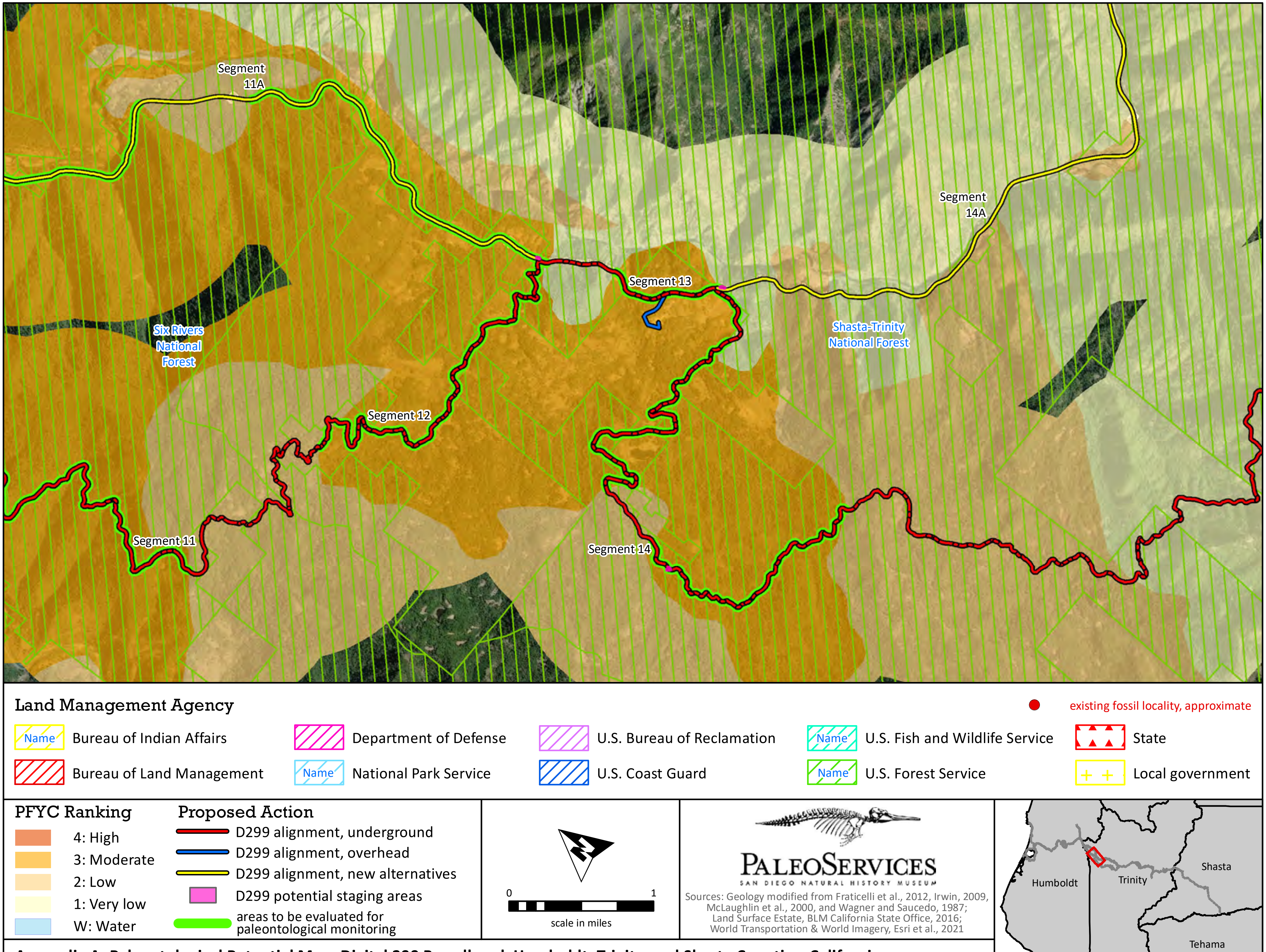

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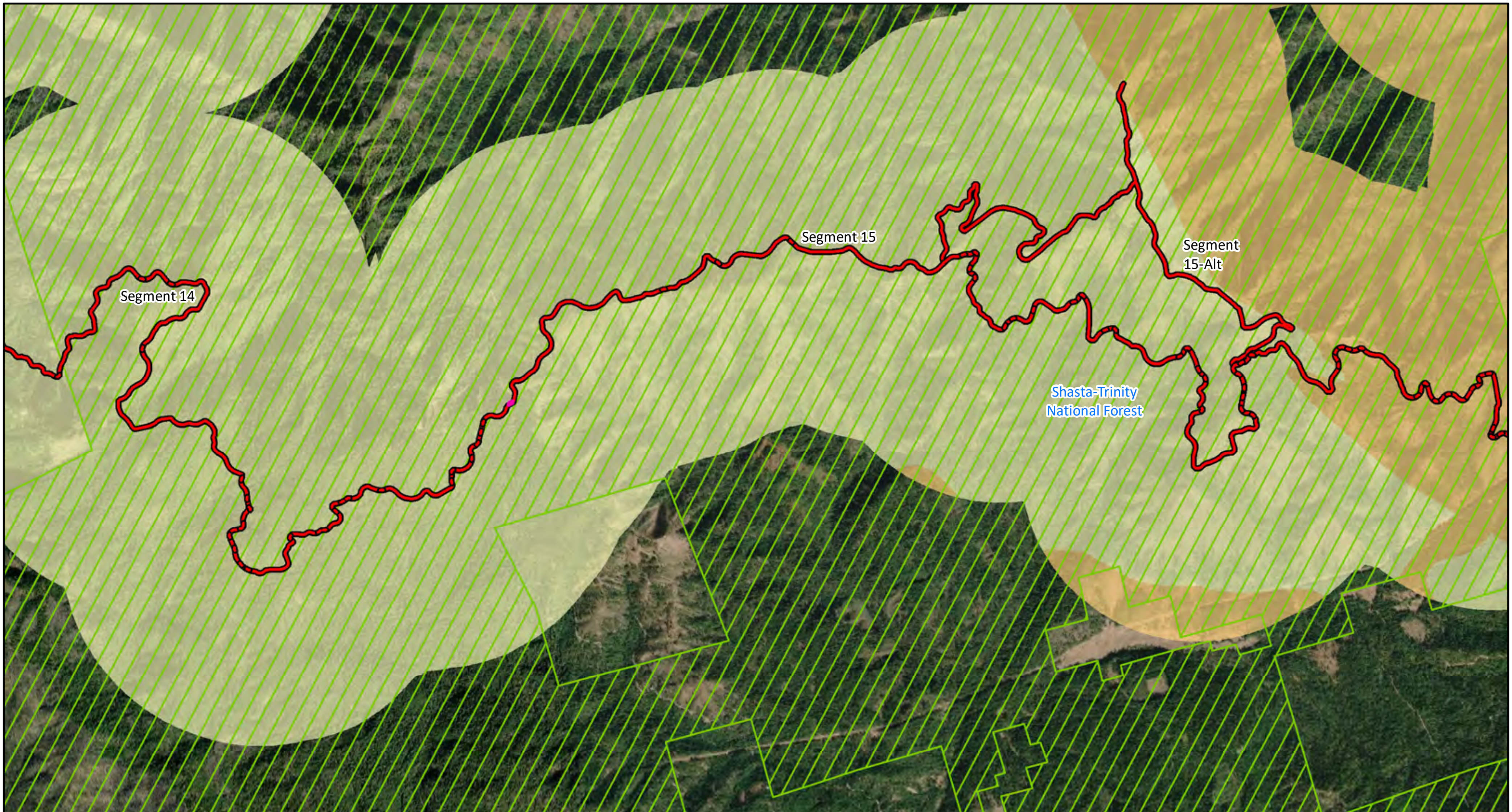

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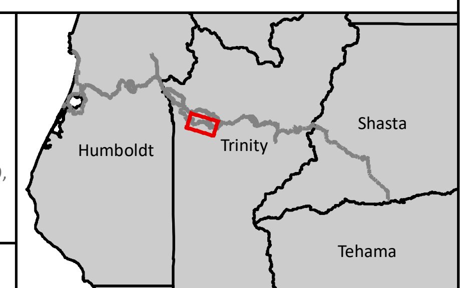

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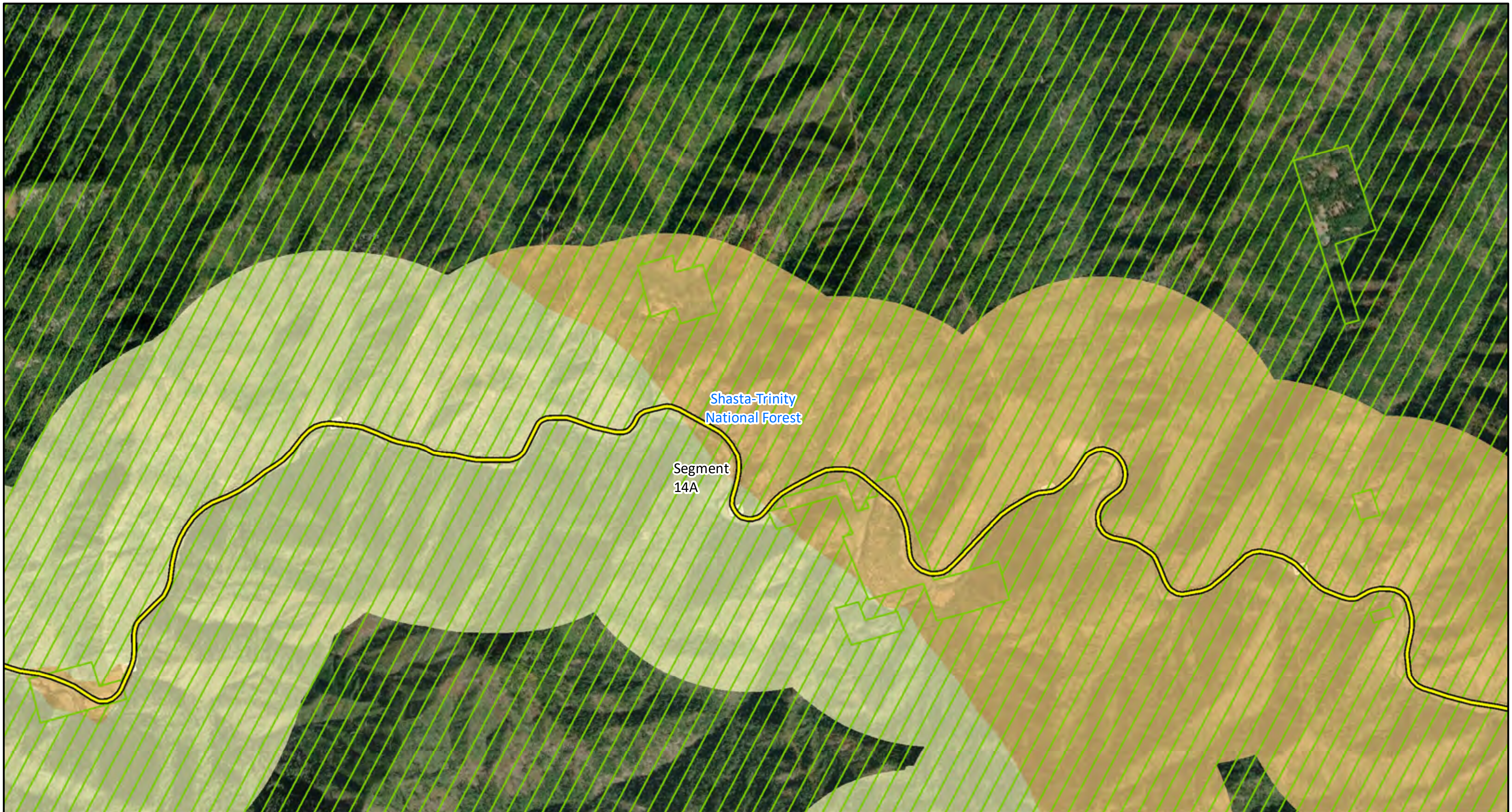

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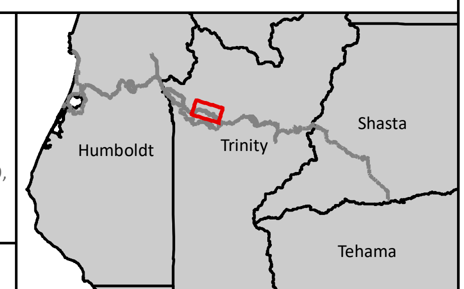

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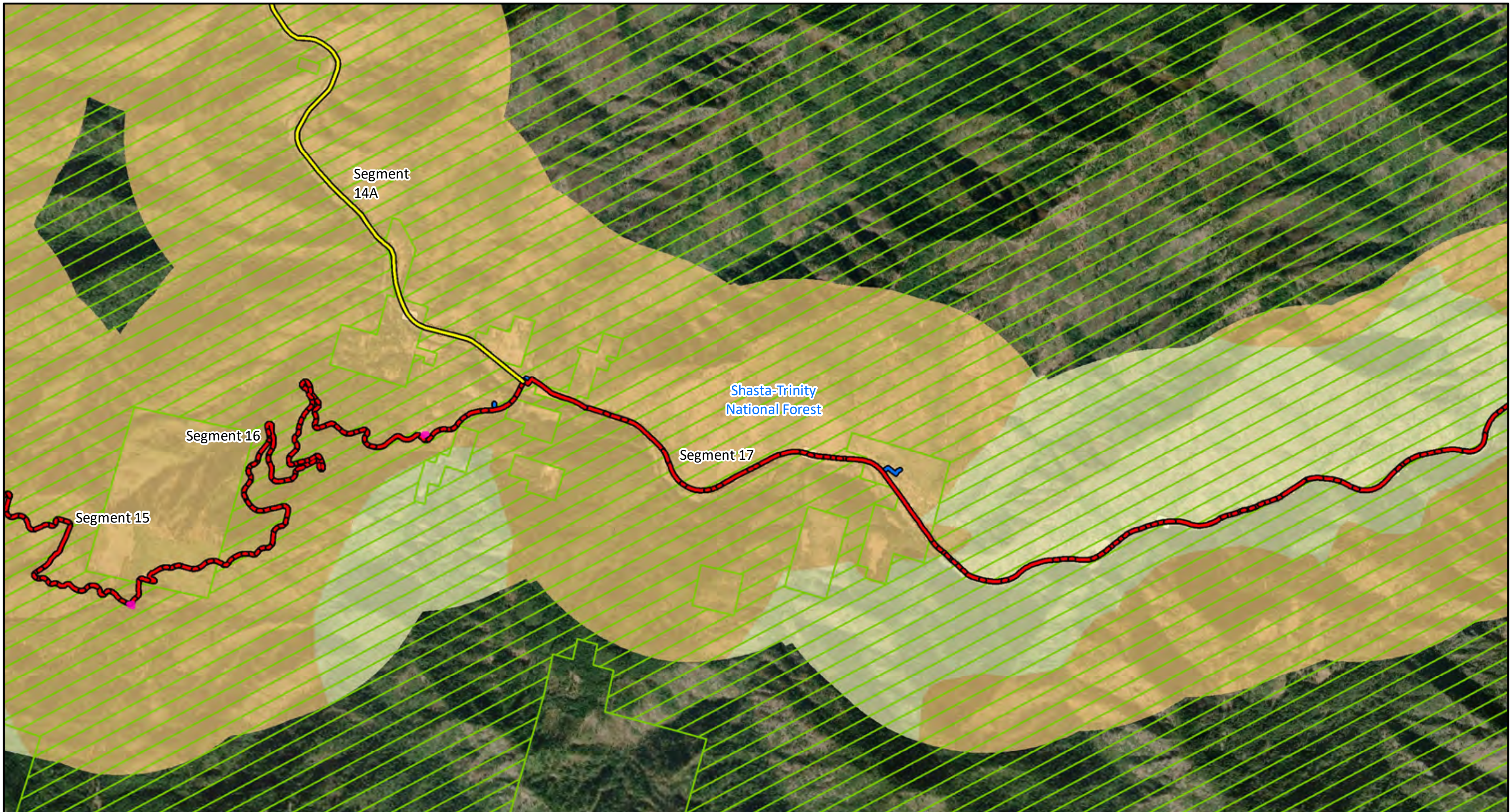

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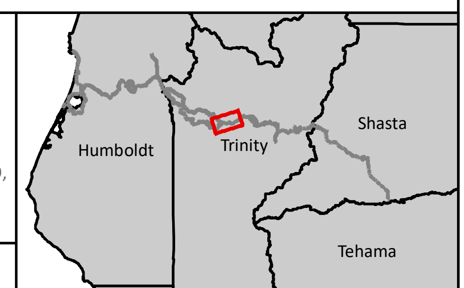

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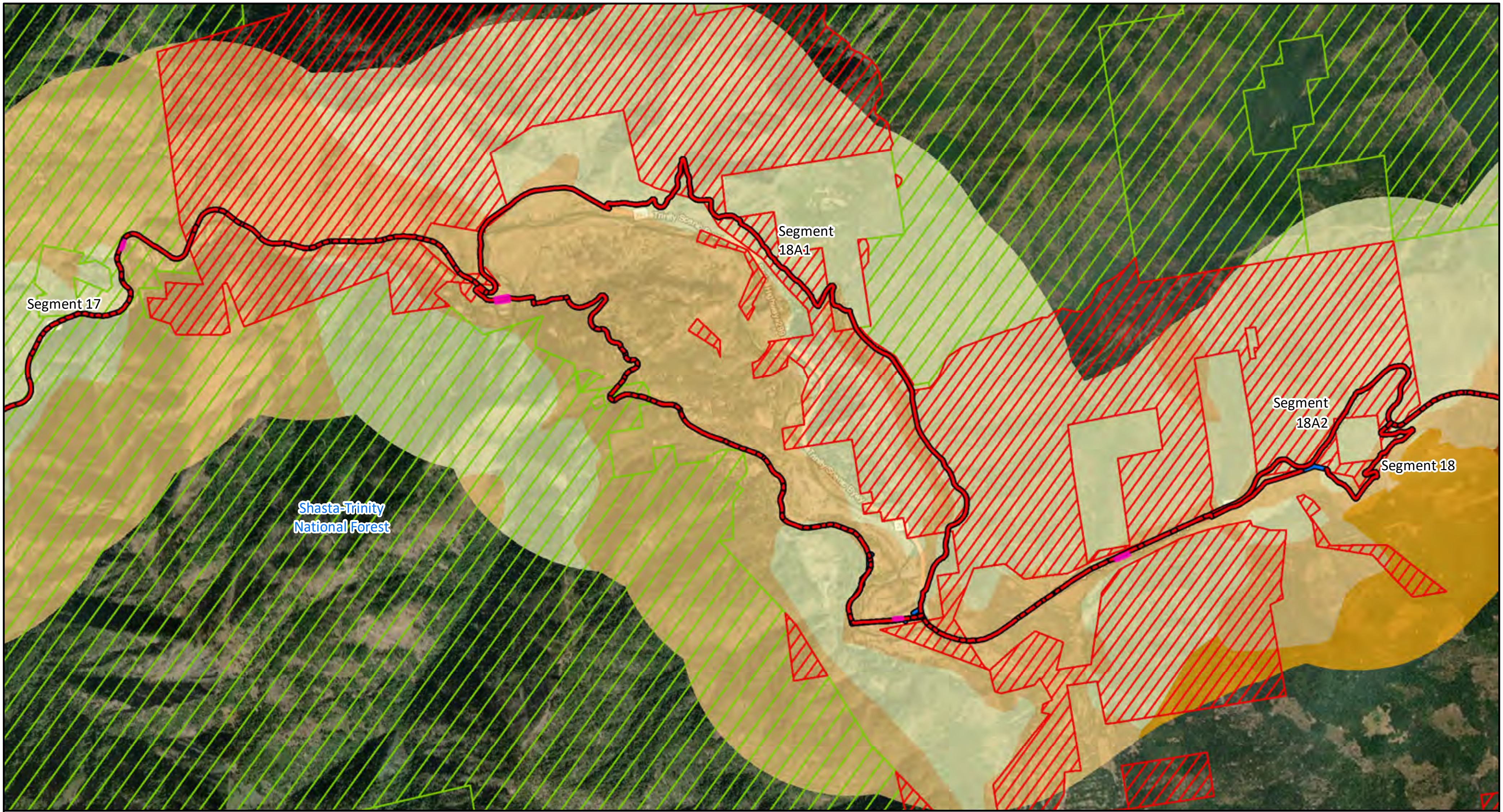

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Proposed Action

- D299 alignment, underground
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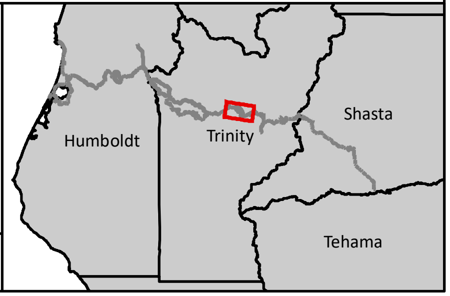
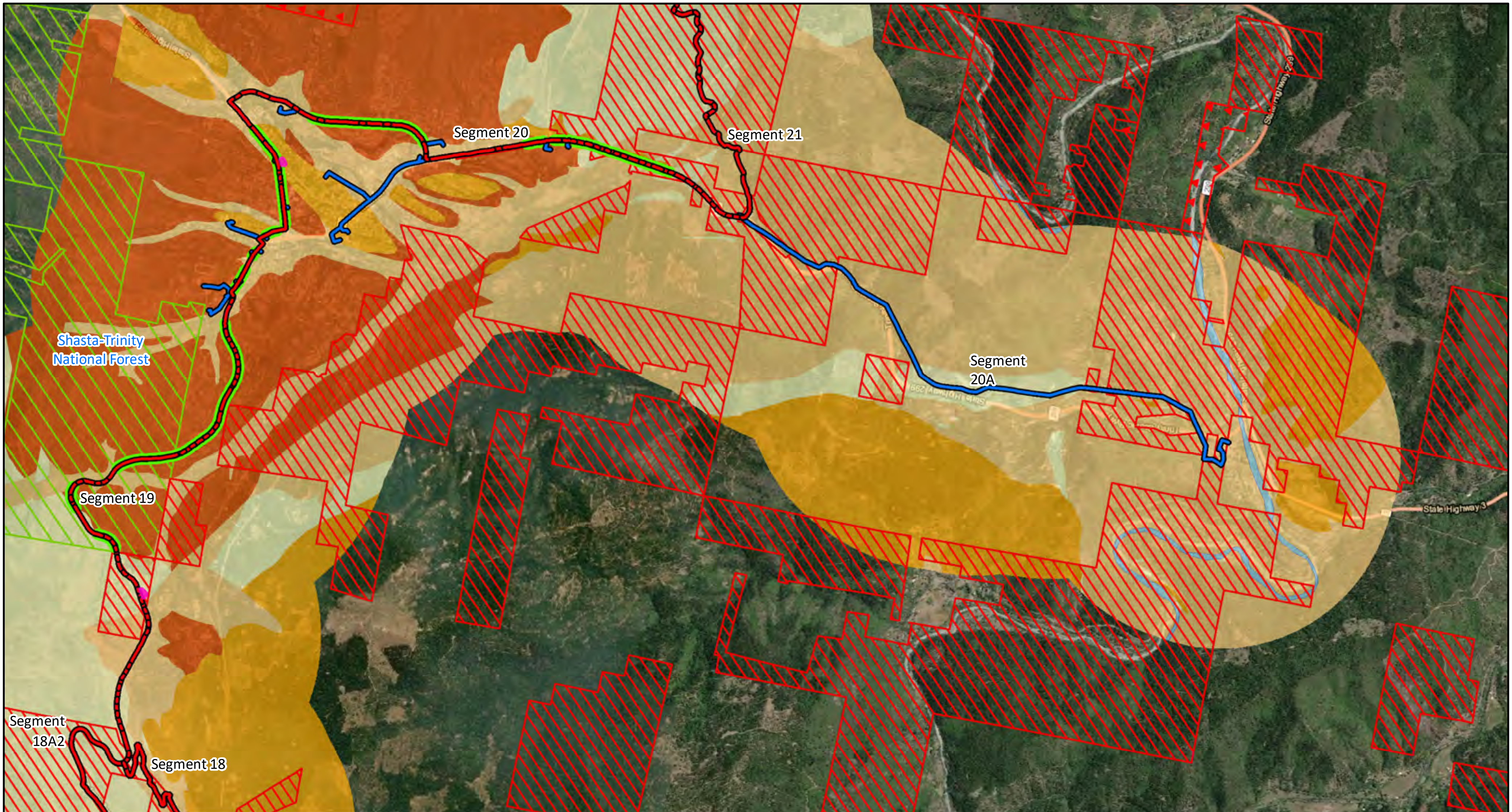
0 1
scale in miles

PALEOSERVICES
SAN DIEGO NATURAL HISTORY MUSEUM

Sources: Geology modified from Fraticelli et al., 2012, Irwin, 2009, McLaughlin et al., 2000, and Wagner and Saucedo, 1987; Land Surface Estate, BLM California State Office, 2016; World Transportation & World Imagery, Esri et al., 2021



Appendix A: Paleontological Potential Map, Digital 299 Broadband, Humboldt, Trinity, and Shasta Counties, California



Land Management Agency

- existing fossil locality, approximate
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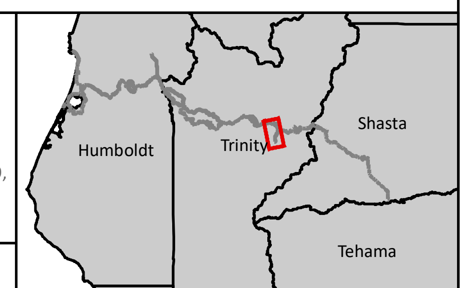

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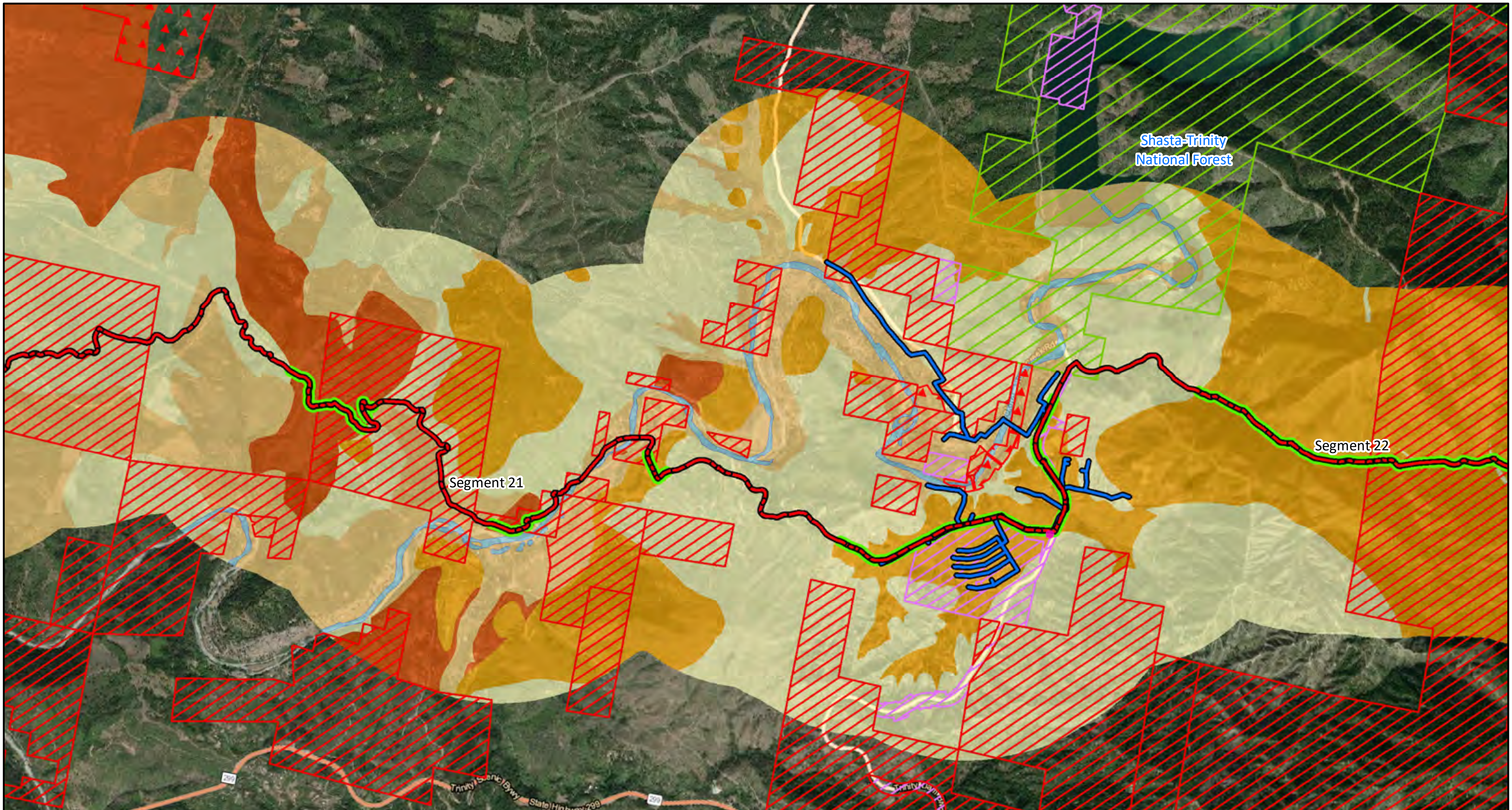

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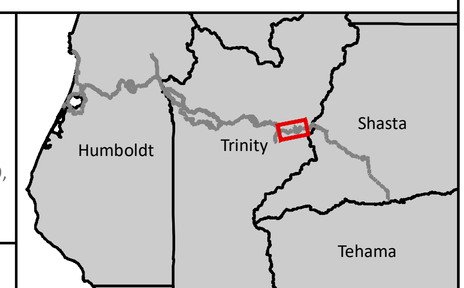

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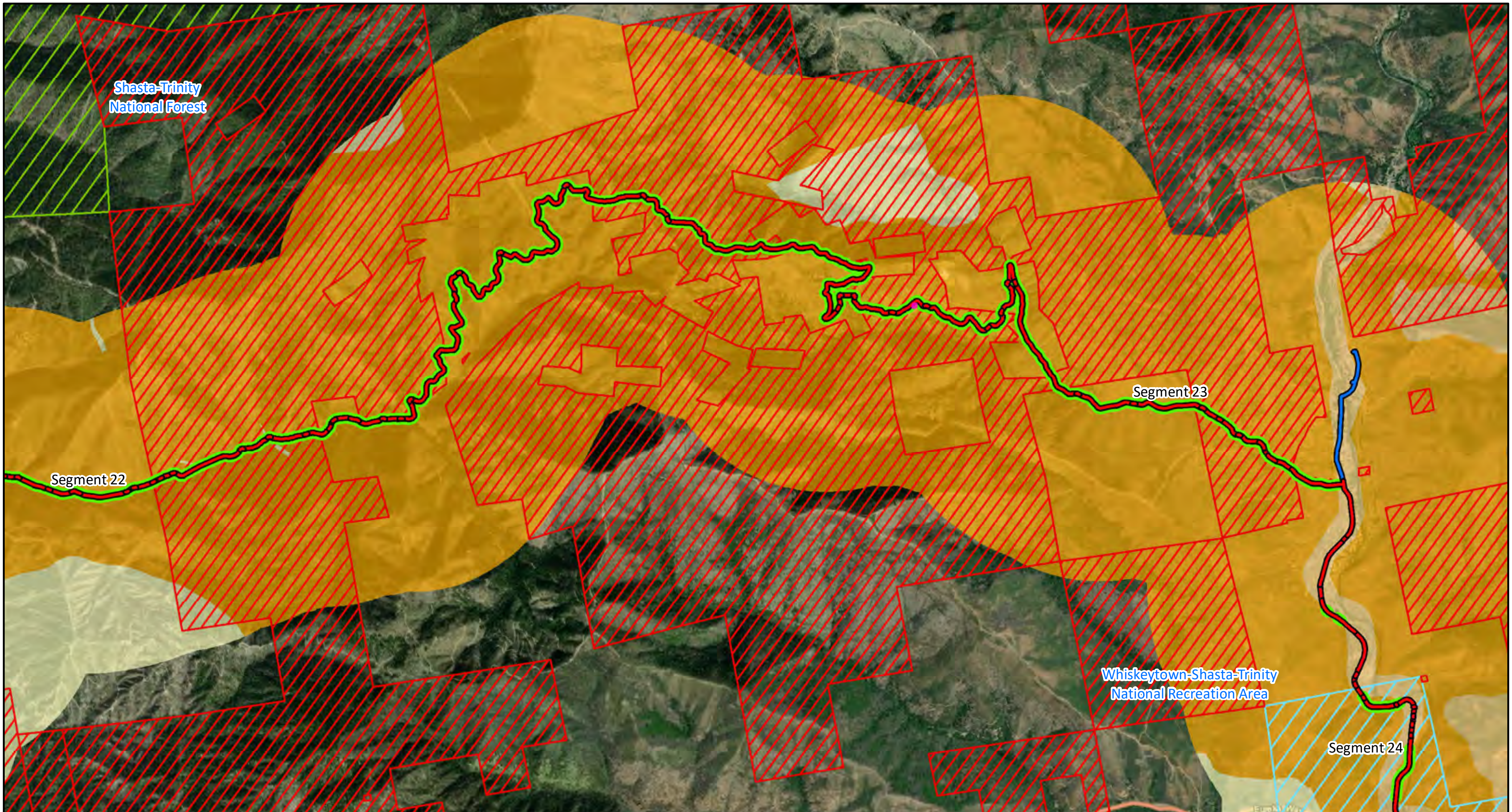

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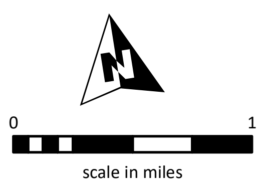

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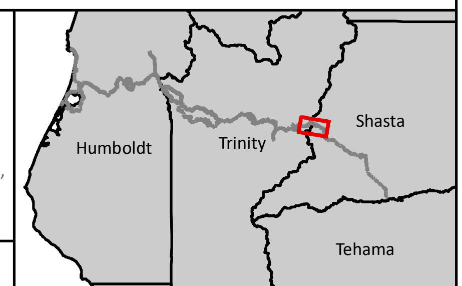

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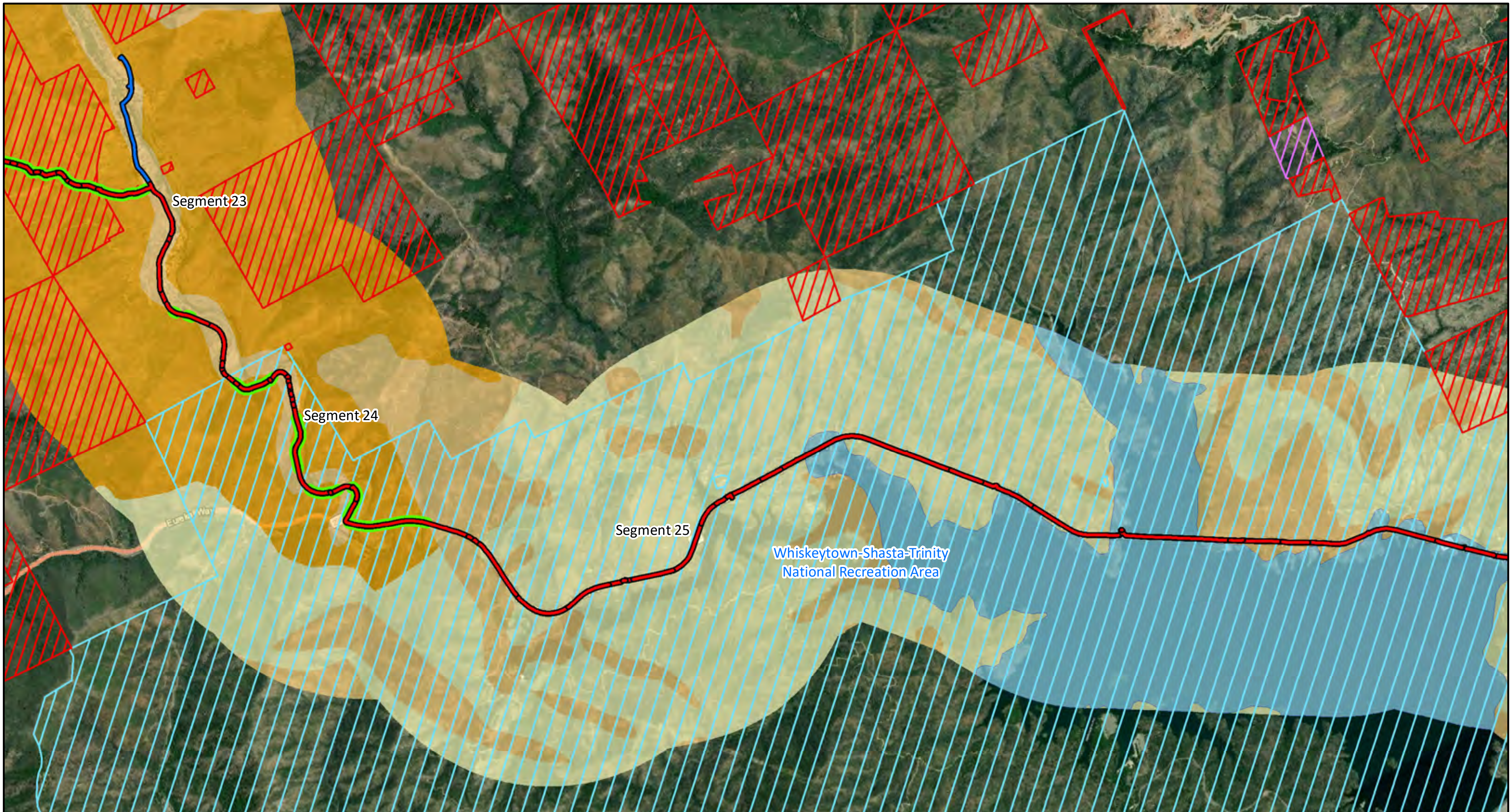

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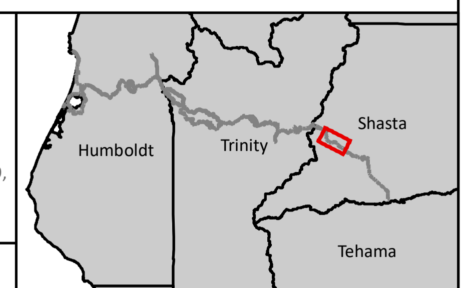

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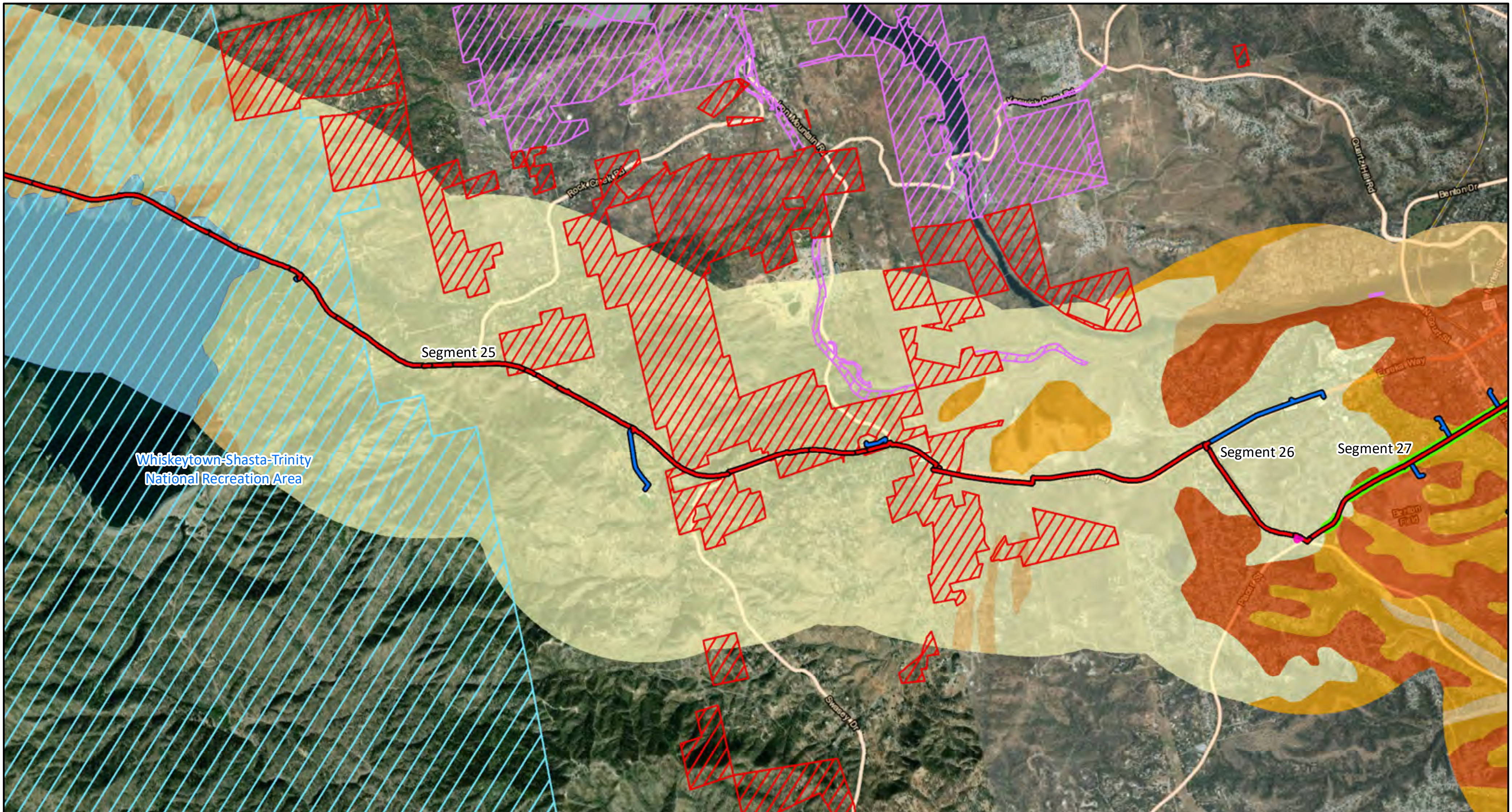

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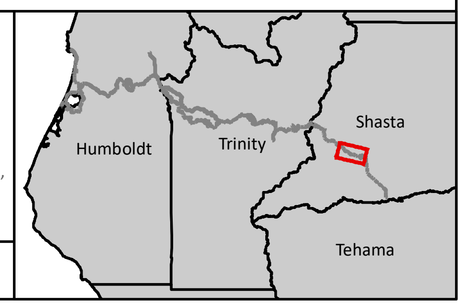

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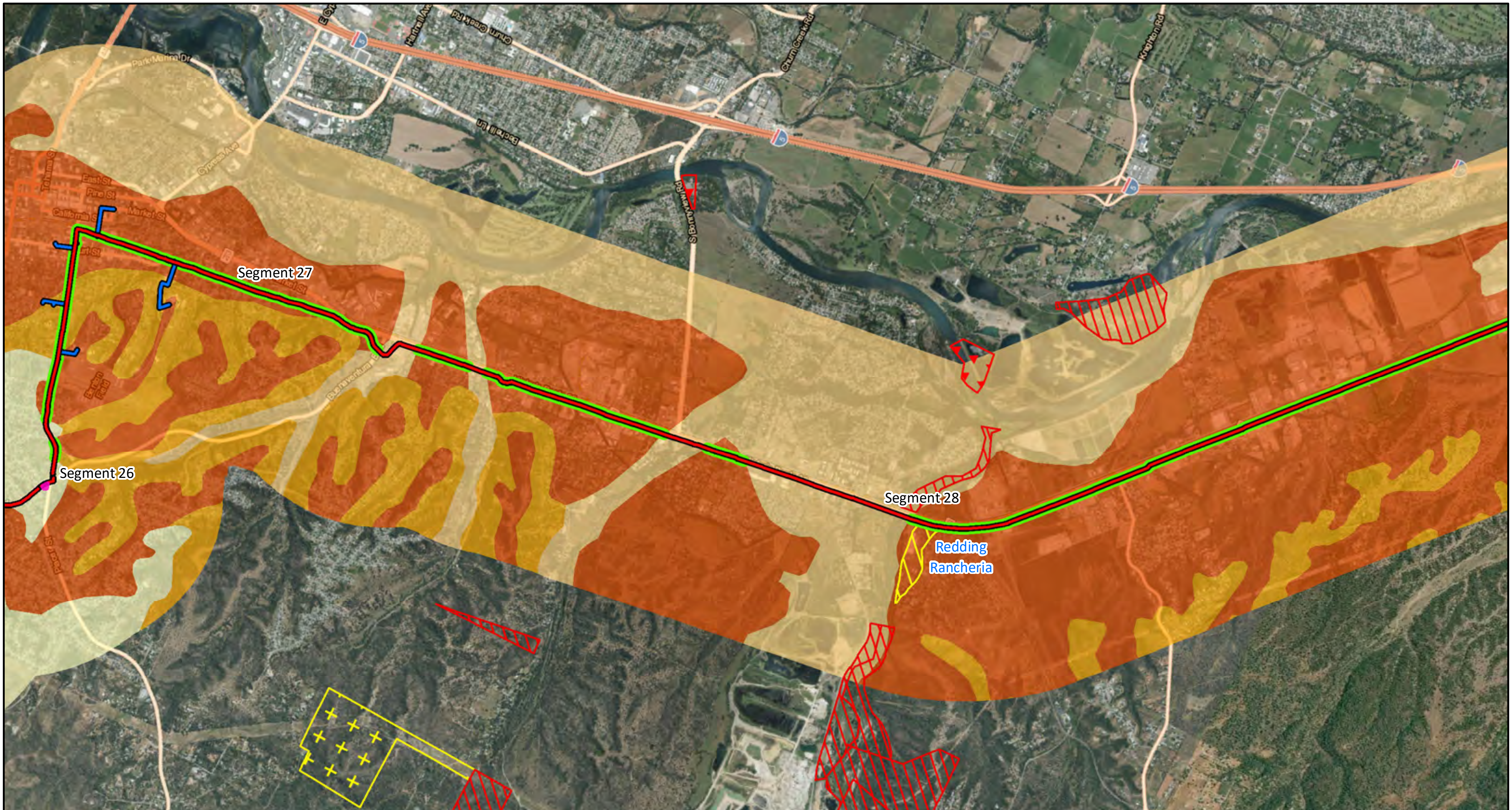

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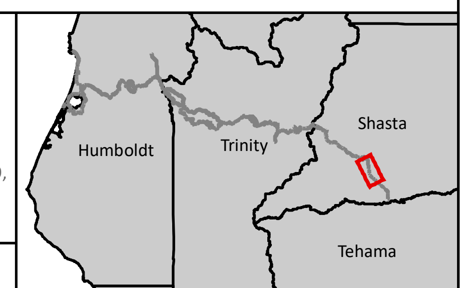

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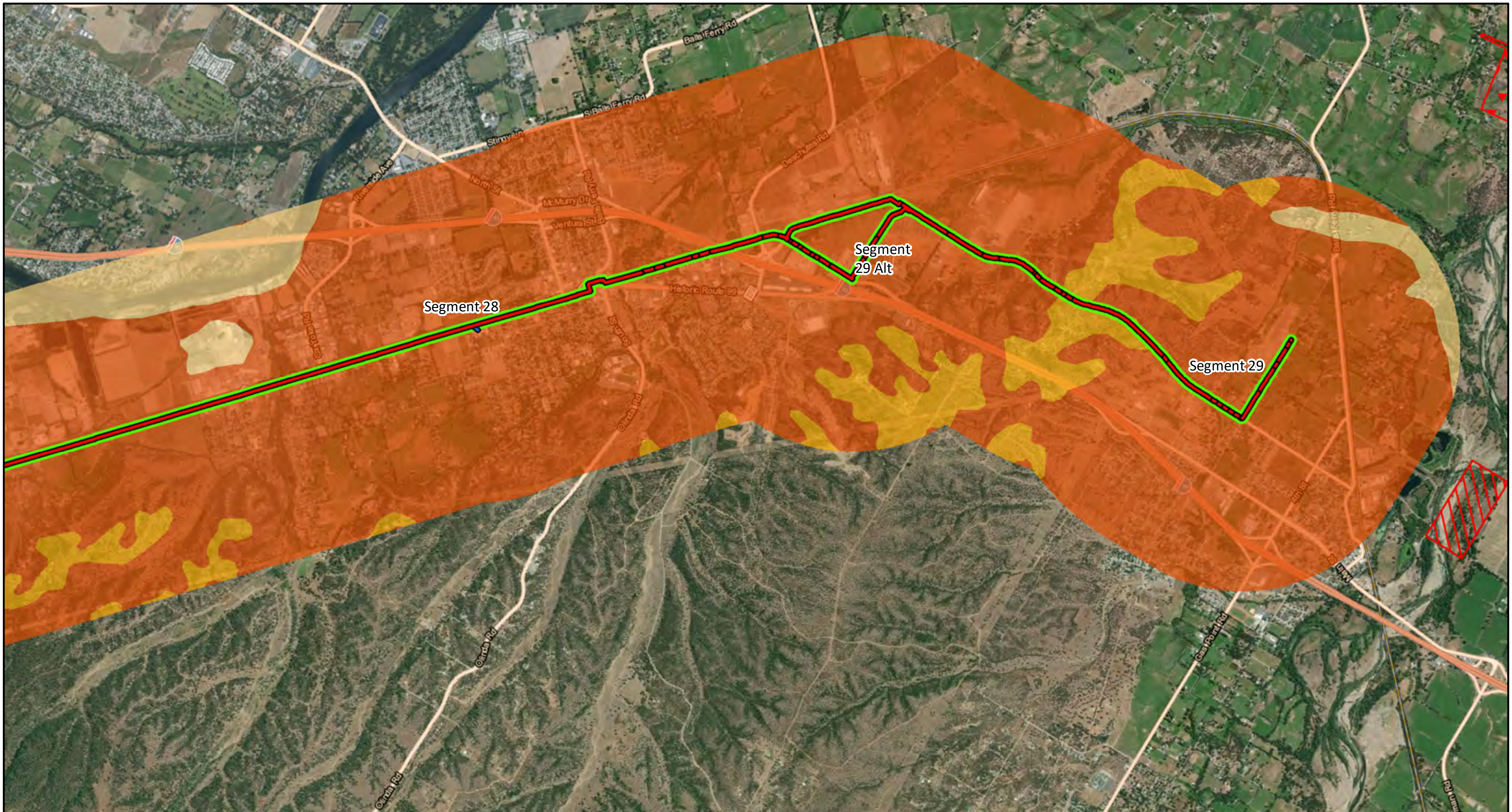

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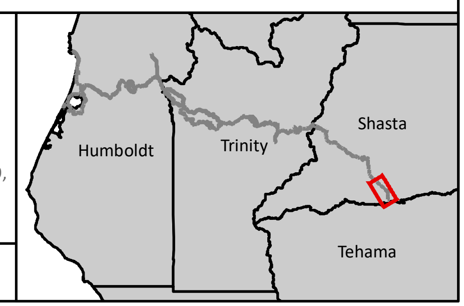

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