Attachment H-4 Landslide Inventory

APPENDIX E

LANDSLIDE INVENTORY

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APPENDIX E

LANDSLIDE INVENTORY

E.1 INTRODUCTION

This appendix presents summary information and site maps of each landslide that was identified along the proposed alignments that could potentially affect the stability of proposed tower foundations or associated work areas or multi-use areas. This landslide inventory was compiled from review of published literature and limited field reconnaissance.

The proposed alignments reviewed include the IPC Proposed Route; Proposed 230 kV Rebuild; Proposed 138 kV Rebuild; West of Bombing Range Road Alternative 1; West of Bombing Range Road Alternative 2; Morgan Lake Alternative; and Double Mountain Alternative. Shaw Environmental & Infrastructure, Inc. (Shaw) reviewed the majority of the transmission line route and compiled identified landslides in their Desktop Geotechnical Report, dated January 19, 2012. Landslides along subsequent new alignments and changes to the previous alignments were compiled by Shannon & Wilson, Inc. In this appendix, Shannon & Wilson has integrated the relevant data compiled by both Shannon & Wilson and Shaw. The landslide inventory was compiled from the following data sources:

- Review of GIS files compiled by Oregon Department of Geology and Mineral Industries (DOGAMI) in the Statewide Landslide Information Database for Oregon (SLIDO), version 3.4 (Burns and Watzig, 2017); the review included landslides within a 1-mile wide route corridor; initial work by Shaw utilized SLIDO, version 2 (Burns and others, 2011);
- Review of existing geologic maps, including Engineering Geology of the La Grande Area, Union County, Oregon, by Schlicker and Deacon (1971); the maps were compiled and geo-referenced in GIS along the alignment to confirm the location of each SLIDO landslide along the route and to check that each mapped landslide was included in the SLIDO database;
- Site reconnaissance (by Shaw) along portions of the original alignment, conducted on October 26-28 and November 15-18, 2011;
- Site reconnaissance (by Shannon & Wilson) along portions of new alignment alternatives and select alignment changes, conducted July 30 through August 2, 2012, and October 16-18, 2013;
- Review of aerial photography (Shaw reviewed 1:24,000 scale aerial photographs provided by 3Di, LLC, of Eugene, Oregon (3Di), and the ESRI Microsoft Virtual Earth

layer in GIS; Shannon & Wilson reviewed aerial photographs from both ESRI and Google Earth);

- Review of Digital Terrain Models (DTMs) along 1-mile-wide route corridors; and
- DOGAMI LiDAR Data Viewer (relevant LiDAR data was only available for portions of the Meacham Lake, Huron, Kamela SE, Hilgard, LaGrande SE, Glass Hill, Craig Mountain, North Powder, Telocaset, Baker, Virtue Flat, and Owyhee Dam quadrangles); No LiDAR data was available in Idaho.

A summary description is presented below for each identified landslide feature that intersects one of the alignments, as well as for landslide features that are near the alignments and oriented in such a way that they could be reasonably suspected of having the capacity to impact proposed structures. The text is followed by map sheets that show the locations of mapped landslides relative to the proposed alignment features.

The Landslide Inventory Index Map (Sheet 1) shows the entire project alignment and locations of subsequent Landslide Inventory maps (Sheets 2 through 26). Where map sheets are not shown along the alignment on the Landslide Inventory Index Map (Sheet 1), relevant landslides were not identified based on the data sources reviewed. All recognized landslide features are shown within the limits of each map sheet. However, discussions are only provided for those features judged potentially capable of impacting proposed structure stability. The map sheets and landslide descriptions are arranged from north to south, beginning in Morrow County, Oregon, and ending in Malheur County, Oregon.

Table E1 presents landslide data for multi-use areas located away from the proposed alignment such that they fall outside the boundaries of the maps presented. Table E1 includes all multi-use areas not shown on the landslide map sheets for which a SLIDO feature or suspected landslide is identified within a half mile.

Mapped features were given designations based on their source. Features identified in the SLIDO database are preceded by “SLIDO.” Features that were identified from published geologic maps, but not included in the SLIDO database, were designated with an arbitrary number, preceded by “MLS.” Features identified from field reconnaissance or review of LiDAR or aerial imagery were designated with an arbitrary number, preceded by “PLS.” Each description below is preceded by a header that provides UTM coordinates (in meters) for a point near the geographic center of discussed feature.

In the time since Shaw issued their Desktop Geotechnical Report in 2012, SLIDO has changed the identification labels of some landslides in its database multiple times. The current version of

SLIDO-3.4 uses identification labels that contain both an abbreviation of the data source and a number. In the Landslide Inventory maps and landslide descriptions below, we abbreviate the landslide identification labels by using only the number following the data source. For example, we refer to SLIDO-3.4 landslide "MadiIP2007_43" as "SLIDO 43." Full SLIDO-3.4 identification labels are provided in the headers for each description.

E.2 LANDSLIDE DESCRIPTIONS

E.2.1 SLIDO 43

SLIDO-3.4 MadiIP2007_43
Northing: 5051807
Easting: 298836
Sheets 2, 3

SLIDO 43 intersects the alignment between towers 17/1 and 23/1. It is a broad, gently sloping alluvial fan and is not a landslide. A site visit was conducted on November 18, 2011.

E.2.2 PLS-001

PLS-001
Northing: 5031371
Easting: 391097
Sheet 4

PLS-001 is an approximately 230-acre potential landslide that was identified from available LiDAR data. PLS-001 has not been verified in the field and should not be considered a landslide based solely on interpretation of the LiDAR data. This IPC Proposed Route crosses this potential landslide between towers 89/4 and 90/3, potentially affecting the stability of towers 89/4 through 90/2, and associated work areas. A field reconnaissance of this area should be performed as part of the geotechnical exploration program.

E.2.3 PLS-002

PLS-002
Northing: 5026719
Easting: 396357
Sheet 5, 6

PLS-002 is an approximately 460-acre potential landslide that was identified in available LiDAR data. PLS-002 has not been verified in the field and should not be considered a landslide based solely on interpretation of the LiDAR data. The IPC Proposed Route passes above this potential landslide between towers 93/5 and 95/3, potentially affecting the stability of those proposed towers and associated work areas. A field reconnaissance along this portion of the alignment should be performed as part of the geotechnical exploration program.

E.2.4 SLIDO 10

SLIDO-3.4 BussC2006_10
Northing: 5022505
Easting: 397680
Sheet 6

SLIDO 10 is referenced at a scale of 1:100,000 (Buss, 2006), and it's located over 2,000 feet southwest of the IPC Proposed Route, near tower 96/3. It is mapped as talus/colluvium and will not likely impact the proposed alignment or any associated work areas or multi-use areas. A field reconnaissance of this area should be performed as part of the geotechnical exploration program.

E.2.5 SLIDO 134

SLIDO-3.4 FernML2010_134
Northing: 5018900
Easting: 406277
Sheet 8

SLIDO 134 is referenced at a scale of 1:100,000 from Ferns et al., 2010. The same limits of this landslide (Holocene Qls) were mapped at the scale of 1:24,000 by Barrash and others (1980), covering approximately 132 acres. Schlicker and Deacon (1971) mapped slightly different extents of the same feature at a scale of 1:24,000. IPC Proposed Route towers 102/1 and 102/2 and associated work areas are on the margins of the mapped landslide limits, and Morgan Lake Alternative tower ML-4/2 and its associated work area are within the mapped landslide limits.

Review of aerial photos, the DTM, and LiDAR images suggest that most of this landslide has not recently been active. However, a field reconnaissance of this area should be performed as part of the geotechnical exploration program.

E.2.6 SLIDO 129

SLIDO-3.4 FernML2010_129
Northing: 5019127
Easting: 407892
Sheet 9

SLIDO 129 is referenced at a scale of 1:100,000 (Ferns et al., 2010) and its mapped extents intersect the IPC Proposed Route between towers 103/3 and 103/4. The slide appears to be contained within a drainage spanned by the two towers and is therefore unlikely to affect the proposed towers or work areas. A field reconnaissance of this area should be performed as part of the geotechnical exploration program.

E.2.7 SLIDO 127

SLIDO-3.4 FernML2010_127
Northing: 5018167
Easting: 411384
Sheets 9, 11

SLIDO 127 is referenced at a scale of 1:100,000 (Ferns et al., 2010) and is located about 200 feet south of the IPC Proposed Route, between towers 105/5 and 106/1. It is mapped as a landslide, but does not appear to be recently active, based on review of aerial photographs. Proposed towers 105/5 and 106/1, and associated work areas, are in the proximity of the mapped debris fan, and a field reconnaissance of this area should be performed as part of the geotechnical exploration program.

E.2.8 Schlicker and Deacon, 1971

Northing: 5018552
Easting: 412472
Sheets 11

Schlicker and Deacon (1971) mapped several landslides in the areas west and south of La Grande at a scale of 1:24,000. The majority of the landslide features mapped by Schlicker and Deacon (1971) were similarly mapped as landslides or alluvial fans in Ferns and others (2010), which is locally the basis of the current SLIDO database. While the two map sets generally agree, there are differences in the mapped limits of some landslide and alluvial fan areas. One of the landslides mapped by Schlicker and Deacon (1971), not included in SLIDO, intersects the IPC Proposed Route between towers 106/3 and 106/4. Based on review of topography and aerial photographs, this mapped landslide may impact the proposed work areas around tower 106/4. A field reconnaissance of this area should be performed as part of the geotechnical exploration program.

E.2.9 SLIDO 380, 33

SLIDO-3.4 FernML2010_380
Northing: 5016237
Easting: 414116
Sheets 11, 12

SLIDO-3.4 WalkGW2002_33
Northing: 5016237
Easting: 414116
Sheets 11, 12

SLIDO 380 and 33 appear to refer to the same landslide feature and are referenced at scales of 1:100,000 and 1:500,000, respectively (Ferns et al., 2010; Walker, 2002). The IPC Proposed Route crosses the mapped limits of the slide between towers 108/2 and 109/2, and may affect stability at towers 108/3 through 109/2, along with associated work areas. Schlicker and Deacon (1971) mapped slightly different extents of the same features at a scale of 1:24,000. In the Schlicker and Deacon (1971) map, the extents of one slide area are about 650 feet southeast of tower 107/4 and 465 feet northeast of tower 107/5. A field reconnaissance of all these areas should be performed as part of the geotechnical exploration program.

E.2.10 SLIDO 225

SLIDO-3.4 FernML2010_225
Northing: 5013877
Easting: 417421
Sheets 12, 13

SLIDO 225 is mapped as a landslide referenced at a scale of 1:100,000 (Ferns et al., 2010). It intersects the IPC Proposed Route between towers 110/2 and 112/2, and may affect stability at towers 110/1 through 112/1, along with associated work areas. A field reconnaissance of this area should be performed as part of the geotechnical exploration program. Schlicker and Deacon (1971) mapped slightly different extents of the same feature at a scale of 1:24,000.

E.2.11 SLIDO 115

SLIDO-3.4 FernML2010_115
Northing: 5010654
Easting: 418706
Sheet 13

SLIDO 115 is referenced at a scale of 1:100,000 (Ferns et al., 2010), and its mapped extents intersect the IPC Proposed Route between towers 112/5 and 113/1. The feature is mapped as an alluvial fan, not a landslide; and the material appears to be contained within a drainage spanned by the two towers. The feature is unlikely to affect the proposed towers or associated work areas. However, a field reconnaissance of this area should be performed as part of the geotechnical exploration program.

E.2.12 SLIDO 114

SLIDO-3.4 FernML2010_114
Northing: 5009120
Easting: 419492
Sheets 13, 14

SLIDO 114 is mapped as a landslide and referenced at a scale of 1:100,000 (Ferns et al., 2010). It intersects the IPC Proposed Route between towers 113/3 and 114/3, and may affect stability at towers 113/4, 113/5, 114/2, along with associated work areas. A field reconnaissance of this area should be performed as part of the geotechnical exploration program.

E.2.13 SLIDO 117

SLIDO-3.4 FernML2010_117
Northing: 5007537
Easting: 417623
Sheet 15

SLIDO 117 is referenced at the scale of 1:100,000 (Ferns et al., 2010). The feature is located approximately 1,000 feet east of the Morgan Lake Alternative alignment, near towers ML-14/2 and ML-14/3. A landslide is not shown at this location on the 1:24,000 scale *Geologic Map of the Glass Hill Quadrangle* (Barrash et al., 1980), and landslide deposit features are not apparent on the DTM or on aerial photos. Landslide deposits are shown on the Barrash et al. (1980) map approximately 2,500 east of SLIDO 117, further away from the alignment, and it may be possible that SLIDO 117 was inaccurately geo-referenced. A field reconnaissance of the area around SLIDO 117 should be performed as part of the geotechnical exploration program.

E.2.14 SLIDO 112

SLIDO-3.4 FernML2010_112
Northing: 5004077
Easting: 419720
Sheet 15

SLIDO 112 is referenced at the scale of 1:100,000 (Ferns et al., 2010), but no landslide is shown at the location of SLIDO 112 on the 1:24,000 scale *Geologic Map of the Glass Hill Quadrangle* (Barrash et al., 1980). The mapped limits of SLIDO 112 intersect the Morgan Lake Alternative alignment between towers ML-17/2 and ML-17/3, with the limits of the feature being approximately 150 feet southeast of tower ML-17/2. The OGDC geologic map shows a contact between the Dacite of Mount Emily (Tpd) and the Grande Ronde Basalt (Tcgf) at this location. Review of the DTM and aerial photos shows no evidence of a landslide, but the upper contact of the Grande Ronde Basalt is known to be landslide prone. A field reconnaissance of this area should be performed as part of the geotechnical exploration program.

E.2.15 SLIDO 48

SLIDO-3.4 WalkGW2002_48
Northing: 5002373
Easting: 419983
Sheet 16

SLIDO 48 is mapped as a landslide and referenced at a scale of 1:500,000 (Walker, 2002). A landslide is not shown at this location on the 1:100,000 scale map by Ferns et al. (2010) or the 1:24,000 scale map by Barrash et al. (1980). Review of the DTM and aerial photographs does not suggest the presence of a landslide, but field reconnaissance of this area should be performed as part of the geotechnical exploration program.

E.2.16 SLIDO 311

SLIDO-3.4 FernML2010_311
Northing: 5002434
Easting: 421959
Sheet 16

SLIDO 311 is referenced at a scale of 1:100,000 (Ferns et al., 2010), and its mapped extents intersect the IPC Proposed Route between towers 118/4 and 118/6 and the Morgan Lake Alternative alignment between towers ML-19/2 and ML-19/3. While IPC Proposed Route tower 118/5 and its associated work area are within the area mapped as SLIDO 311, the feature is considered as talus/colluvium, not a landslide, and is therefore unlikely to affect either alignment. While review of the DTM and aerial photographs does not suggest the presence of a landslide, a field reconnaissance of the area should be performed as part of the geotechnical exploration program.

E.2.17 SLIDO 2280, 2282, 2279, 2281, 56

SLIDO-3.4 FernML2001a_2280 and FernML2001b_2282
Northing: 5001693
Easting: 421505
Sheets 16

SLIDO-3.4 FernML2001b_2281
Northing: 4999554
Easting: 422283
Sheets 16

SLIDO-3.4 FernML2001a_2279
Northing: 5001494
Easting: 421225
Sheets 16

SLIDO-3.4 WalkGW2002_56
Northing: 4998896
Easting: 421881
Sheet 16

SLIDO 2280 and 2282 are a single small landslide that is located on the boundary between the USGS Glass Hill and Craig Mountain quadrangles. Review of the DTM and aerial photographs suggest that the features of the landslide extend beyond the SLIDO mapped limits, as shown on the Landslide Inventory (Sheet 16). The IPC Proposed Route crosses the apparent landslide limits between towers 118/6 and 119/2. An existing road is present in the apparent head scarp area (near the 2280 and 2282 contact line).

SLIDO 2279 is a small landslide located 300 feet south of SLIDO 2280 and 2282. An existing road is present in the apparent head scarp area. Review of the DTM suggests that SLIDO 2279 represents a debris flow source area for landslide deposits and colluvium that have been deposited in SLIDO 2281 between proposed tower locations 119/1 and 119/2.

SLIDO 56 and 2281 are mapped as the same landslide complex with different boundaries. SLIDO 56 is referenced at a scale of 1:500,000 (Walker et al., 2002), and SLIDO 2281 is referenced at a scale of 1:24,000 (Ferns, et al., 2001b). Portions of this landslide complex are also mapped at a scale of 1:24,000 by Barrash et al. (1980). The northern portion of the landslide complex, where the mapped extents intersect the IPC Proposed Route, was mapped as

colluvium by Barrash, et al. (1980). However, landslide debris from SLIDO 2279, 2280, and 2282 are apparent in LiDAR data from this area.

Field reconnaissance between towers 118/6 and 119/3 should be performed as part of the geotechnical exploration program.

E.2.18 SLIDO 1113

SLIDO-3.4 AshlRP1966_1113
Northing: 4937305
Easting: 457071
Sheet 17

SLIDO 1113 is referenced at a scale of 1:21,100 (Ashley, 1966), and its mapped extents intersect the IPC Proposed Route between towers 171/1 and 171/2. The feature is mapped as alluvial fan deposits, not a landslide, and it is spanned between the two towers, so it is unlikely to affect the proposed tower foundations or associated work areas. For confirmation, a field reconnaissance of this area should be performed as part of the geotechnical exploration program.

E.2.19 SLIDO 1115

SLIDO-3.4 AshlRP1966_1115
Northing: 4936808
Easting: 457368
Sheet 17

SLIDO 1115 is referenced at a scale of 1:21,100 (Ashley, 1966), and its mapped extents intersect the IPC Proposed Route between towers 171/2 and 171/3. The feature is mapped as alluvial fan deposits, not a landslide, and it is spanned between the two towers, so it is unlikely to affect the proposed tower foundations or associated work areas. For confirmation, a field reconnaissance of this area should be performed as part of the geotechnical exploration program.

E.2.20 SLIDO 1103

SLIDO-3.4 AshlRP1966_1103
Northing: 4935742
Easting: 459042
Sheets 17

SLIDO 1103 is mapped by Ashley (1966) as stream alluvium and alluvial fans, not a landslide. The IPC Proposed Route crosses the feature between towers 171/4 and 172/1. The proposed tower locations and associated work areas are outside and above the mapped limits of the alluvium, which forms a flood plain along the banks of Burnt River. The area between towers 171/4 and 172/1 was visited on October 18, 2013, and evidence of landslide hazards was not observed.

E.2.21 SLIDO 1677

SLIDO-3.4 AshlRP1966_1677
Northing: 4935755
Easting: 457095
Sheet 17

SLIDO 1677 is referenced at a scale of 1:21,100 (Ashley, 1966), and its mapped extents intersect the IPC Proposed Route between towers 171/4 and 172/1. The feature is approximately 400 feet northeast of proposed tower 172/1 and is mapped as a landslide. Tower 172/1 and its associated work area are located on a ridge, well outside and above the mapped extents; but a field reconnaissance of this area should be performed as part of the geotechnical exploration program.

E.2.22 SLIDO 164, 167

SLIDO-3.4 AshlRP1966_164
Northing: 4932113
Easting: 459313
Sheet 18

SLIDO-3.4 AshlRP1966_167
Northing: 4931951
Easting: 459819
Sheet 18

SLIDO 164 and 167 were mapped as talus or colluvium by Ashley (1966), at a scale of 1:21,100. The IPC Proposed Route crosses the features between towers 175/1 and 175/3, with tower 175/2 and much of its associated work area being within the mapped extents. As the deposits are mapped as talus or colluvium, and not as landslides, and since tower 175/2 is on relatively level ground, the deposits are not likely to threaten the stability of proposed structures or work areas. For confirmation, a field reconnaissance of this area should be performed as part of the geotechnical exploration program.

E.2.23 PLS-005

PLS-005
Northing: 4921189
Easting: 473299
Sheet 20

PLS-005 is a small (approximately 1.7-acre) potential landslide that was identified during field reconnaissance. No evidence of recent movement was observed. The nearest proposed tower location (IPC Proposed Route tower 186/2) is approximately 500 feet uphill of this small potential landslide, and the proposed tower and work area would not be affected by it.

Photo 1: Toe of PLS-005 looking northeast from Dixie Creek Road

E.2.24 MLS-001

MLS 001
Northing: 4919678
Easting: 473265
Sheet 20, 21

MLS-001 is a possible landslide which crosses the IPC Proposed Route between towers 186/4 and 187/4, potentially affecting towers 187/1 to 187/4 and all associated work areas. MLS-001 is not included in SLIDO but is shown in published geologic mapping (Brooks, H.C., 1979). A field reconnaissance of this area should be performed as part of the geotechnical exploration program.

E.2.25 SLIDO 1706

SLIDO-3.4 BrooHC1979a_1706
Northing: 4917799
Easting: 472736
Sheets 21

SLIDO 1706 is referenced at a scale of 1:62,500 as a 387-acre landslide, and is part of a large landslide complex (approximately 3,300 acres) that extends around the north side of Table Rock Butte (Brooks, 1979). The IPC Proposed Route crosses the mapped extents of SLIDO 1706

between tower locations 188/1 and 188/3. A field reconnaissance of this area should be performed as part of the geotechnical exploration program.

E.2.26 SLIDO 1708

SLIDO-3.4 BrooHC1979a_1708
Northing: 4916158
Easting: 473547
Sheet 22

SLIDO 1708 is referenced at a scale of 1:62,500 as a 39-acre landslide on a northwest-facing slope above Goodman Creek (Brooks, 1979). The IPC Proposed Route crosses the landslide between towers 189/1 and 189/3, with tower 189/2 and its associated work area located within the mapped extents. Aerial photographs show existing transmission towers within the mapped limits of SLIDO 1708. The presence of existing transmission towers within this landslide suggests that the site is stable. However, a field reconnaissance of this area should be performed as part of the geotechnical exploration program.

E.2.27 SLIDO 1711

SLIDO-3.4 BrooHC1979a_1711
Northing: 4914501
Easting: 475058
Sheet 22

SLIDO 1711 is referenced at a scale of 1:62,500 as a 133-acre landslide complex (Brooks, 1979). An existing transmission line and access road run parallel to and along the mapped upper boundary of the landslide area. The IPC Proposed Route crosses the landslide below the existing road and transmission line, between proposed towers 190/2 and 191/2. The proposed towers and associated work areas are located at ridge spurs, between the gullies which are potential debris flow pathways. A field reconnaissance of this area should be performed as part of the geotechnical exploration program.

E.2.28 SLIDO 384, 1690, 1691

SLIDO-3.4 WalkGW2002_384
Northing: 4895721
Easting: 483947
Sheet 24

SLIDO-3.4 BrooHC1976_1691
Northing: 4895834
Easting: 484544
Sheet 24

SLIDO-3.4 BrooHC1976_1690
Northing: 4865101
Easting: 483604
Sheet 24

SLIDO 384 is referenced at a scale of 1:500,000 (Walker, 2002) and SLIDO 1690 and 1691 are referenced at a scale of 1:250,000 (Brooks and others, 1976). Brooks (1976) mapped the area as landslide deposits. The proposed locations of IPC Proposed Route towers 204/2 through 205/2 and associated work areas are within the limits of the mapped landslide deposits. On October 17, 2013, a site visit of this landslide area was conducted. It is our opinion that SLIDO 384, 1690, and 1691 map an ancient landslide complex. We observed some eroded (old) scarps, areas of hummocky topography, and generally mature drainages. The lack of fresh scarps and maturity of the drainages suggests that the landslide is old and may not be currently active. If scarps, steep slopes, and loose material are avoided, it may be possible to build tower foundations through the complex. More detailed reconnaissance of the area should be performed as part of the geotechnical explorations.

Photo 2: Looking south into the toe of landslide complex; approximate locations of towers 204/2 through 204/4 shown for reference.

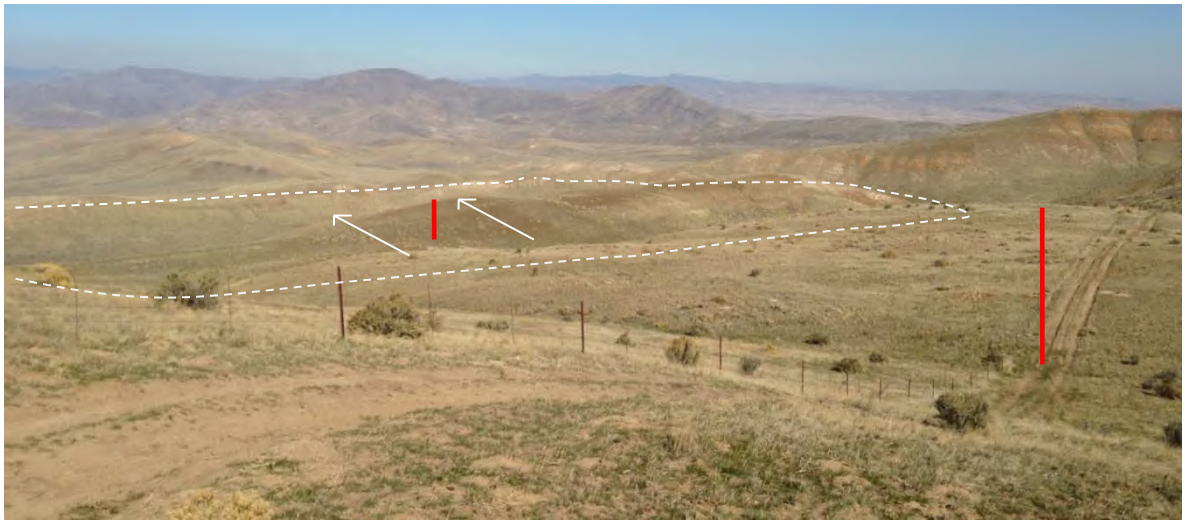


Photo 3: Looking north into the landslide complex; approximate locations of towers 205/2 and 205/3 shown for reference.

E.2.29 SLIDO 2027, 2030

SLIDO-3.4 FernML1993a_2027
Northing: 4866541
Easting: 461275
Sheet 25

SLIDO-3.4 FernML1993a_2030
Northing: 4865497
Easting: 462136
Sheet 25

SLIDO 2027 and 2030 are referenced at the scale of 1:100,000 (Ferns et al., 1993a). However, these landslide deposits (Pleistocene and Holocene Qls) have been mapped at the scale of 1:24,000 (Brooks, 1991). SLIDO 2030 is described as a slumped section of upper-Miocene volcanic rocks over 2 miles long and up to 2,000 feet wide, and SLIDO 2027 is described as a hummocky area underlain by a fragmented sequence of sedimentary deposits with blocks of andesite or basalt (Brooks, 1991). These two landslide areas cover 1,570 acres and are separated by the Malheur River. The IPC Proposed Route crosses the Malheur River Canyon along the northeastern edge of SLIDO 2027 and 2030. Proposed tower 232/3 is located on a bedrock bluff of upper-Miocene volcanic rock. A talus slope is present between the bluff and the Oregon Vale Canal. The canal is located on the landslide deposits (SLIDO 2027) at the base of the talus slope; and proposed tower 232/4 is located in landslide deposits between the canal and the Malheur River. Proposed towers 233/1 to 233/3 are located in the slumped volcanic rocks (SLIDO 2030) on the eastern/southern side of the river.

On November 17, 2011, a site visit of this landslide area was conducted by walking along the access road on the southeast side of the Malheur River from the eastern end of SLIDO 2030. Since the Oregon Canal is constructed on SLIDO 2027, these landslide deposits are potentially relatively stable. More detailed reconnaissance of the area should be performed as part of the geotechnical explorations.

E.2.30 MLS-002

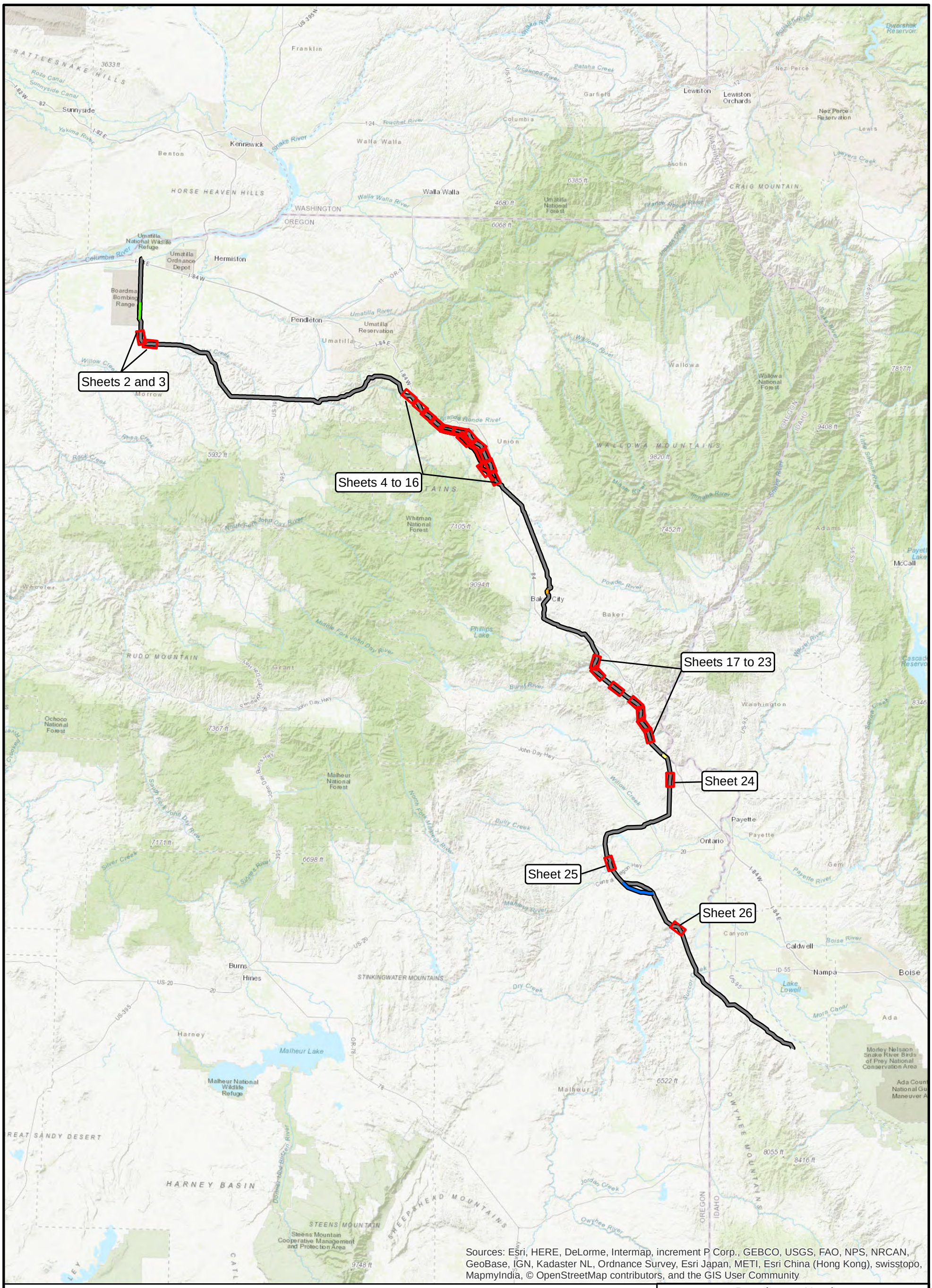
MLS-002
Northing: 4842280
Easting: 486369
Sheet 26

MLS-002 is not included in SLIDO but is on the 1:24,000 scale *Geologic Map of Owyhee Dam Quadrangle* (Ferns, 1989). IPC Proposed Route tower 256/2 and its associated work area are located on the eastern margin of the mapped landslide. This landslide complex was observed from Owyhee Lake Road during a site visit on October 2, 2011. A canal and aqueduct are located on the bluff immediately above the landslide, and a siphon pipe that crosses the Owyhee River Canyon is located along the western edge of the landslide complex. The presence of the water facilities and roads suggests that this landslide is relatively stable. However, more detailed reconnaissance of the area should be performed as part of the geotechnical explorations.

Photo 4: View of MLS-002 looking southeast from Owyhee River Road.

TABLE E1: LANDSLIDE DATA FOR MULTI-USE AREAS LOCATED OUTSIDE MAP BOUNDARIES

Multi-Use Area	Northing (meters)	Easting (meters)	SLIDO ID	Distance to Multi-Use Area (feet)	Direction from Multi-Use Area	Map Unit Label	SLIDO Type	Likely Hazard
MU BA-04	4936252	461150	AshlRP1966_1103	1,800	NW	Qal	Fan	none
MU BA-04	4936252	461150	ProsHJ1967_1148	1,190	N	Qal	Talus-Colluvium	none
MU BA-04	4936252	461150	ProsHJ1967_1149	2,430	SW	Qal	Talus-Colluvium	none
MU BA-05	4921133	473443	BrooHC1979a_1707	1,078	SW	Qls	Landslide	low
MU BA-06	4911097	478177	BrooHC1979a_3463	890	W	Qtg	Talus-Colluvium	none
MU MA-07	4839634	492740	FernML1993a_2070	1,460	SW	Qls	Landslide	none
MU MO-02	5051813	301969	MadiIP2007_43	330	W	Qf	Fan	none



LEGEND

- IPC Proposed Route
- West Bombing Range Road Alternative 1
- West Bombing Range Road Alternative 2
- Morgan Lake Alternative
- Proposed 230-kV Rebuild
- Proposed 138-kV Rebuild
- Double Mountain Alternative
- Map Sheets

0 20 40 Miles

Boardman - Hemingway
500kV Transmission Line
Oregon - Idaho

LANDSLIDE INVENTORY INDEX MAP

January 2018 24-1-03820-006

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

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SLIDO 3.4 CLASSIFICATION

- Fan
- Landslide
- Talus - Colluvium

MAPPED SLIDE FEATURES

- Flow Direction
- Scarp
- Feature Limits

0 1,000 2,000 Feet

Boardman - Hemingway
500kV Transmission Line
Oregon - Idaho

LANDSLIDE INVENTORY

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500kV Transmission Line
Oregon - Idaho

LANDSLIDE INVENTORY

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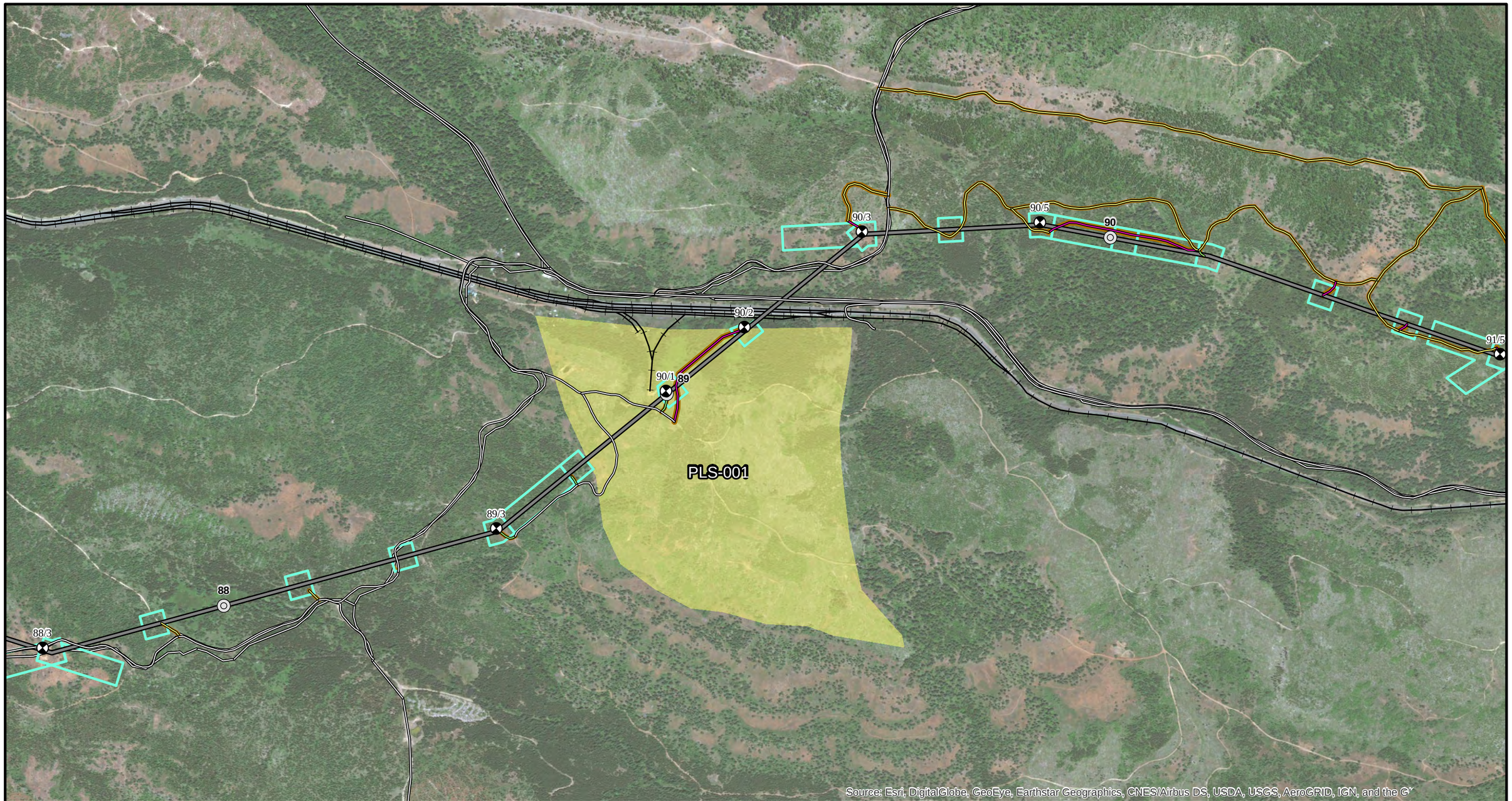

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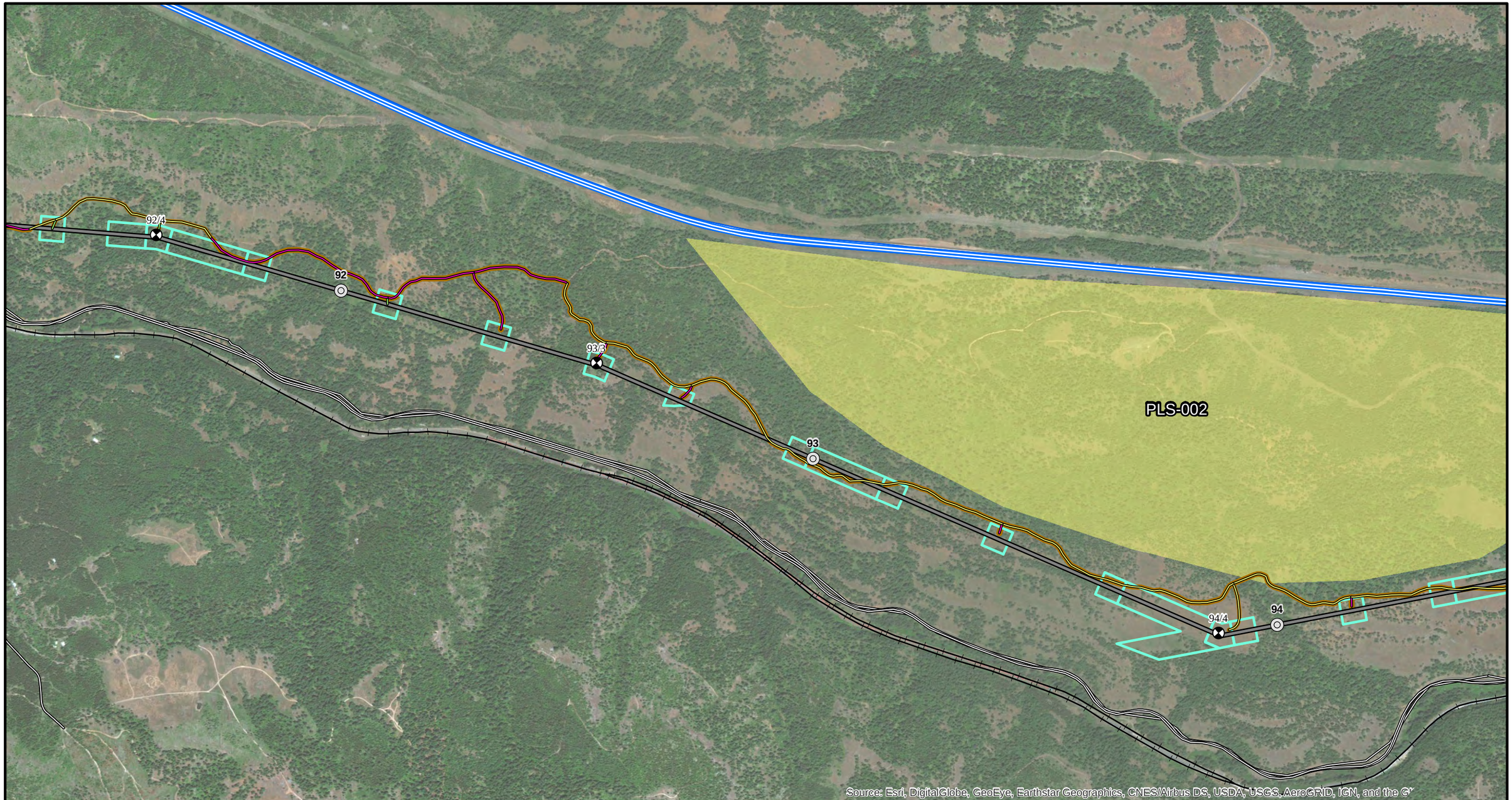

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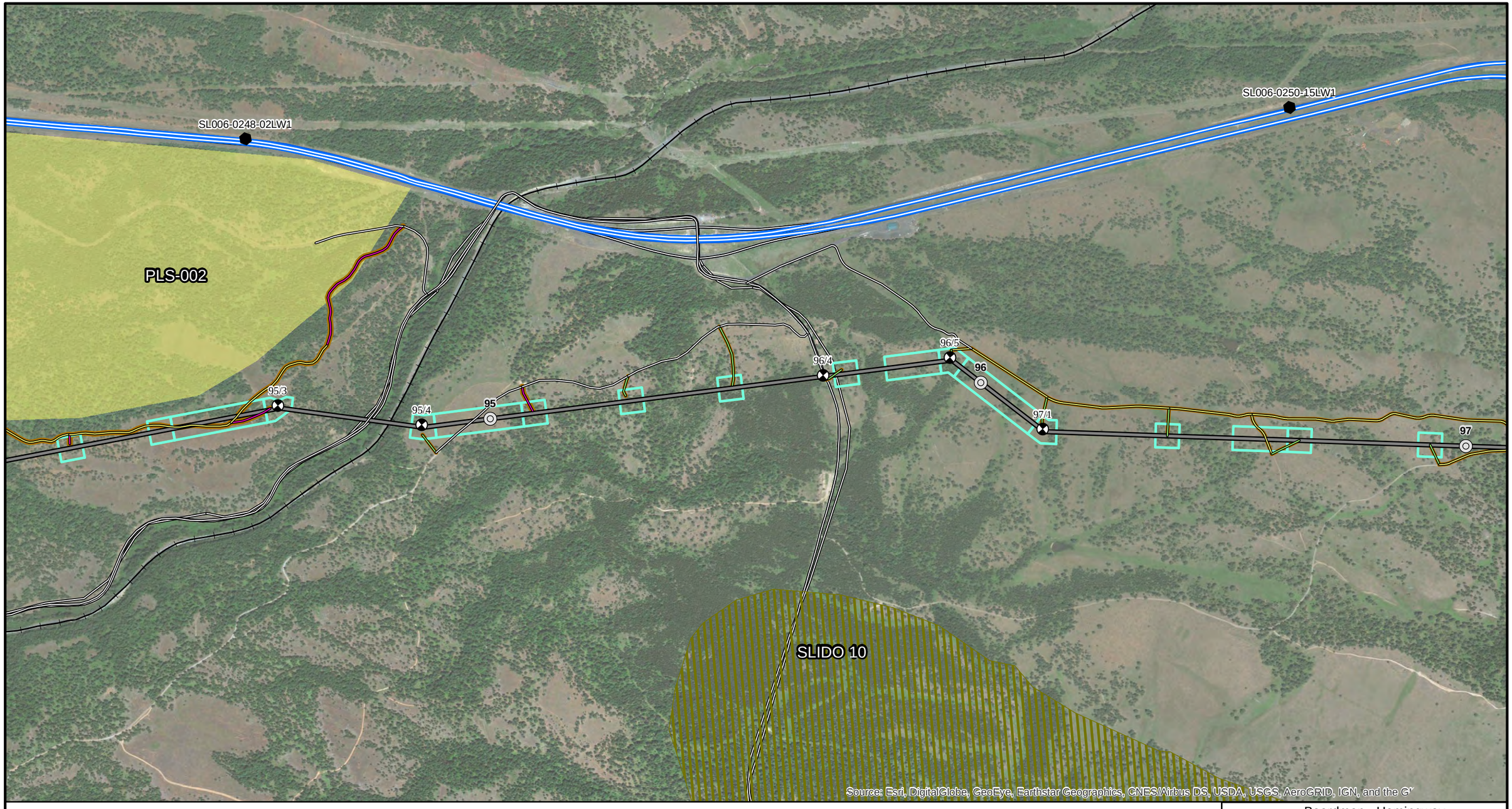

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Boardman - Hemingway
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Oregon - Idaho

LANDSLIDE INVENTORY

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SHANNON & WILSON, INC.
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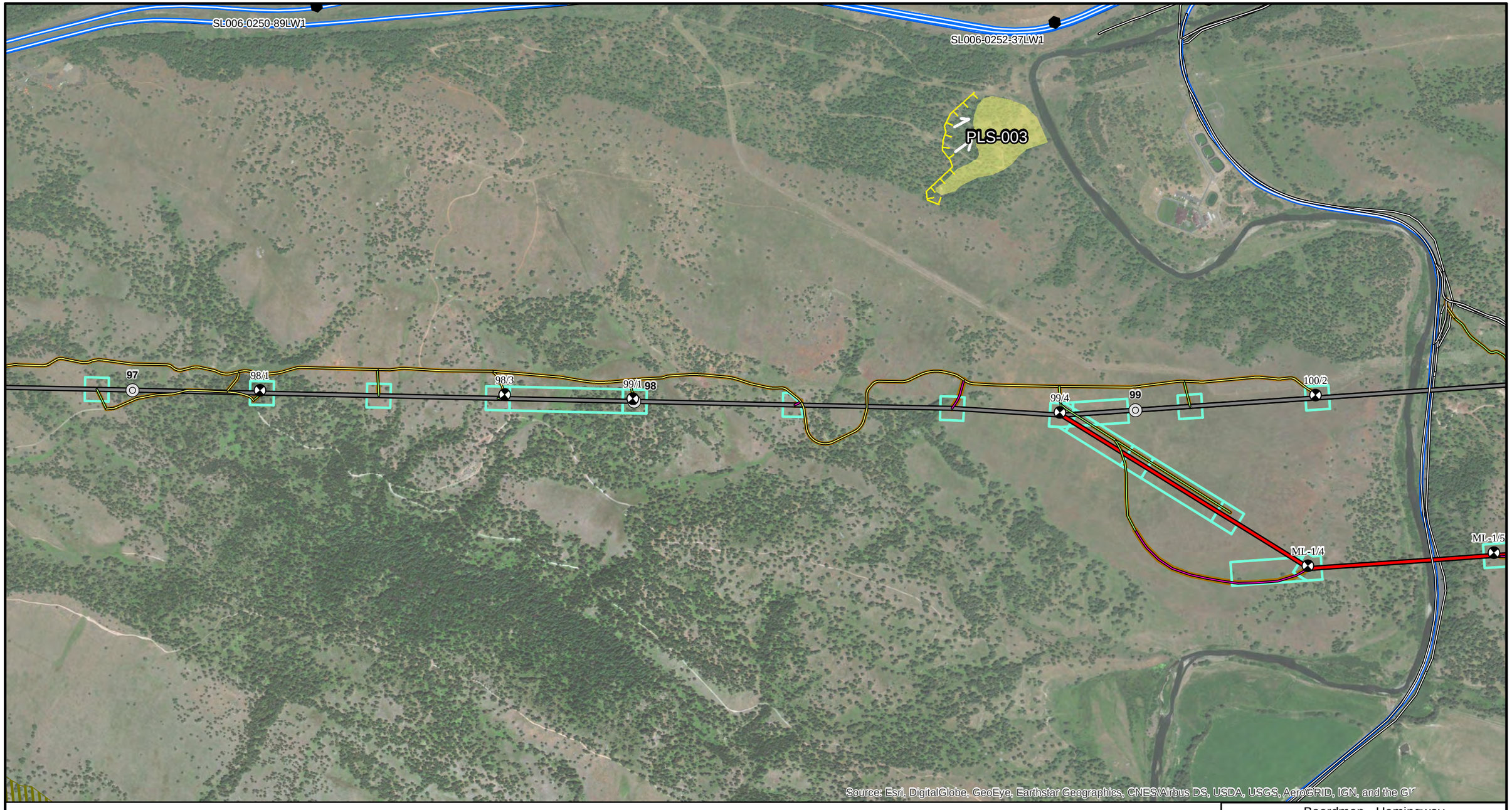

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500kV Transmission Line
Oregon - Idaho

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SLIDO 303

SLIDO 138

SLIDO 136

SLIDO 134

Schlicker and Deacon, 1971

100/3

100

101/1

101

102

ML-1/5

1

ML-2/3

2

3

ML-4/1

ML-4/2

ML-4/3

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS Us

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0 1,000 2,000 Feet

Boardman - Hemingway
500kV Transmission Line
Oregon - Idaho

LANDSLIDE INVENTORY

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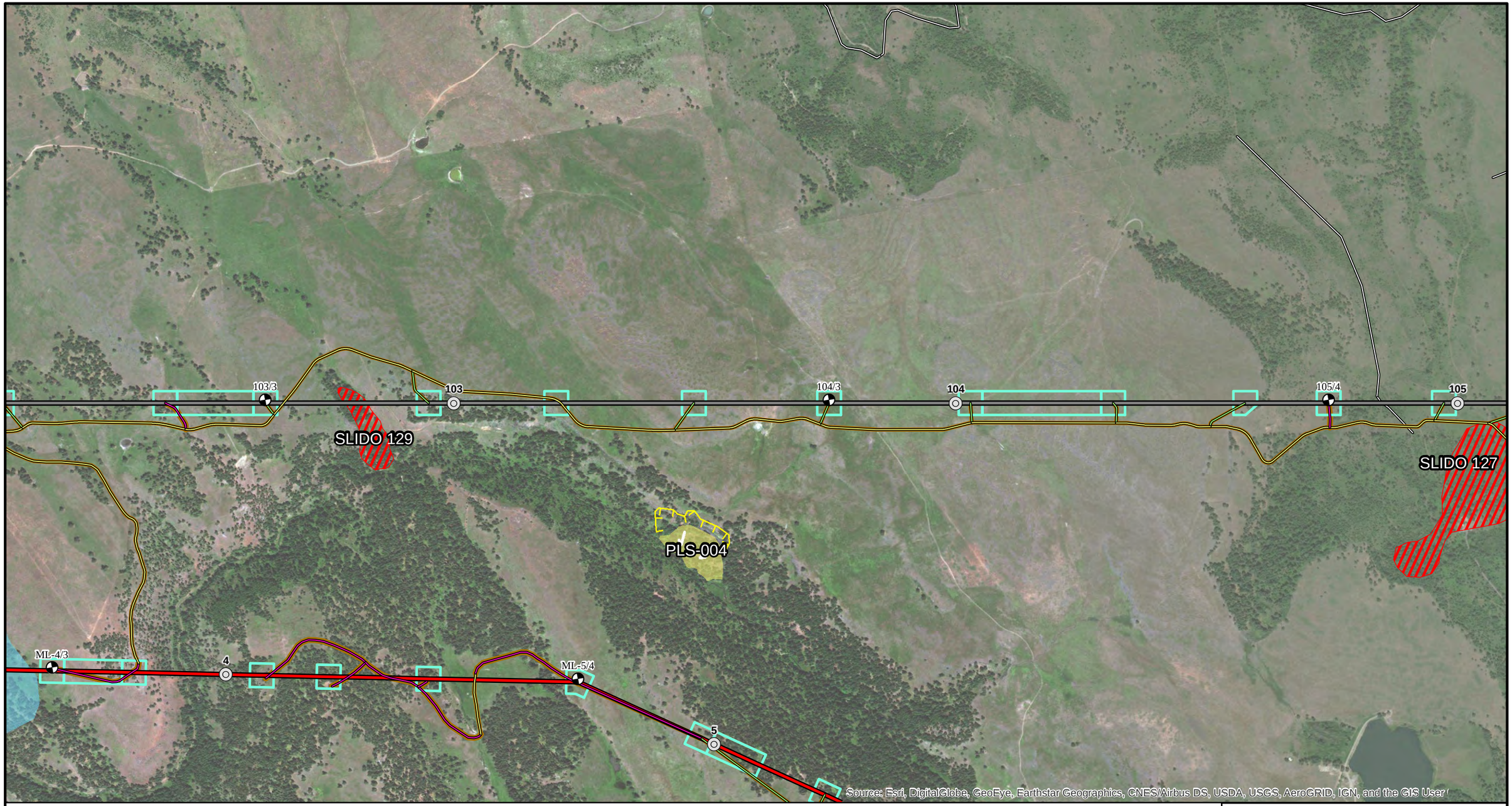
SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS



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LANDSLIDE INVENTORY

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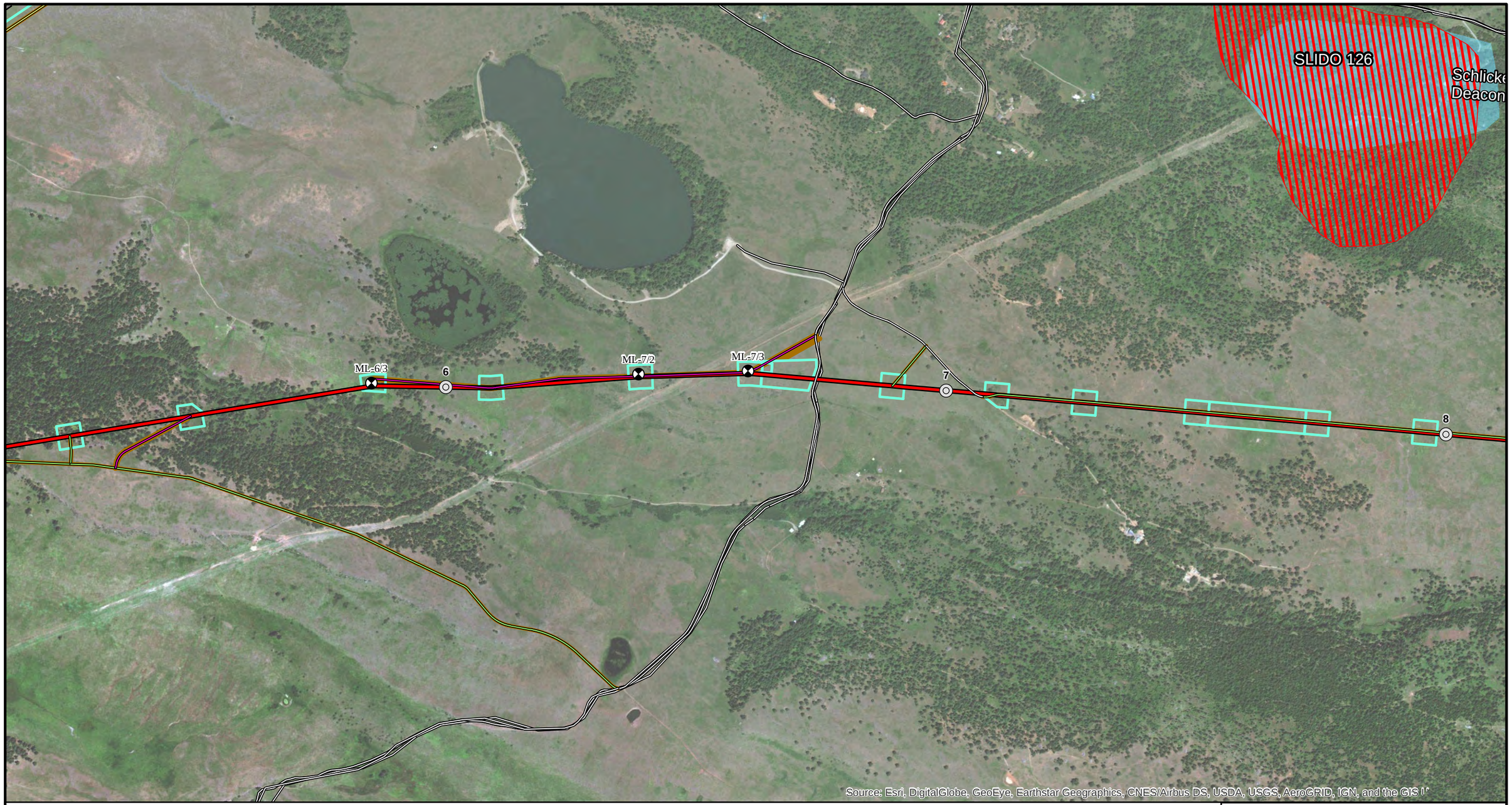

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N W E S

Boardman - Hemingway
500kV Transmission Line
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LANDSLIDE INVENTORY

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SLIDO 332
SLIDO 351
Schlicker and Deacon, 1971
Schlicker and Deacon, 1971
Schlicker and Deacon, 1971
Schlicker and Deacon, 1971
SLIDO 380
106/3
106
105
107
108
SLIDO 127
SLIDO 126
Schlicker and Deacon, 1971
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User

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Boardman - Hemingway
500kV Transmission Line
Oregon - Idaho

LANDSLIDE INVENTORY

April 2018 24-1-03820-006

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

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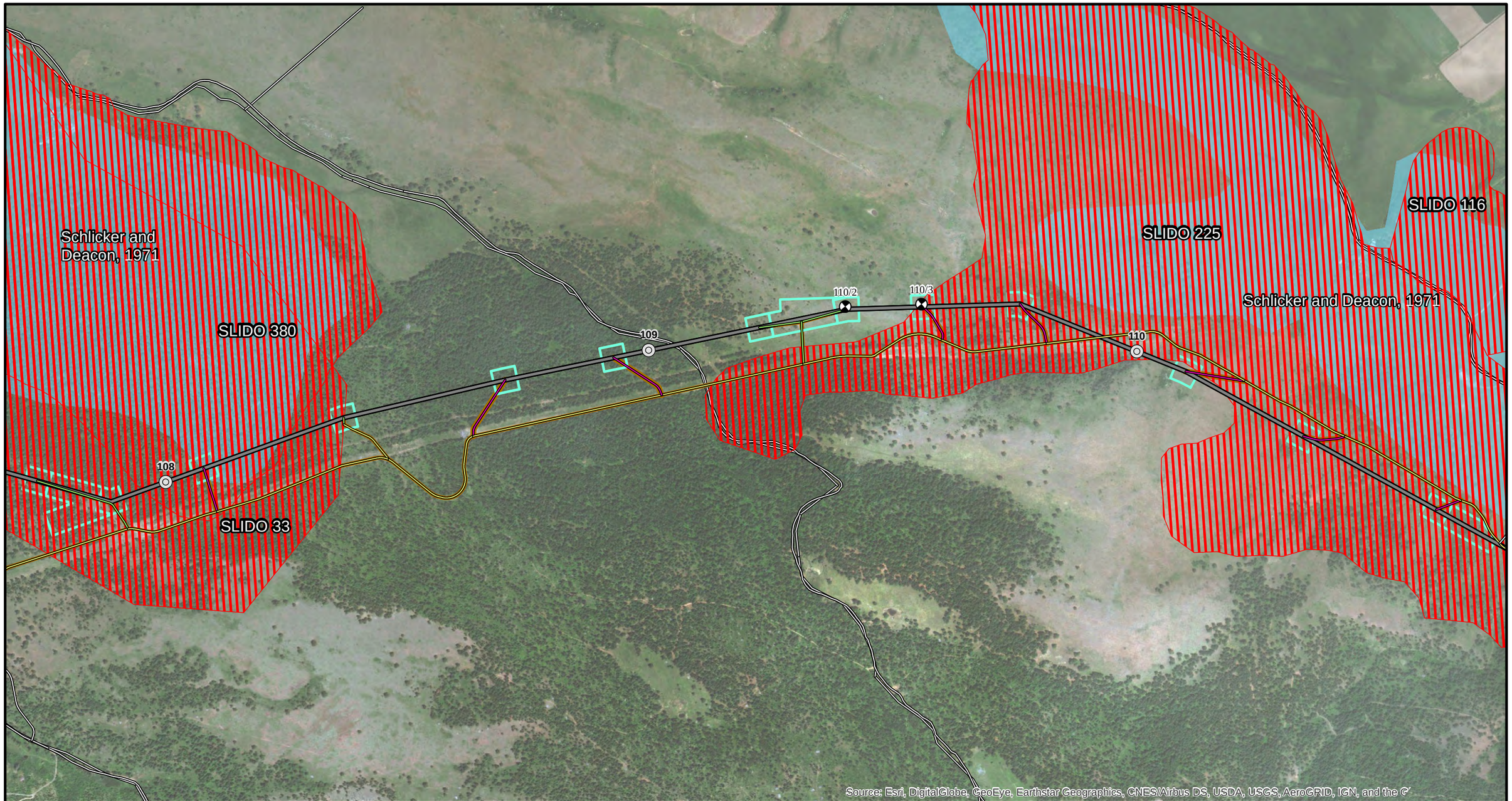

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SHANNON & WILSON, INC.
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Oregon - Idaho

LANDSLIDE INVENTORY

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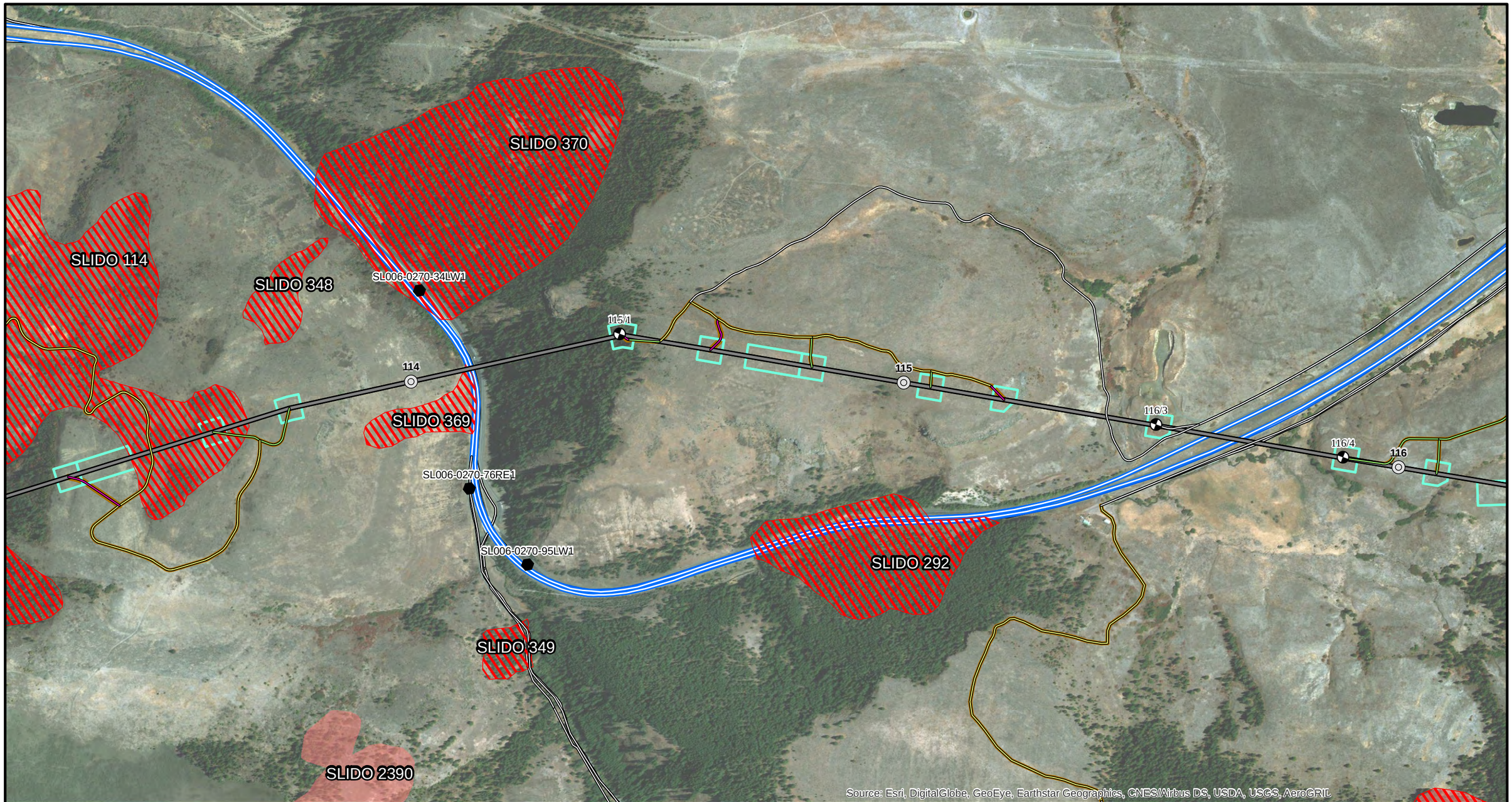

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LANDSLIDE INVENTORY

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SLIDO 117

SLIDO 112

SLIDO 293

ML-14/3

14

ML-15/2

ML-15/4

15

ML-16/1

ML-16/4

16

ML-17/2

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Communit

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SLIDO 186
SLIDO 185
SLIDO 311
SLIDO 2282
SLIDO 2281
SLIDO 2281
SLIDO 2280
SLIDO 2279
Burrash et al, 1980
SLIDO 056
SLIDO 112
SLIDO 48
116/4
116
117/2
117
118
ML-19/1
18
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ML-17/2

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SHANNON & WILSON, INC. GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

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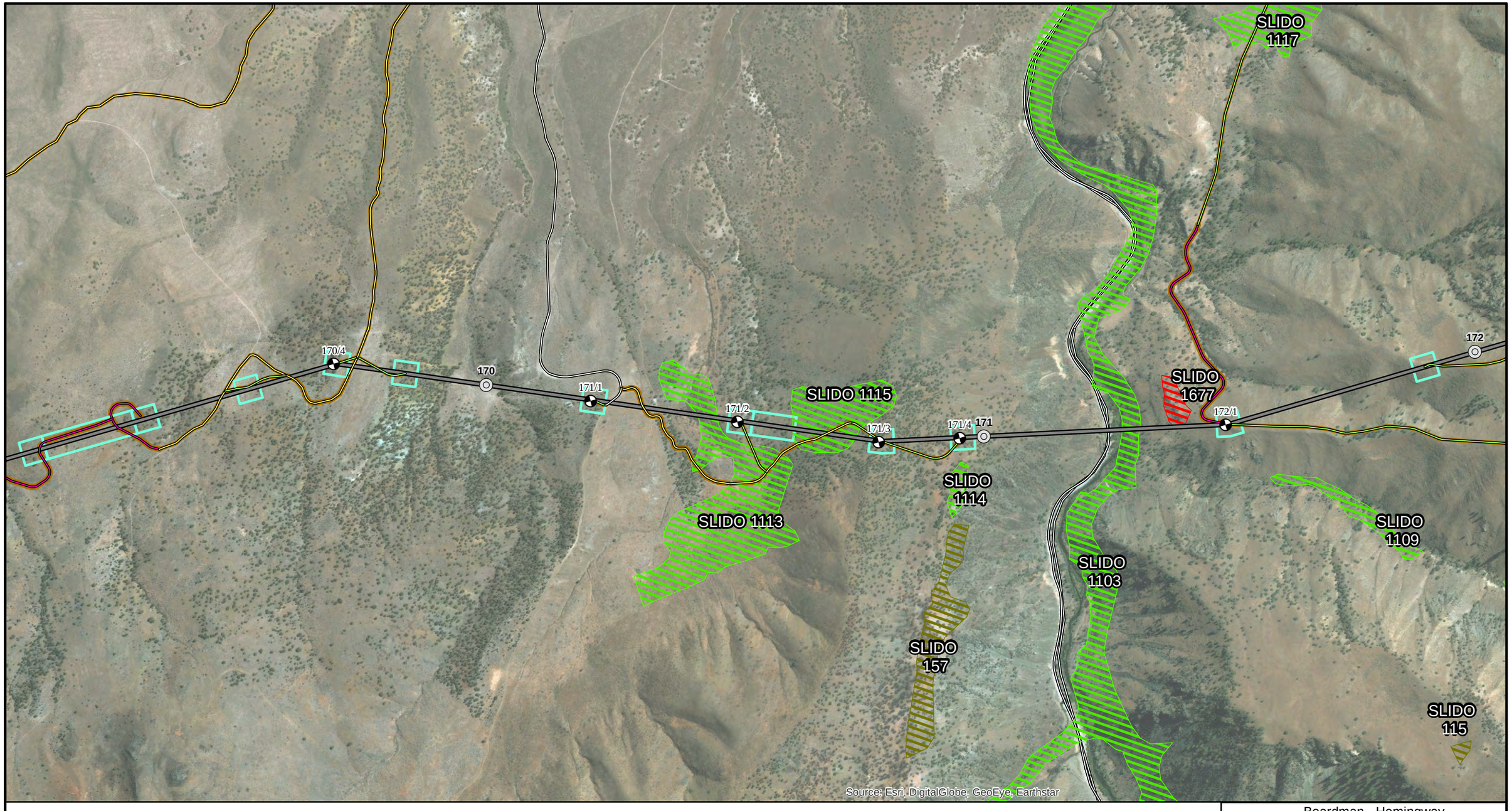

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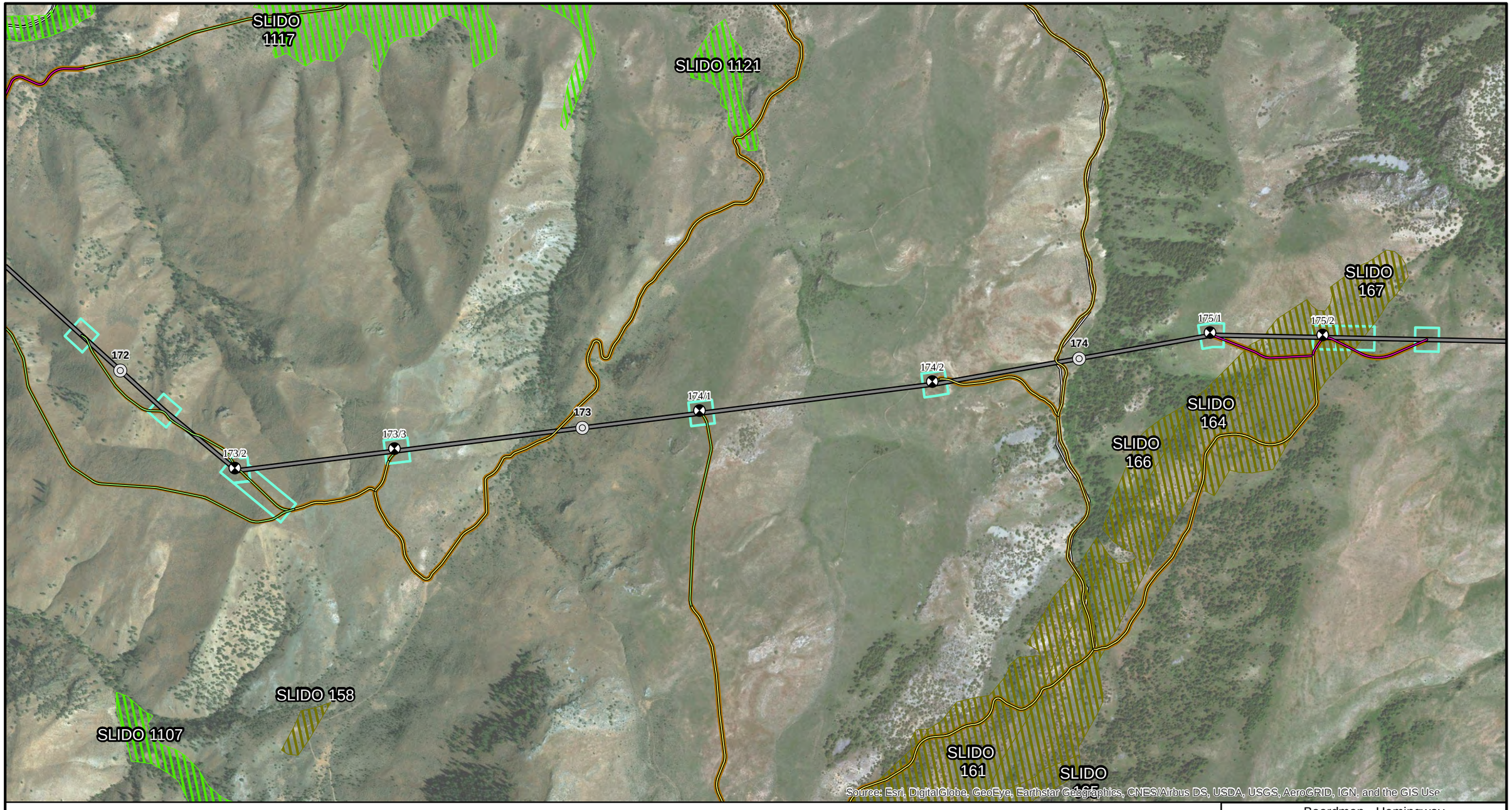

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ROADS

- New, Bladed
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SLIDO 3.4 CLASSIFICATION

- Fan
- Landslide
- Talus - Colluvium

MAPPED SLIDE FEATURES

- Flow Direction
- Scarp
- Feature Limits

0 1,000 2,000 Feet

Boardman - Hemingway
500kV Transmission Line
Oregon - Idaho

LANDSLIDE INVENTORY

April 2018 24-1-03820-006

SHANNON & WILSON, INC. GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

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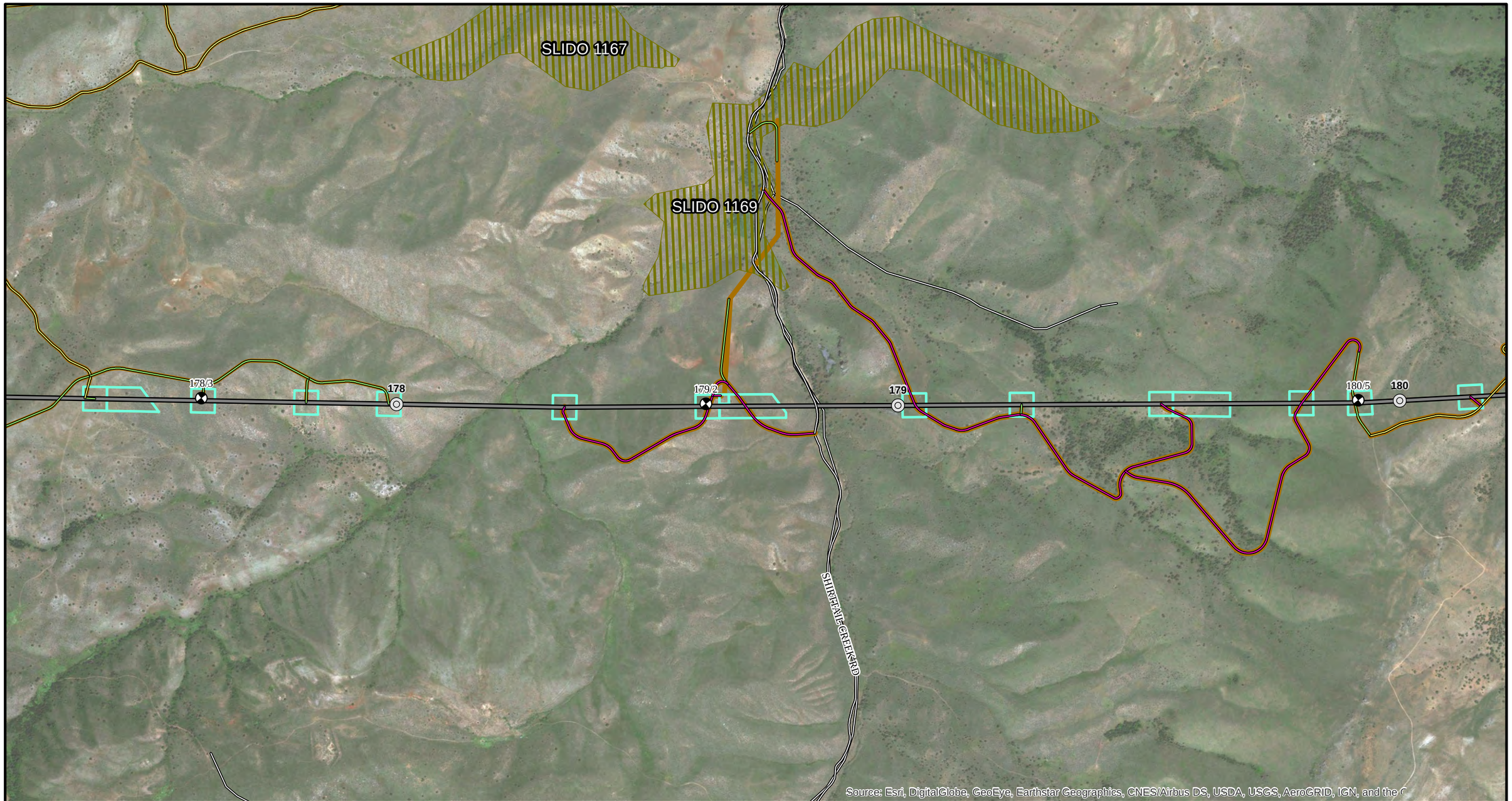

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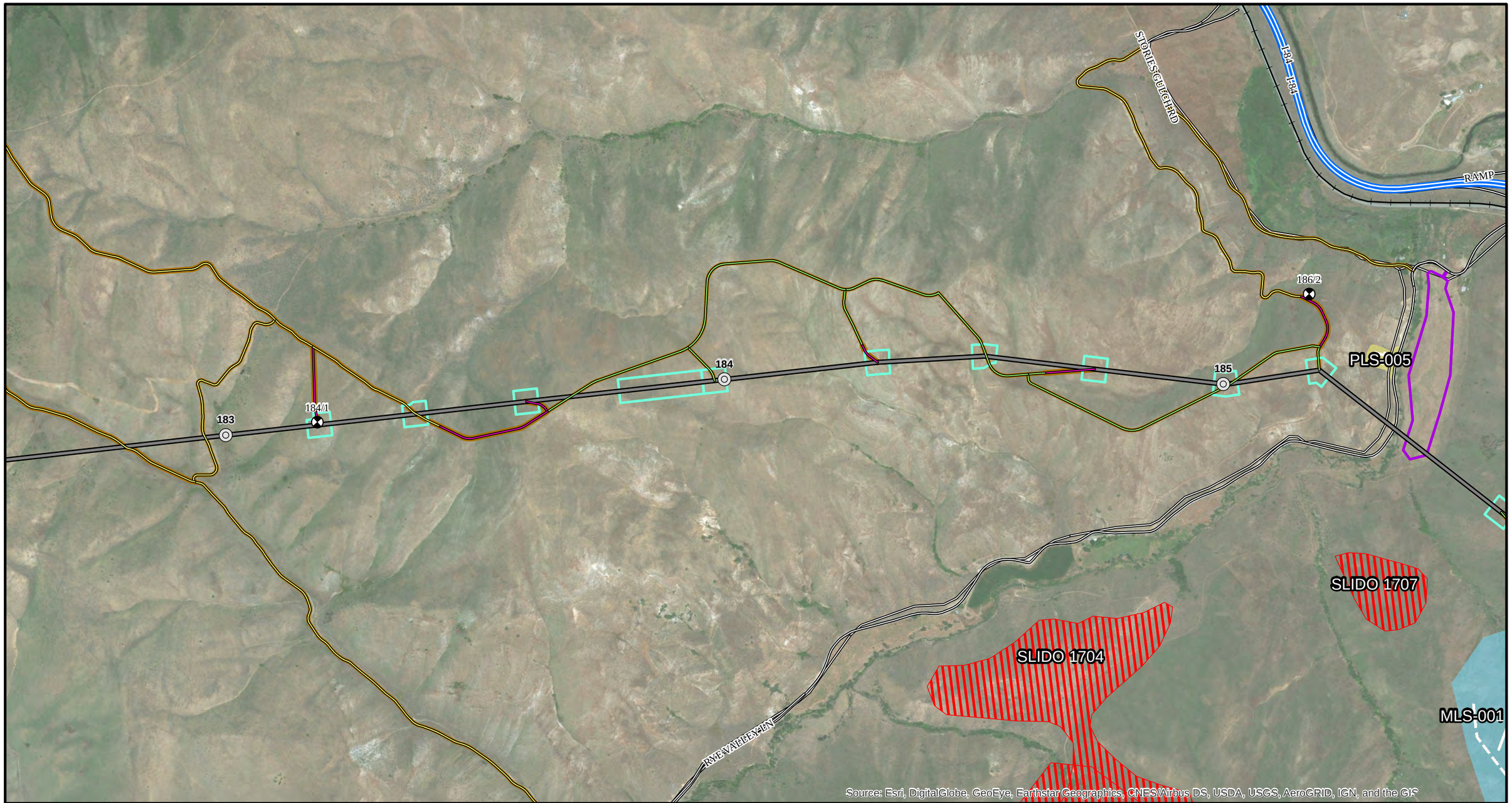

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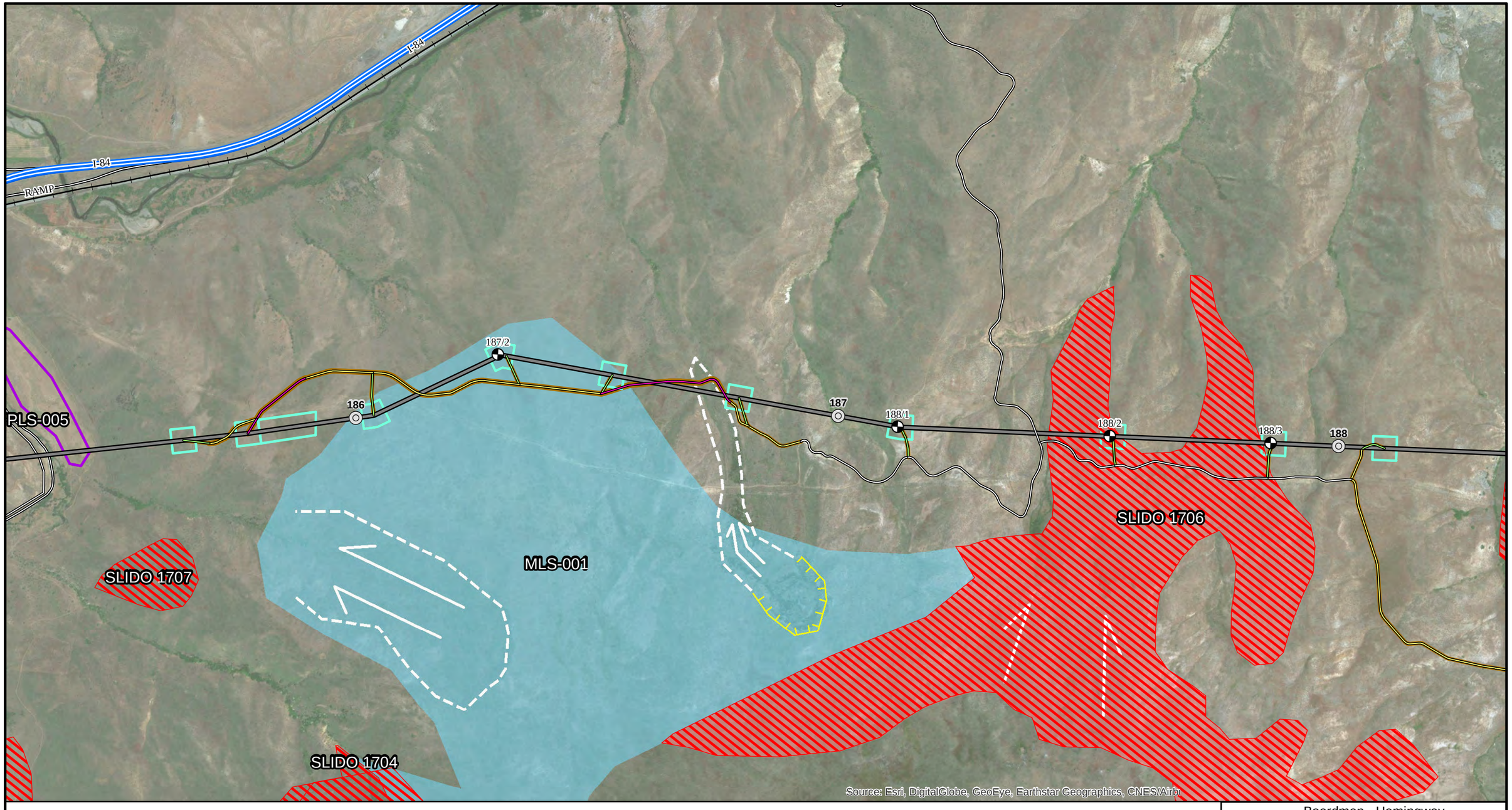

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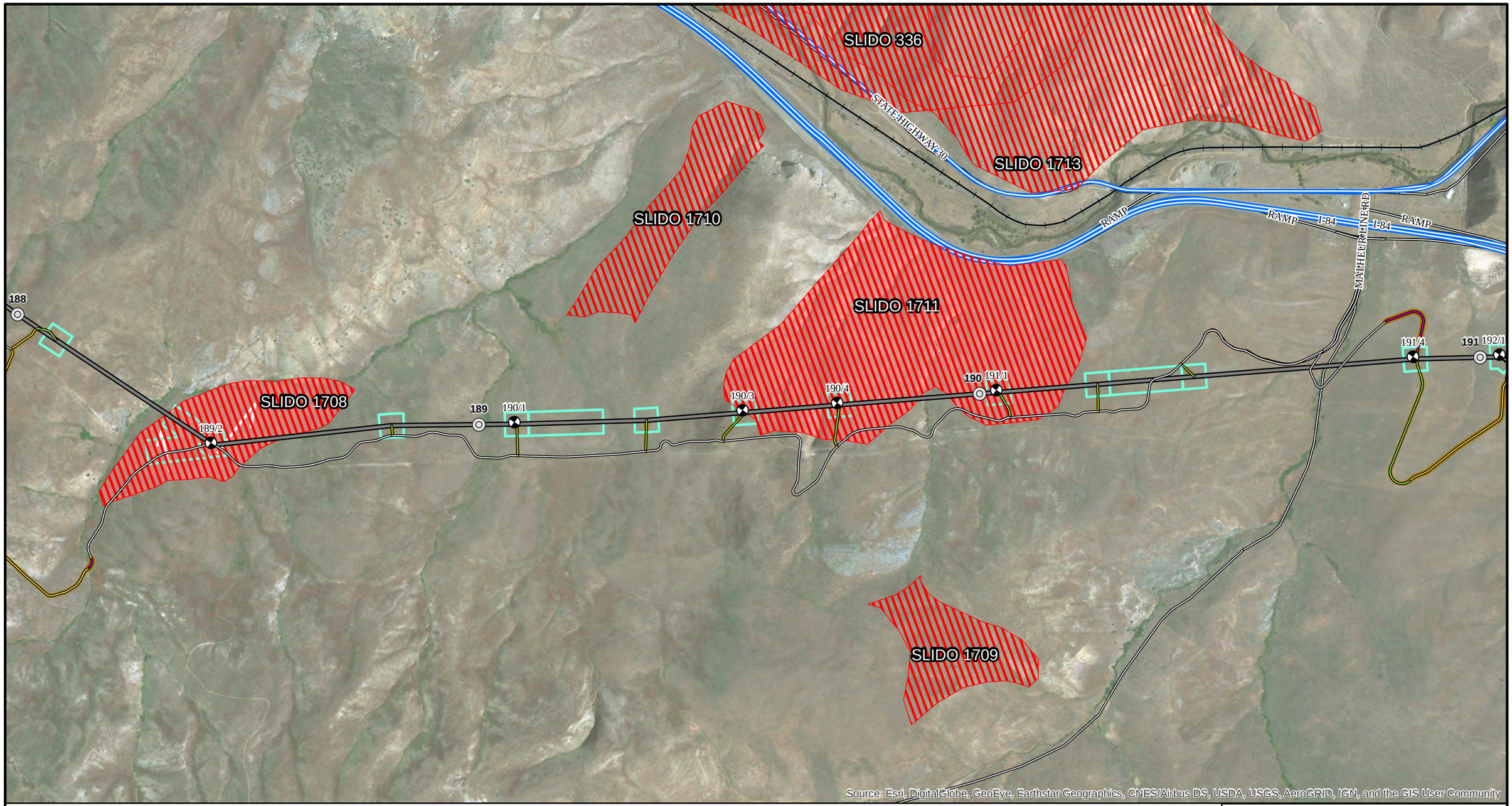

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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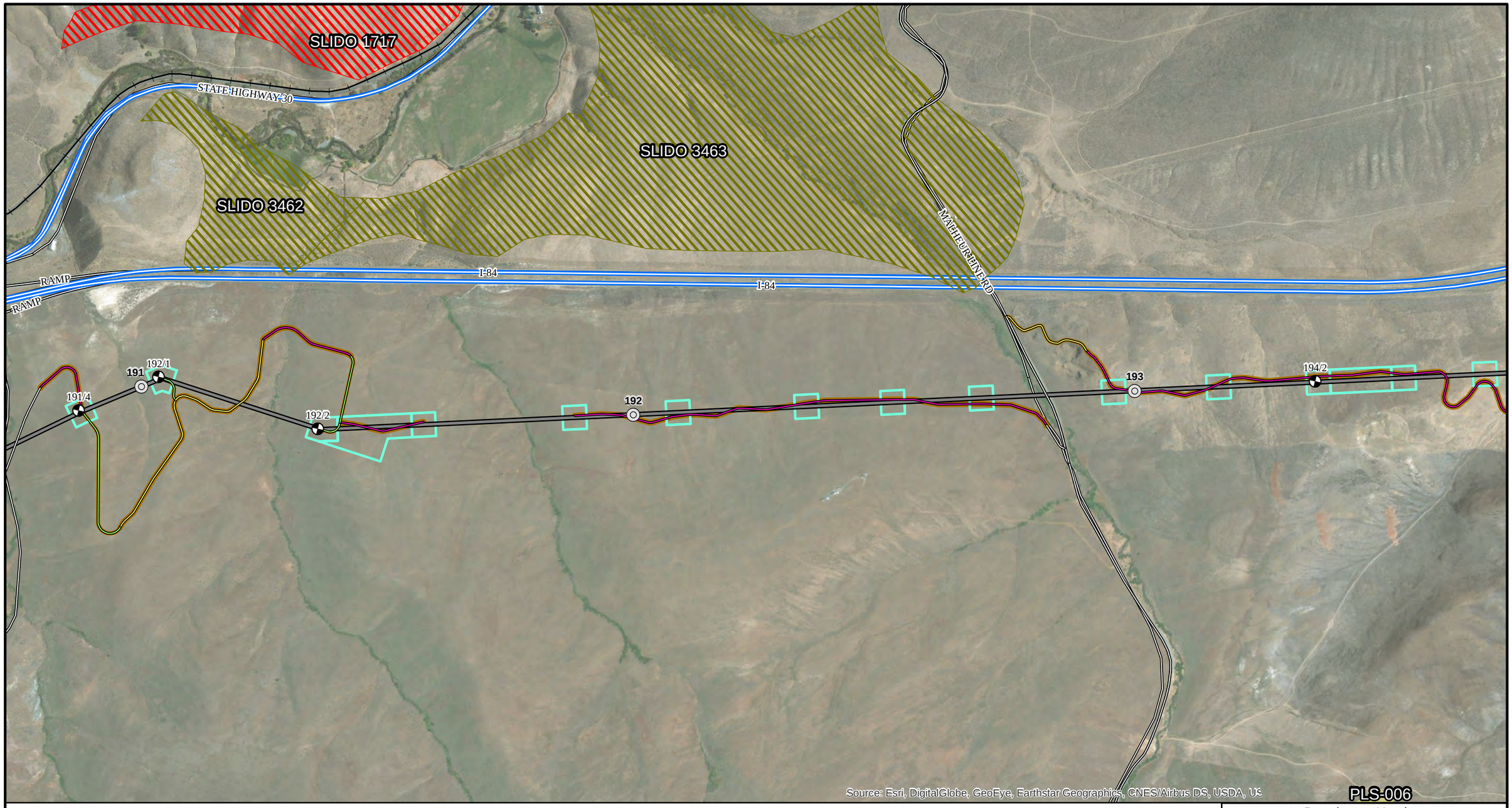

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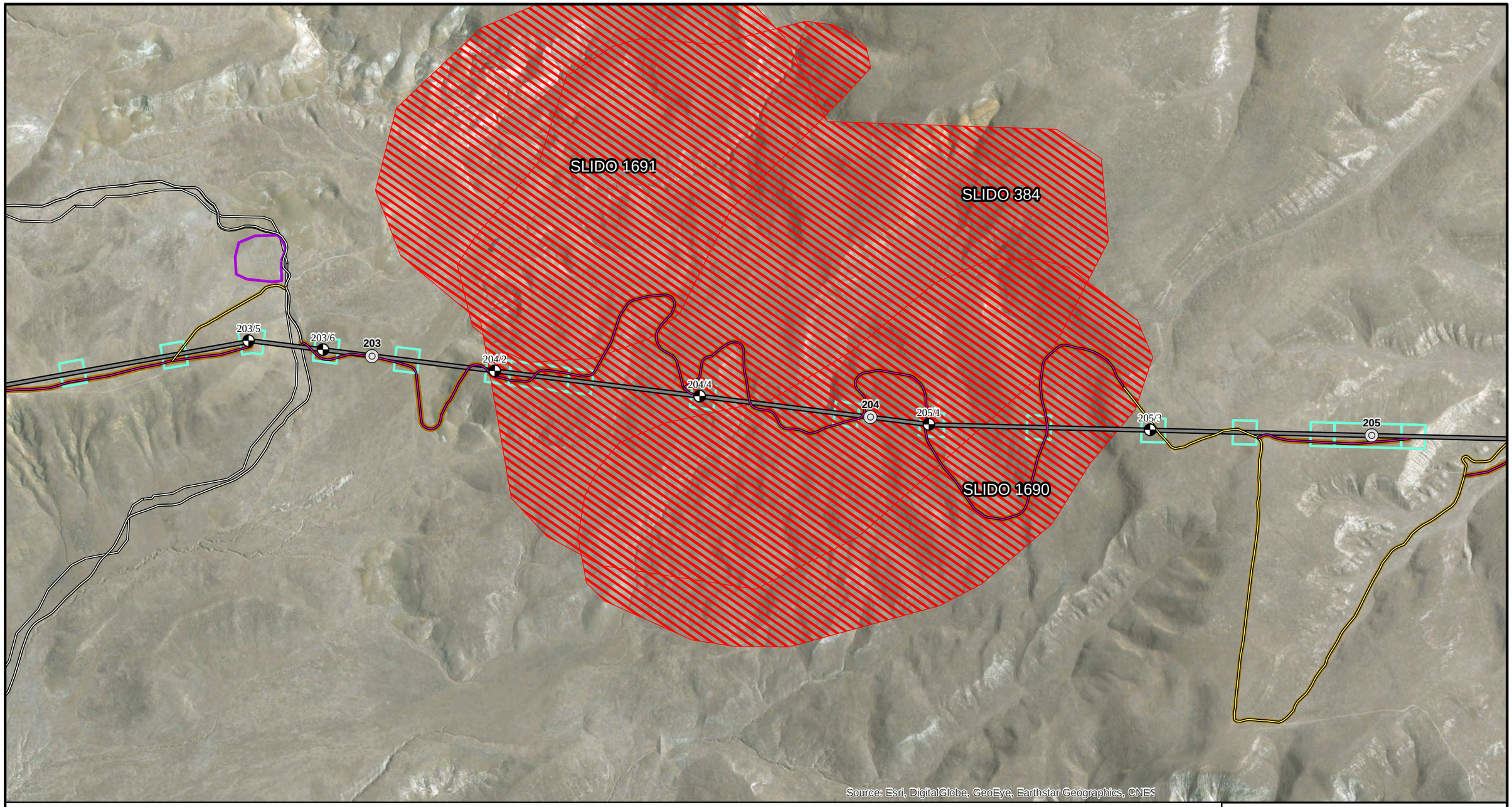

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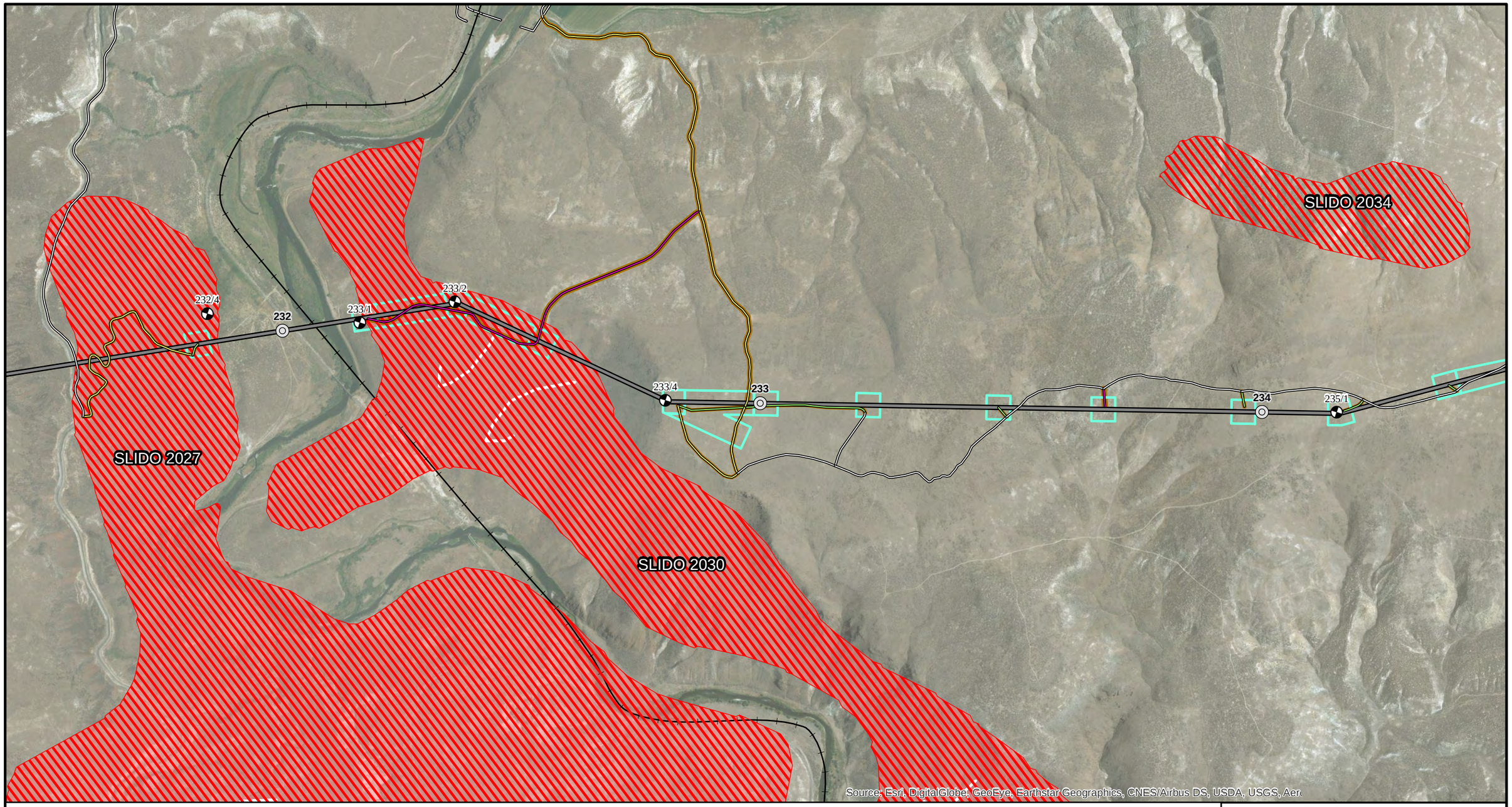

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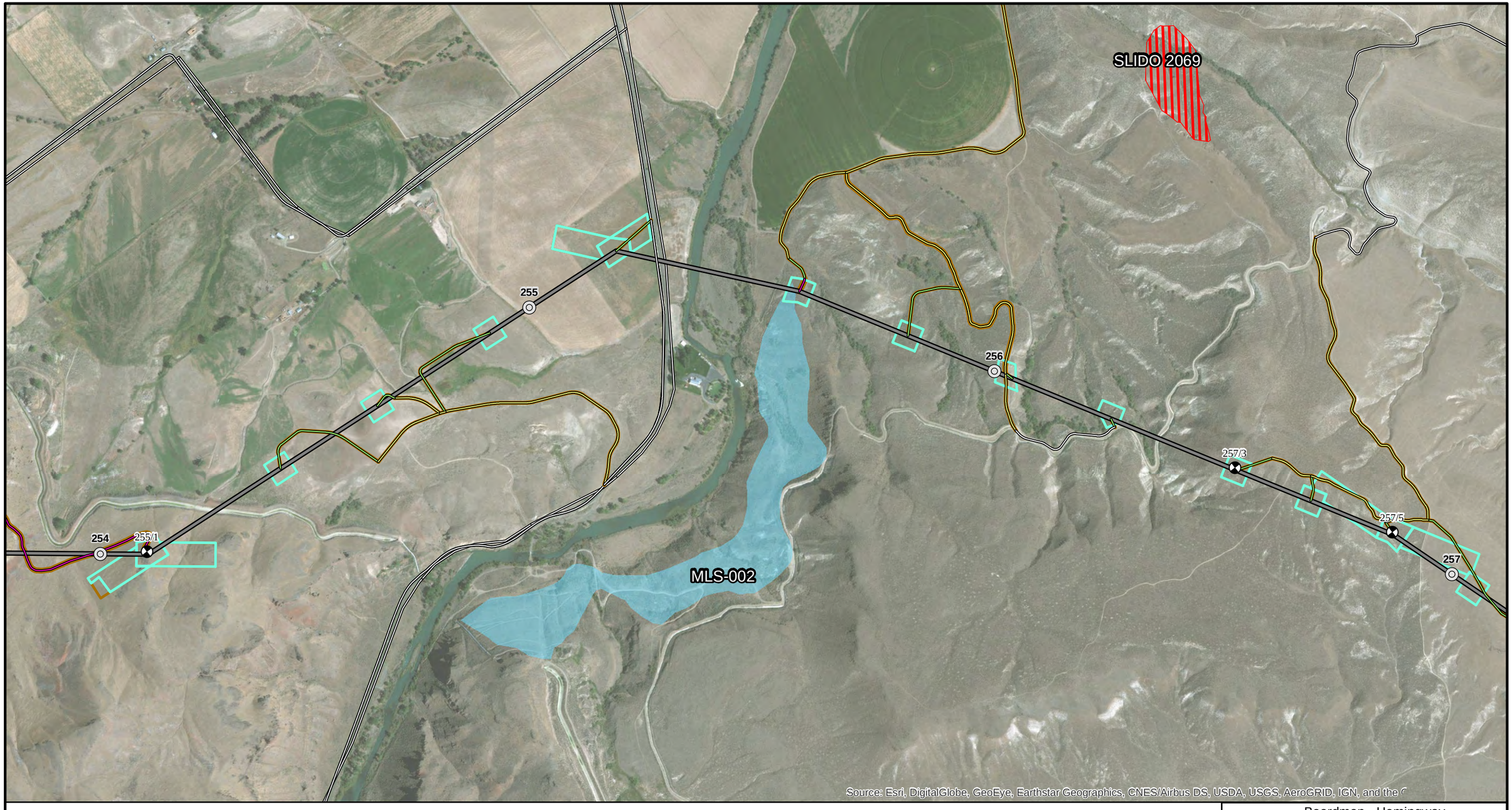

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