Environmental Minor Project Refinement Form

Project Name: West of Devers Upgrade **Request Prepared By:** Sylvia Granados

Project **Date Approval Required:** 6/9/2020 **Variance Request No.:** 37

Date Submitted: 6/2/2020 **Locations:** 6N23, 6S41, 6N42, 6S42, 6N43, 6N44, 6S44, North of Vista Substation; West of 3X50; West of 3X33 (see *Description of Change and Justification* section below and figures attached).

Landowners and Associated Parcel Numbers:

Proposed Work Area	Property Owner	Assessor's Parcel Number
6N23 Tower Site (Figure 1, page 1)	HH Management, LLC	516-030-014
6S41 Tower Site (Figure 1, page 2)	Coachella Valley Commission	517-180-004
6N42 Tower Site (Figure 1, page 3)	Coachella Valley Commission	517-180-005, 517-180-006
6S42 Tower Site (Figure 1, page 3)	Coachella Valley Commission	517-180-005
6N43 Tower Site (Figure 1, page 4)	Coachella Valley Commission	517-180-006
6N44 Tower Site (Figure 1, page 5)	Wayne Uyemura	520-080-011
6S44 Tower Site (Figure 1, page 5)	Wayne Uyemura	520-080-010, 520-080-011
TWA-2-VistaSub_MPR-37 (Figure 2, page 1)	Southern California Edison	0275-201-02
GS-3-3X50-MPR-37 (Figure 2, page 2)	Curti Family Trust 11-26-02	0294-071-01
GS-3-3X33-3X35-MPR-37 (Figure 2, page 3)	Peggy Ann Christian	473-070-015

Current Vegetative Cover/Land Use: Developed/Disturbed; Grassland Forbland; Riparian Woodland

Existing Sensitive Resource? NO ■ YES Specify: SKR suitable habitat; DETO habitat

Modifying (check as many as apply): ☐ MITIGATION MEASURE ☐ PLAN/PROCEDURE ☐ SPECIFICATION ■ DRAWING ☐ PERMIT CONDITION ☐ OTHER

Specify Source (e.g., Mitigation Measure B.5): NTP #4 Scope of Work/Work Areas and MM WQ-3

Description of Change and Justification (Attach additional sheets if needed.)

Attachments:

■ CONSTRUCTION DRAWING ☐ ADDITIONAL ENVIRONMENTAL ANALYSIS ☐ CORRESPONDENCE ☐ OTHER: _____

WOD Mitigation Measure WR-3a and SCE design standards require that SCE conduct a determination as to the lateral erosion and 100-year scour potential for watercourses near proposed structures and other above-ground features. This determination was conducted by a registered professional engineer with expertise in river mechanics, in accordance with MM WQ-3. The determination identified specific structures (listed below) that may be subject to scour and/or lateral movement in a watercourse. As a result of the scour analysis, SCE is proposing the construction of scour protection countermeasures, including protective subterranean rip-rap/grouted rip-rap structures adjacent to and as extensions of the concrete foundations for recently constructed lattice steel towers, to protect the structures against 100-year scour and/or lateral erosion.

The scour protection countermeasures will be constructed primarily of buried/partially buried rip-rap/grouted rip-rap in the following 2 configurations:

1. “Wing-walls” – Rip-rap wing walls constructed just upstream of the transmission structures for which the walls provide protection. In general, the top of the walls will remain approximately 6 inches above ground surface and buried at depths of 4 to 6 feet below the ground surface.

2. Lattice Steel Tower (LST) Foundation Boxes – Rip-rap boxes constructed to surround LST tower legs. The “box” will be approximately 25 feet wide with the individual LST tower leg foundation in the middle of the box. In general, these structures will be buried at a depth of 3.75 feet below the ground surface.

The detailed specifications for the scour protection countermeasures are based on the engineering report prepared for SCE by the Wilson Mikami Corporation for protection of LSTs, attached.

Project Description Change Only - Impacts to Permitted Permanent Impact Areas

The scour protection countermeasures will be located in areas previously approved as permanent tower disturbance areas. Where they intersect jurisdictional features, the impacts have been previously permitted. Scour protection countermeasures will be constructed within the previously approved work areas identified below and shown on Figure 1, pages 1 through 5:

6N23 - Expected high velocities near the site require a high-class rip-rap due to proximity of the wash located east of the site. Due to the size of rip-rap, a windrow revetment is the recommended countermeasure. The permanent impacts associated with these countermeasures total 0.01-acre of the previously approved disturbed tower pad area. See Figure 1, page 1 and Scour Analysis Appendix B attached for details.

6S41 - The tower is located within a large flow area with numerous flow lines with indicators of concentrated runoff (gullies and/or wash) at the tower location. Rip-rap scour countermeasures are required to stabilize 6-10-inch diameter loose cobbles and vegetation debris from upstream. The permanent impacts associated with these countermeasures total 0.046-acre of the previously approved disturbed tower pad area. See Figure 1, page 2 and Scour Analysis Appendix B attached for details.

6N42 - The tower is located within a large flow area with numerous flow lines with indicators of concentrated runoff (gullies and/or wash) at the tower location. Rip-rap scour countermeasures are required to stabilize 6-10-inch diameter loose cobbles and vegetation debris from upstream. The permanent impacts associated with these countermeasures total 0.021-acre of the previously approved disturbed tower pad area. See Figure 1, page 3 and Scour Analysis Appendix B attached for details.

6S42 - The tower is located within a large flow area with numerous flow lines with indicators of concentrated runoff (gullies and/or wash) at the tower location. Rip-rap scour countermeasures are required to stabilize 6-10-inch diameter loose cobbles and vegetation debris from upstream. The permanent impacts associated with these countermeasures total 0.056-acre of the previously approved disturbed tower pad area. See Figure 1, page 3 and Scour Analysis Appendix B attached for details.

6N43 - Due to the proximity of a wash east of the tower site, the northeast tower foundation of Tower 6N43 requires construction of the countermeasures recommended in the Scour Analysis. The permanent impacts associated with these countermeasures total 0.005-acre of the previously approved disturbed tower pad area. See Figure 1, page 4 and Scour Analysis Appendix B attached for details.

6N44 - A gully bisects the Tower 6N44 location and another gully exists east of the tower site. Scour countermeasures are required at the northwest, northeast, and southeast tower foundation in accordance with the Scour Analysis Report. The permanent impacts associated with these countermeasures total 0.042-acre of the previously approved disturbed tower pad area. See Figure 1, page 5 and Scour Analysis Appendix B attached for details.

6S44 - Scour countermeasures to be implemented at northeast foundation of 6S44 only, due to the gully that exists east of the tower site. The permanent impacts associated with these countermeasures total 0.014-acre of the previously approved disturbed tower pad area. See Figure 1, page 5 and Scour Analysis Appendix B attached for details.

The following new temporary work areas are required to safely facilitate wire wreck-out activities:

TWA-2-VistaSub-MPR-37 (Figure 2, page 1)

A new temporary 0.81-acre work area located immediately adjacent to the north side of the Vista Substation is required to stage material and equipment to facilitate the fiber-optic cable and new conduit installation from 220-kV Structure

2N36 to an existing manhole inside the Vista Substation, as shown on Figure 2, page 1. The new work area will not require site improvements in preparation for use since the area is paved.

The new work area is located within the SCE Vista Substation property and the Grand Terrace public ROW and consists of approximately 0.81-acre of developed/disturbed land.

GS-3-3X50-MPR-37 (Figure 2, page 2)

A new temporary 0.06-acre work area located immediately adjacent to the east side of WSS-3-3X50-MPR-34 is required to safely stage material and equipment associated with the wire removal from Supersites 3X29 to 3X50 and 3X51 to 3X65. The new work area will be accessed from WSS-3-3X50-MPR-34, as shown on Figure 2, page 2.

The new work area will be leveled to facilitate the guard structure construction using digger derrick trucks and other equipment associated with wreck-out activities. To the extent possible, the guards will be positioned on existing disturbed or degraded areas within the delineated work area.

The new work area is privately owned, consists of approximately 0.06-acres of grassland/forbland, and is located entirely within the SCE transmission line right-of-way in San Bernardino County.

Lisa Arnador

GS-3-3X33-3X35-MPR-37 (Figure 3, page 3)

A new temporary 0.32-acre work area located east of Redlands Boulevard and south of SF-3-3X33-3X35-2 is required to safely remove the existing Devers-Vista #1 and Devers - San Bernardino #1 circuit wires overhead. Guard structures will be erected within the new work area, on each side of an existing distribution line, to prevent circuit interruptions on the line in the event of a line drop. The work area will be accessed from SF-3-3X33-3X35-2, as shown on Figure 2, page 3.

The new work area will be leveled to facilitate the guard structure construction using digger derrick trucks and other equipment associated with wreck-out activities. To the extent possible, the guards will be positioned on existing disturbed or degraded areas within the delineated work area.

The new work area is privately owned, consists of approximately 0.22-acre developed/disturbed land and 0.10-acre riparian woodland, and is located entirely within the SCE transmission line right-of-way.

Environmental Analysis

No impacts to regulated trees, jurisdictional waters, biological, or cultural resources are anticipated during the use of the new work area.

Biological Resources

A desktop analysis was conducted for the new work area using aerial imagery, publicly available data, and project biological data. The new work areas were covered during previous surveys, including FRED Preconstruction Survey IDs 000163; 000221, 000121; and 000117, 000120. The scour sites are currently active and were covered during FRED Preconstruction Survey IDs: 000146 and 000173.

Desert Tortoise – The new work areas are not located within the range of this species, therefore no impacts to desert tortoise are anticipated. The scour countermeasure sites located within desert tortoise (DETO) modeled habitat (see Figure 1, pages 1-5). A potential (class 4) DETO burrow was observed within supersite 6X42 approximately 25 feet south of the access road during the 2011 and 2012 protocol desert tortoise surveys, however, no desert tortoise or sign have been observed within the scour countermeasure sites during preconstruction surveys, protocol desert tortoise surveys, or construction monitoring covering these areas. With surveys and monitoring, no impacts are anticipated.

Special-status Terrestrial Herpetofauna – No special-status terrestrial herpetofauna have been observed within the new work areas or scour countermeasure sites during project-related surveys. However, many species have the potential to occur throughout the project area. A preconstruction survey of the new work areas will be conducted prior to use. With implementation of mitigation measures and biological monitoring during construction, no significant impacts to special-status terrestrial herpetofauna are anticipated.

Burrowing Owl – Burrowing owl (BUOW) habitat in the form of annual and perennial grasslands and scrublands characterized by low-growing vegetation is present throughout the project area. No occupied burrows or associated buffers currently intersect the proposed work areas.

Active owl burrows observed during preconstruction surveys and during construction would be mitigated in accordance with the Burrowing Owl Management and Passive Relocation Plan. With implementation of mitigation measures, including appropriate avoidance buffers and biological monitoring during construction, no impacts to burrowing owls are anticipated.

Nesting Birds – Suitable substrates for nesting birds protected by the California Fish and Game Code and Migratory Bird Treaty Act, including trees, shrubs, man-made structures, and the ground surface, can be found throughout the project area. Preconstruction surveys, including surveys for nesting birds during the avian breeding season (Jan 1 – Aug 31), will be conducted prior to the initiation of construction in the new work areas and scour countermeasure sites. If active nests are identified, avoidance buffers will be established in accordance with the Nesting Bird Management Plan.

As shown on Figure 2 pages 1 and 3, active Red-tailed Hawk (Buteo jamaicensis) nests exist within the vicinity of TWA-2-VistaSub-MPR-37 (FRED_000556) and GS-3-3X33-3X35-MPR-37 (FRED_000835), however no active nest buffers intersect the proposed work areas. Red-tailed Hawk nest (FRED_000556) is located approximately 414 feet south of TWA-2-VistaSub-MPR-37 and common raven nest (FRED_000835) is located approximately 850 feet east of GS-3-3X33-3X35-MPR-37, both well outside the existing nest buffers. With implementation of the NBMP, no impacts are anticipated.

Observations of special-status bird species [e.g., Cooper's Hawk (FRED_Species_000321), Le Conte's Thrasher (FRED_Species_000167), American White Pelican (FRED_Species_000415), and Loggerhead Shrike (FRED_Species_000261)] have occurred in the vicinity of the work areas. However, the observations were ephemeral and are not associated with active nests. Therefore, no impacts area anticipated. If active nests are discovered in the future, impacts will be mitigated in accordance with the NBMP.

Listed Riparian Birds – No suitable habitat for riparian birds (least Bell's vireo [LBVI]/Southwestern willow flycatcher [SWFL]) occurs within 500 feet of the new work areas. Therefore, no impacts are anticipated.

Coastal California Gnatcatcher [CAGN] – No suitable habitat for CAGN occurs within 500 feet of the new work areas. Therefore, no impacts are anticipated.

Golden Eagle – Based on aerial habitat assessments, limited suitable nesting habitat for golden eagles was identified within 2 miles of the scour countermeasure sites in Segment 6. Protocol aerial surveys conducted for the project in 2019 showed no golden eagle nests within 2 miles of the survey area. Golden eagles have been observed foraging north and east of Segment 6 (Figure 1, page 1). On March 5, 2020, one GOEA of unknown age was observed soaring on the ridge approximately 0.5 miles NNW of Tower 6N23 and drifted out of sight to the north (FRED Species Event 000414). Based on information from the Coachella Valley Conservation Commission, a perennial Golden Eagle nest is located in Big Morongo Canyon, more than 2-miles from the scour countermeasure sites. Therefore, no impacts are anticipated.

Based on aerial habitat assessments and protocol surveys conducted for the project, no suitable nesting habitat for golden eagles is located within 2 miles of the new work areas. Following protocol aerial surveys conducted for the project, there are no known golden eagle nests within 2 miles of the new work areas, however an observation of one GOEA (FRED_Species_000111) occurred in the vicinity of GS-3-3X33-3X35-MPR-37 (Figure 2, page 3). However, the observation was ephemeral and not associated with an active nest. Therefore, no impacts area anticipated. If active nests are discovered in the future, impacts will be mitigated in accordance with the NBMP.

Stephens' Kangaroo Rat – Areas of suitable habitat for Stephens' kangaroo rat (SKR) are mapped within GS-3-3X50-MPR-37 (Figure 1, page 2).

A habitat assessment, pedestrian surveys, and several consecutive years of trapping surveys have been conducted within suitable habitat areas of the Project. Based on a lack of historic data, habitat conditions, and negative results over several years of surveys, SKR are not expected. Therefore, no impacts are anticipated.

To minimize temporal habitat loss, a portion of previously approved work area in San Bernardino County, which was determined to no longer be necessary for construction, will be removed from the project data and avoided to offset mapped habitat impacts to GS-3-3X50-MPR-37 (Figure 2, Page 2).

The other new work areas and scour countermeasure sites are not located within suitable habitat for the species; therefore, no impacts to SKR are anticipated.

Special-status Bats – No suitable bat roosting habitat or buffers occur within the new work areas or scour countermeasure sites; therefore, no impacts to special-status bats are anticipated.

Special-status Small Mammals – Special-status small mammals such as the pallid San Diego pocket mouse, northwestern San Diego pocket mouse, American badger, desert kit fox, San Diego desert woodrat, and/or San Diego black-tailed jackrabbit can occur in many parts of the project area. Ringtail and Palm Springs round-tailed ground squirrel are not anticipated to occur in the new work areas. If any of these species are found, potential impacts will be addressed according to the Small Mammals Avoidance and Minimization Plan.

Little pocket mouse (including Los Angeles pocket mouse [LAPM] and Palm Springs pocket mouse [PSPM] subspecies) occupied habitat is widespread throughout Segment 6. Historical observations of San Diego pocket mouse occur within supersites 6X41, 6X42, 6X43, and 6X44. The project has been designed to minimize impacts to little pocket mice to the extent feasible.

A 10-foot no-entry buffer was established around desert midden observed in Figure 1, pages 2-5, using ESA signage. If construction determines avoidance of a buffer is not possible, a qualified biologist will relocate the midden in accordance with the Special Status Small Mammal Avoidance and Minimization Plan.

Special-status Plants – Coachella Valley milk-vetch (Astragalus lentiginosus var. coachellae [CVMV]; FE, CRPR 1B.2) modeled habitat overlaps scour supersites 6S23, 6S41 and 6X42 (see Figure 1, pages 1-3). Previous comprehensive surveys have failed to locate CVMV in the survey area. Chaparral sand verbena (Abronia villosa var. aurita; CRPR 1B.1) occupied habitat intersects supersites 6X23 and associated access roads (Figure 1, page 1). White-bracted spineflower (Chorizanthe xanti var. leucotheca; CRPR 1B.2) occupied habitat are located along the access road approximately 300 feet west of supersite 6S41, approximately 200 feet north of supersite 6X43, and south of 6X42 (see Figure 1, pages 2-3). The special status plants have been flagged for avoidance.

If additional special-status plants are later identified during clearance sweeps/monitoring, they will be avoided to the extent feasible. Unavoidable impacts to special-status plants will be addressed in accordance with the Special-status Plant Salvage and Relocation Plan.

Regulated Trees – No tree trimming or tree removal is required for construction activities within the new work areas or scour countermeasure sites. Therefore, no impacts are anticipated.

Jurisdictional Waters

Where previously approved temporary and permanent work areas intersect jurisdictional features, SCE obtained permits pursuant to Sections 404 and 401 of the Clean Water Act and Section 1600 et seq. of California Fish and Game Code, as appropriate. The permanent scour design countermeasures were determined necessary by a registered professional engineer, to protect the new transmission line towers shown in Figure 1, pages 1 – 5, against 100-year scour and/or lateral erosion as required by MM WR-3a. The countermeasures are considered fill or permanent impacts with regard to jurisdictional features. Where the scour protection countermeasures intersect jurisdictional features in previously approved permanent work areas, the activity would only constitute a project description change, as permanent impacts were already permitted and mitigated accordingly. Where scour protection countermeasures intersect jurisdictional features within temporary work areas, the area would now be a permanent impact. The USACE, SWRCB, and CDFW have been notified of the proposed activities and SCE will amend the permits and mitigate accordingly, if/as needed as directed by the agencies

Non-wetland water features intersect scour site countermeasures to be constructed at tower sites 6S41 (Figure 1, page 2) and 6N42 (Figure 1, page 3). No jurisdictional water features intersect the other scour countermeasure sites or new work areas shown in Figure 1, pages 1, 4-5 or Figure 2, pages 1 - 3. With stormwater pollution prevention plan BMPs in place, no impacts to jurisdictional waters are anticipated in these locations.

Cultural Resources

The new work areas and scour countermeasure sites are located within the WOD APE and were covered within the record search data that was conducted during previous WOD surveys and studies. The record search and survey results for the new work areas and scour countermeasure sites were negative for cultural resources. *Williams, Audry. 2016. Cultural*

Resources Management Plan for Southern California Edison Company's West of Devers Transmission Line Upgrade Project, Riverside and San Bernardino Counties, California. Prepared by Southern California Edison.

Paleontological Resources

The WOD Paleontological Resources Mitigation and Monitoring Plan (PRMMP) requires full-time, qualified paleontological construction monitoring in areas determined to have moderate (PFYC 3) to very high (PFYC 5) sensitivity. Sediments of unknown (PFYC U) sensitivity shall be monitored by a qualified paleontological monitor on a part-time basis and geologic units with very low (PFYC 1) or low (PFYC 2) sensitivity may be spot checked to confirm paleontological sensitivity.

Per the PRMMP, *the types of construction activities that require monitoring or spot-checking include:*

- *Grading*
- *Drilling (if drill bit is greater than two feet in diameter)*
- *Excavation for retaining walls*
- *Excavation of construction areas*

Types of construction activities that will not require monitoring or spot-checking, regardless of paleontological sensitivity include:

- *Small diameter drill holes (less than two feet in diameter)*
- *Pile driving*
- *Project activities that do not involve ground disturbance*

The following work areas are located within areas of low PFYC 2 paleontological sensitivity and may initially be spot checked to confirm paleontological sensitivity by a qualified paleontological monitor, if grading or excavation are required:

- TWA-2-VistaSub-MPR-37
- GS-3-3X33-3X35-MPR-37
- 6N23, 6S41, 6N42, 6S42, 6N43, 6N44 and 6S44

The following work area is located within in area of moderate PFYC 3 paleontological sensitivity and requires full-time construction monitoring by a qualified paleontological monitor, if grading or excavation occur:

- GS-3-3X50-MPR-37

Resources:

Biological NO SENSITIVE RESOURCES PRESENT ■ SENSITIVE RESOURCES PRESENT ☐ N/A

New Survey Report Attached: YES ■ NO

If No, Previous Biological Survey Reference: A preconstruction survey will be conducted prior to initiating work in the new work areas. The new work areas were covered during active FRED Preconstruction Survey IDs 000163; 000221, 000121; and 000117, 000120. The scour countermeasure sites are currently active and were covered during FRED Preconstruction Survey IDs: 000146 and 000173.

Cultural : ■ NO RESOURCES PRESENT ☐ RESOURCES PRESENT WITH PROJECT APE: ☐ YES ■ NO ■ (PAVED/GRAVEL AREA AND NO GROUND DISTURBANCE)

If in APE, Previous Cultural Survey Reference:

If not in APE, attach new survey report.

The new work areas and scour countermeasure sites are located within the WOD APE and were covered within the record search data that was conducted during previous WOD surveys and studies. The record search and survey results for the work areas were negative for cultural resources. Williams, Audry. 2016. *Cultural Resources Management Plan for Southern California Edison Company's West of Devers Transmission Line Upgrade Project*, Riverside and San Bernardino Counties, California.

Other Potential Impacts: (Check any potential changes to permitted impacts and provide details below. Attach additional sheets if needed.)

☐ AIR QUALITY	☐ LAND USE	☐ TRAFFIC
☐ BIOLOGICAL RESOURCES	☐ NOISE	☐ VISUAL
☐ CONTAMINATED SOILS	☐ PALEO RESOURCES	☐ WATER RESOURCES
☐ CULTURAL RESOURCES	☐ SOCIOECONOMIC	☐ WETLANDS
☐ HAZARDOUS MATERIALS	☐ STORM WATER (SWPPP)	

NA

CEQA and Permitting: (Provide details for any "Yes" answer and attach additional information if needed.)

1. Will modification involve substantial changes that will require major changes to the CEQA document?
   ☐ YES ■ NO
2. Will modification result in new significant environmental effects or a substantial increase in the severity of previously identified impacts?
   ☐ YES ■ NO
3. Additional agency notifications and/or permit modifications required? ☐ YES ■ NO

Conditions of Approval or Reasons for Denial: (Attach additional information if needed.)

___ Required Signatures: (Attached email approvals may be used in lieu of signatures.)

__X__ Chief Construction Inspector or Foreman: ■ VARIANCE MODIFICATION IS NEEDED FOR SAFE AND EFFICIENT CONSTRUCTION

Name: Jeff Miller Signature: _____ Date: 6/2/2020

Environmental Inspector: ■ FIELD REVIEW COMPLETE

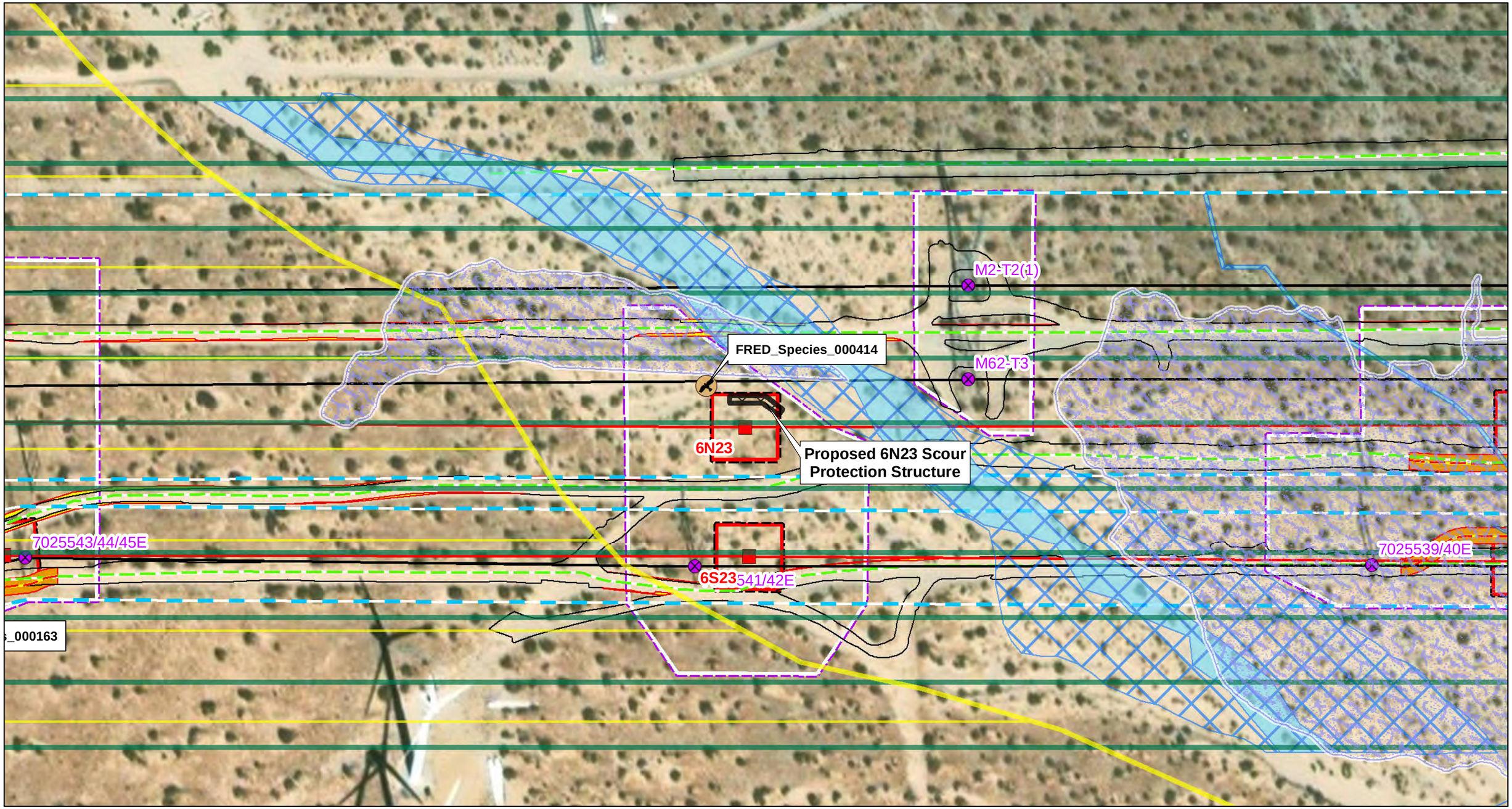
Name: Lisa Amador Signature: Lisa Amador Date: 6/2/2020

__X__ Land Agent: ■ CONSISTENT WITH EXISTING RIGHTS ☐ NEW RIGHTS OBTAINED

Name: James Spence Signature: _____ Date: 6/2/2020

__X__ Environmental Compliance Lead: ■ APPROVED ☐ APPROVED WITH CONDITIONS (SEE CONDITIONS ABOVE) ☐ DENIED

Name: Sylvia Granados Signature: Sylvia Granados Date: 6/2/2020



SOUTHERN CALIFORNIA EDISON
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SCE, ESRI World Imagery

LEGEND

- Scour Protection Structure
- Chaparral Sand Verbena

FRED Species Event

- Golden Eagle
- Coachella Valley Milk-Vetch Modeled Habitat
- Desert Tortoise Modeled Habitat

Non-wetland Waters

- CDFW Jurisdiction
- USACE/RWQCB Jurisdiction

Major Trans Structure

- Proposed

- Remove

Major Trans Line

- Proposed
- Existing

Civil Access Roads Lines

- New Access Road
- Existing Access Road

Civil Access Road Areas

- Existing Road Edge
- Designed Road Boundary
- Potential Road Widening
- Existing ROW

Construction Areas

- O&M Tower Area
- Structure Work Area

FIGURE 1

Southern California Edison
West of Devers Upgrade Project
Proposed Scour Protection Areas
MPR #37

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FRED_Species_000167

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7025600/01E

6S41

Proposed 6S41 Scour Protection Structures

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SCE, ESRI World Imagery

LEGEND

- Scour Protection Structure
- White-Bracted Spineflower

FRED Species Event

- Le Conte's Thrasher

FRED Habitat Event

- Desert Woodrat (10ft Buffer)
- Coachella Velley Milk-Vetch Modeled Habitat
- Desert Tortoise Modeled Habitat

Non-wetland Waters

- CDFW Jurisdiction
- USACE/RWQCB Jurisdiction

Major Trans Structure

- Proposed
- Remove

Major Trans Line

- Proposed
- Existing

Civil Access Roads Lines

- New Access Road
- Existing Access Road

Civil Access Road Areas

- Existing Road Edge
- Designed Road Boundary

- Potential Road Widening
- Existing ROW

Construction Areas

- O&M Tower Area
- Structure Work Area
- Wire Setup

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FIGURE 1

Southern California Edison
West of Devers Upgrade Project
Proposed Scour Protection Areas
MPR #37

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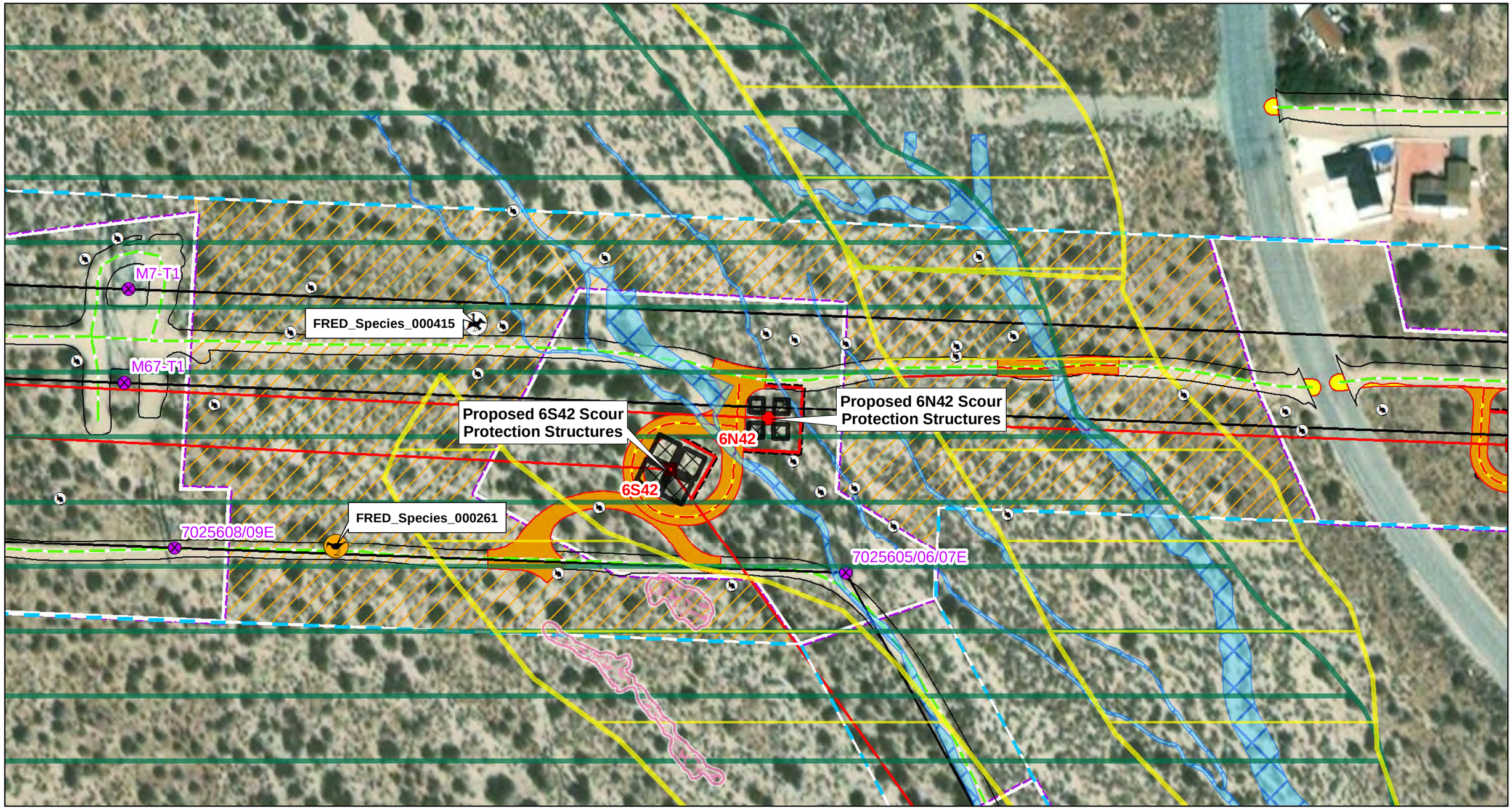

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SCE, ESRI World Imagery

LEGEND

- Scour Protection Structure
- White-Bracted Spineflower

FRED Species Event

- American White Pelican
- Loggerhead Shrike

FRED Habitat Event

- Desert Woodrat (10ft Buffer)
- Coachella Valley Milk-Vetch Modeled Habitat
- Desert Tortoise Modeled Habitat

Non-wetland Waters

- CDFW Jurisdiction
- USACE/RWQCB Jurisdiction

Major Trans Structure

- Proposed
- Remove

Major Trans Line

- Proposed
- Existing

Civil Access Roads Lines

- New Access Road
- Existing Access Road

Civil Access Road Areas

- Existing Road Edge
- Designed Road Boundary
- Potential Road Widening
- Existing ROW

Construction Areas

- O&M Tower Area
- Structure Work Area
- Wire Setup

FIGURE 1

Southern California Edison
West of Devers Upgrade Project
Proposed Scour Protection Areas
MPR #37

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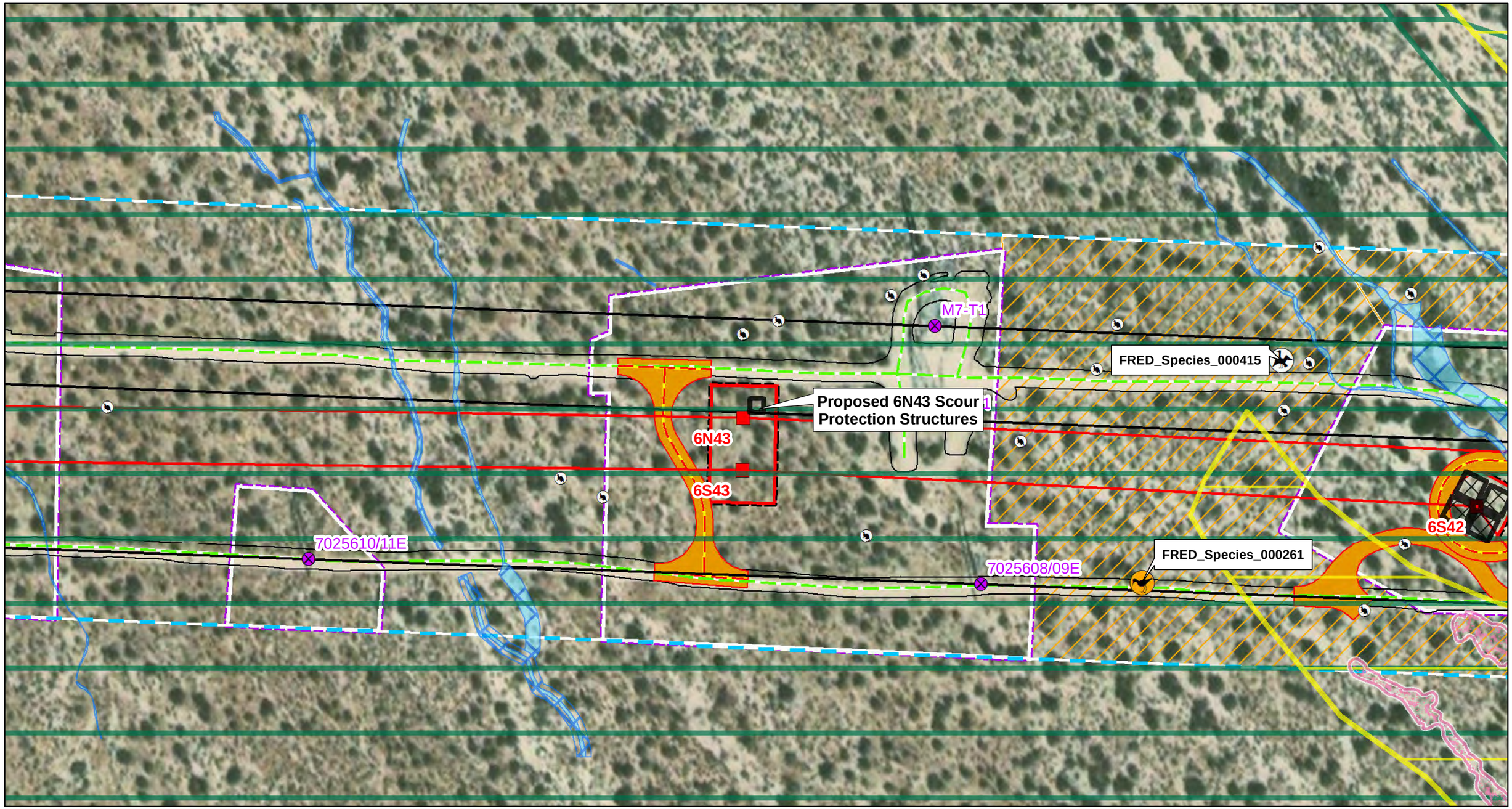

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SCE, ESRI World Imagery

LEGEND

- Scour Protection Structure
- White-Bracted Spineflower

FRED Species Event

- American White Pelican
- Loggerhead Shrike

FRED Habitat Event

- Desert Woodrat (10ft Buffer)
- Coachella Valley Milk-Vetch Modeled Habitat
- Desert Tortoise Modeled Habitat

Non-wetland Waters

- CDFW Jurisdiction
- USACE/RWQCB Jurisdiction

Major Trans Structure

- Proposed
- Remove

Major Trans Line

- Proposed
- Existing

Civil Access Roads Lines

- New Access Road
- Existing Access Road

Civil Access Road Areas

- Existing Road Edge
- Designed Road Boundary
- Existing ROW

Construction Areas

- O&M Tower Area
- Structure Work Area
- Wire Setup

FIGURE 1

Southern California Edison
West of Devers Upgrade Project
Proposed Scour Protection Areas
MPR #37

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Proposed 6N44 & 6S44 Scour Protection Structures

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0 50 100

FEET

SCE, ESRI World Imagery

LEGEND

Scour Protection Structure

FRED Habitat Event

Desert Woodrat (10ft Buffer)

Desert Tortoise Modeled Habitat

Non-wetland Waters

CDFW Jurisdiction

USACE/RWQCB Jurisdiction

Major Trans Structure

Proposed

Remove

Major Trans Line

Proposed

Existing

Civil Access Roads Lines

New Access Road

Existing Access Road

Civil Access Road Areas

Existing Road Edge

Designed Road Boundary

Potential Road Widening

Existing ROW

Construction Areas

O&M Tower Area

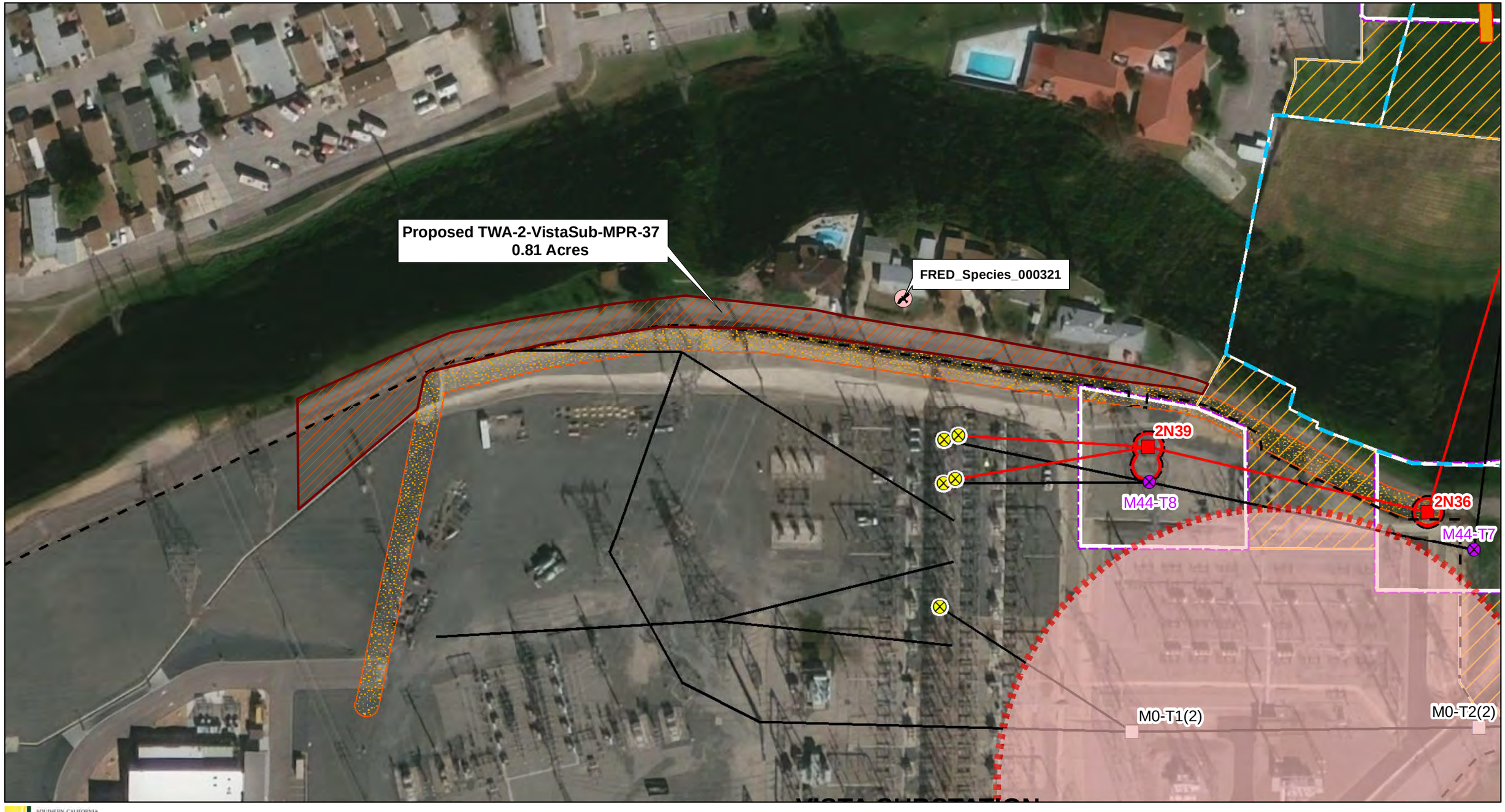
Structure Work Area

FIGURE 1

Southern California Edison
West of Devers Upgrade Project
Proposed Scour Protection Areas
MPR #37

\\galt\Proj\SoCalEDISON\493461\MapFiles\Plans\MPR_37_2020-05-22\Fig1_MPR37_Scour_Protection_Areas_6N44_6S44_2020-06-01.mxd (6/1/2020)

JACOBS



SOUTHERN CALIFORNIA EDISON
An EDISON INTERNATIONAL™ Company

N

0 50 100
FEET

SCE, ESRI World Imagery

LEGEND

- Proposed MPR #37 Work Area
- Proposed Offset Area

FRED Active Nest Buffer

- Red-tailed Hawk (300ft Buffer)

FRED Species Event

- Cooper's Hawk

Major Trans Structure

- Proposed
- Modify
- Remove
- Existing

Major Trans Line

- Proposed
- Existing

Civil Access Road Areas

- Designed Road Boundary
- Existing Substation Area
- Existing ROW

Construction Areas

- General Disturbance Area
- O&M Tower Area
- Structure Work Area
- Wire Setup

FIGURE 2

Southern California Edison
West of Devers Upgrade Project
Proposed Work Areas
MPR #37

\\galt\Proj\SoCalEDISON\493461\MapFiles\Plans\MPR_37_2020-05-22\Fig2_MPR37_Work_Areas_2020-06-01.mxd (6/1/2020)

JACOBS

PP#123237

Proposed GS-3-3X50-MPR-37
0.06 Acres

3S65

FRED_Species_000103

M3-T2

Proposed Offset Area
0.06 Acres

3N50

PP#123238

3S50

M37-T1

M97-T1

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N

0 50 100
FEET

SCE, ESRI World Imagery

LEGEND

- Proposed MPR #37 Work Area
- Proposed Offset Area
- Stephens' Kangaroo Rat Suitable Habitat

Non-wetland Waters

- CDFW Jurisdiction
- USACE/RWQCB Jurisdiction

Major Trans Structure

- Proposed
- Remove

Major Trans Line

- Proposed
- Existing

Civil Access Roads Lines

- New Access Road
- Existing Access Road

Civil Access Road Areas

- Existing Road Edge
- Designed Road Boundary

- Potential Road Widening
- Existing ROW

Construction Areas

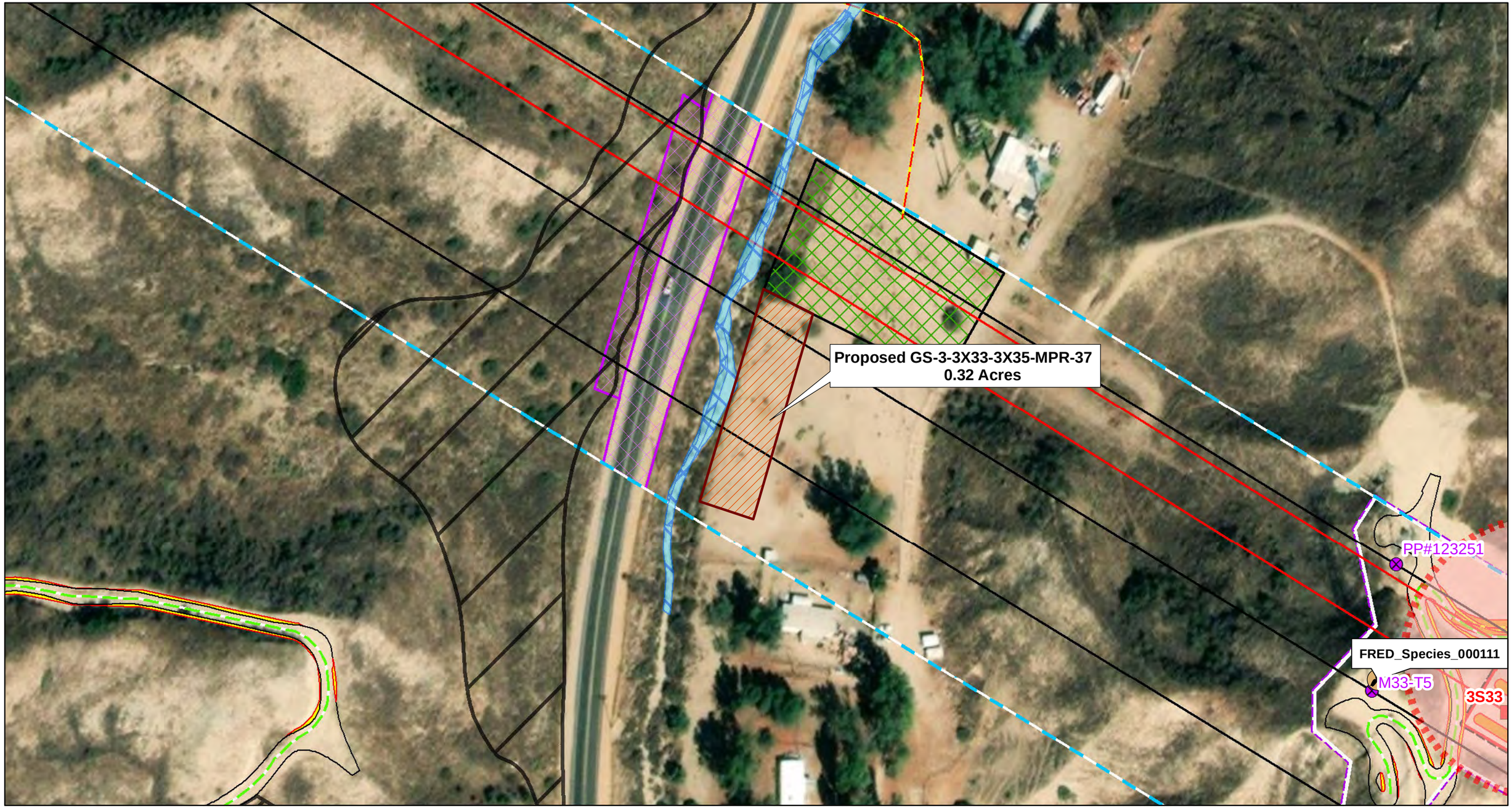
- O&M Tower Area
- Structure Work Area

FIGURE 2

Southern California Edison
West of Devers Upgrade Project
Proposed Work Areas
MPR #37

\\galt\Proj\SoCalEDISON\493461\MapFiles\Plans\MPR_37_2020-05-22\Fig2_MPR37_Work_Areas_2020-06-01.mxd (6/1/2020)

JACOBS



SOUTHERN CALIFORNIA EDISON
An EDISON INTERNATIONAL™ Company

N

0 50 100
FEET

SCE, ESRI World Imagery

LEGEND

- Proposed MPR #37 Work Area
- Proposed Offset Area
- Stephens' Kangaroo Rat Suitable Habitat

FRED Active Nest Buffer

- Common Raven (150ft Buffer)

FRED Species Event

- Golden Eagle

Non-wetland Waters

- CDFW Jurisdiction
- USACE/RWQCB Jurisdiction

Major Trans Structure

- Proposed
- Remove

Major Trans Line

- Proposed
- Existing

Civil Access Roads Lines

- New Access Road
- Existing Access Road

Civil Access Road Areas

- Existing Road Edge
- Designed Road Boundary

- Potential Road Widening
- Existing ROW

Construction Areas

- Construction Work Site
- Guard Pole
- O&M Tower Area
- Structure Work Area

FIGURE 2

Southern California Edison
West of Devers Upgrade Project
Proposed Work Areas
MPR #37

\\galt\Proj\SoCalEDISON\493461\MapFiles\Plans\MPR_37_2020-05-22\Fig2_MPR37_Work_Areas_2020-06-01.mxd (6/1/2020)

JACOBS

SCOUR COUNTERMEASURES REPORT

WEST OF DEVERS
SOUTHERN CALIFORNIA EDISON

LATTICE STEEL TOWERS

County of Riverside

Prepared For:

Southern California Edison
One Innovation Way
Pomona, CA 91768

Prepared By:

WILSON•MIKAMI•CORPORATION
9 CORPORATE PARK•SUITE 100•IRVINE•CA•92606
PHONE: (949) 679-0090 FAX: (949) 679-0091

Job No. 10074.14

March 2018
Revised August 2019

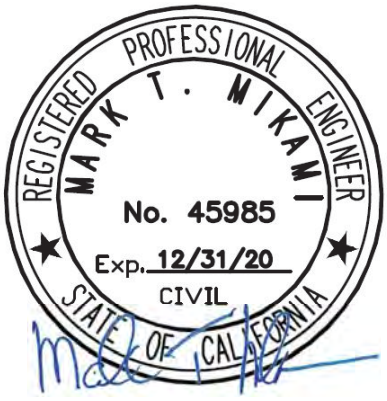


TABLE OF CONTENTS

VOLUME I

* *Articulated Concrete Block removed as an option for scour countermeasure.*

I. INTRODUCTION

Wilson Mikami Corporation (WMC) has prepared this report for Southern California Edison to provide information on scour countermeasures at tower sites within the West of Devers 220kV Transmission line project. Sites analyzed are from the Scour Analysis Report, Volume I (ref. 1), previously produced by WMC. Initially site locations for analysis were pulled from the Geotechnical Report prepared by Kleinfelder (ref.2), Table 6-3, which indicates tower sites with scour potential. Tower sites are located within the unincorporated areas of Riverside County (see Vicinity Map).

Tower sites 4N64 and 4N65 are not included in this report because they were designed for 20-feet of scour and their calculated potential scour depth was calculated at 12-feet per separate Flood Hazard Report (ref. 4). No surface protection would be required at these tower sites.

All sites were initially evaluated for rip-rap protection. ~~Those that required a rip-rap class equal to or greater than Class IV (d_{50}=15 in, W_{50}=300 lbs) were evaluated for Articulated Concrete Block (ACB).~~

Articulated Concrete Block (ACB) was removed as a countermeasure in the revised report. In addition, scour countermeasure implementation was revised at sites based on observations and recommendations contained in the ***Tower Scour Site Visit Memo*** *included in Appendix F. See Table 1 Summary of Results for revised implementation of scour countermeasures.*

II. SCOUR COUNTERMEASURES

A. RIP-RAP METHODOLOGY

Sites were first evaluated using Hydraulic Engineering Circular (HEC) No. 23 (ref. 3). Design Guideline 11, Rock Rip-Rap at Bridge Piers, was used to size the rip-rap. Formula 11.1 solved for the median stone diameter (d_{50}). Formula 11.2 solved for the design velocity given an average velocity that was determined for each site in the previous Scour Report (ref. 1).

Spreadsheets can be found in Appendix A that calculate the d_{50} for each site. Results show that scour at sites 6X41 through 6X45 can be countered using Class II rip-rap, while the remaining sites will require Class IV or larger rip-rap. ~~Sites 5X05, 5X19, 6X23 and 6S32 will be evaluated with the ACB system.~~

Exhibits can be found in Appendix B for sites that will be using the rock rip-rap countermeasure for surface protection as well as Tables 4.1 and 4.2 from HEC-23 that give guidance on size and weight of rip-rap classes.

~~B. ARTICULATED CONCRETE BLOCK (ACB) METHODOLOGY~~

~~Sites requiring surface protection equal to or greater than Class IV rip-rap were evaluated using Design Guideline 8 of HEC No. 23 (ref. 3) for use of an ACB system to provide required protection at tower legs.~~

~~The hydraulic stability of ACB system is analyzed using a Target Factor of Safety (FS), based on Fig. 8.2 from the Guideline, and a calculated FS given the specific site hydraulics and geometry, as well as the particular ACB specifications. The product FS must be greater than the target FS in order for the particular block class to be acceptable.~~

~~Calculations for the ACB sites can be found in Appendix C. A spreadsheet was used to first determine the target FS, a local shear stress, and then a FS for the particular block being evaluated. Calculations were made on a number of different blocks, but only the acceptable block class was included in the Appendix.~~

~~Exhibits can be found in Appendix D for sites that will be using the ACB countermeasure for surface protection.~~

III. RESULTS

Results for all calculations can be found in Appendices A ~~and C~~. Site exhibits may be found in Appendices B ~~and D~~.

~~WMC evaluated the use of "Armorflex" system manufactured by Contech for sites where the rip-rap class exceeded Class IV. Calculations determined that block class 85-L will provide the required surface protection at all sites that exceeded Class IV rip-rap.~~

Table 1 follows and gives a summary of all sites and countermeasures.

See Appendix E for an engineer's estimate of cost.

TABLE 1
SUMMARY TABLE OF RESULTS

TOWER	COUNTERMEASURE SYSTEM	RIP-RAP CLASS	BLOCK CLASS "ARMORFLEX"	TARGET FS (ACB)	PRODUCT FS (ACB)
4N64	NONE REQUIRED	N/A	N/A	N/A	N/A
4N65	NONE REQUIRED	N/A	N/A	N/A	N/A
5N05 [1]	~~ACB~~	~~IV~~	~~85-L~~	~~4.2~~	~~13.5~~ *
5S05 [1]	~~ACB~~	~~IV~~	~~85-L~~	~~4.2~~	~~13.5~~ *
5N19 [2]	~~ACB~~	~~X~~	~~85-L~~	~~4.2~~	~~4.5~~ *
5S19 [2]	~~ACB~~	~~X~~	~~85-L~~	~~4.2~~	~~4.5~~ *
6N23 [7]	RIP-RAP ~~ACB~~	VII	~~85-L~~	~~4.2~~	~~8.1~~ *
6S23 [2]	~~ACB~~	~~VII~~	~~85-L~~	~~4.2~~	~~8.1~~ *
6S32 [2]	~~ACB~~	~~X~~	~~85-L~~	~~4.2~~	~~4.6~~ *
6S41 [3]	RIP-RAP	IV ~~II~~	N/A	N/A	N/A
6N42 [3]	RIP-RAP	IV ~~II~~	N/A	N/A	N/A
6S42 [3]	RIP-RAP	IV ~~II~~	N/A	N/A	N/A
6N43 [4]	RIP-RAP	II	N/A	N/A	N/A
6S43 [2]	~~RIP-RAP~~	~~II~~	~~N/A~~	~~N/A~~	~~N/A~~
6N44 [5]	RIP-RAP	II	N/A	N/A	N/A
6S44 [6]	RIP-RAP	II	N/A	N/A	N/A
6N45 [2]	~~RIP-RAP~~	~~II~~	~~N/A~~	~~N/A~~	~~N/A~~
6S45 [2]	~~RIP-RAP~~	~~II~~	~~N/A~~	~~N/A~~	~~N/A~~

*[1] Recommended that scour countermeasures **not** be implemented at tower site. A soil cement berm is recommended along the southerly edge of the proposed access road and north of the 5N05 tower to divert runoff away from the tower foundations. The berm will be added to the Access Road Rough Grading Plans.*
*[2] Recommended that scour countermeasures **not** be implemented at all tower foundations.*
[3] Rip-rap scour countermeasures upsized two classes due to observation of 6"-10" loose cobbles at tower site, see Appendix F site visit memo.
[4] Scour countermeasures to be implemented at northeasterly foundation of 6N43 only, see Appendix F site visit memo.
[5] Scour countermeasures to be implemented at northwesterly, northeasterly and southeasterly foundations of 6N44 only, see Appendix F site visit memo.
[6] Scour countermeasures to be implemented at northeasterly foundation of 6S44 only, see Appendix F site visit memo.
[7] Expected high velocities near site require a high class of rip-rap to be utilized. Due to the size of rip-rap, a windrow revetment is the recommended countermeasure. See Appendix B site exhibit for details.

** Articulated Concrete Block removed as an option for scour countermeasure.*

IV. REFERENCES

1. Scour Analysis Report, Volume I, Wilson Mikami Corporation, November 2017.
2. Geotechnical Investigation Report for West of Devers Upgrade Project, Kleinfelder, 2015.
3. Hydraulic Engineering Circular No. 23, Bridge Scour and Stream Instability Countermeasures, 3rd Edition, U.S. Department of Transportation, Federal Highway Administration, 2009.
4. Flood Hazard Report for SCE El Casco Substation, prepared by Wilson Mikami Corporation, March 2008.

V. FIGURES

VICINITY MAP

VI. APPENDICES

APPENDIX A
Rip-Rap Sizing Calculations

HEC-23 RIP RAP STONE SIZE EQUATION:

$$d_{50} = \frac{0.692 \times (V_{des})^2}{(Sg - 1) \times 2g} \qquad V_{des} = K_1 \times K_2 \times V_{ave}$$

TOWER: **6N23**

	Output
	Input

d_{50}=	2.02	Particle size for which 50% is finer by weight (ft)
V_{ave}=	11.74	Average velocity (See hydraulic calculations)
V_{des}=	17.61	Design velocity at the pier (ft/s)
Sg=	2.65	Specific gravity of riprap (taken as 2.65)
g=	32.2	Acceleration of gravity (32.2 ft/s^2)
K1=	1.5	Shape factor equal to 1.5 for round nosed pier
K2=	1.0	Velocity adjustment for location in channel (ranges from 0.9 for pier near bank, to 1.7 for pier located in main current of flow around sharp bend)

RIP RAP CLASS= VII

HEC-23 RIP RAP STONE SIZE EQUATION:

$$d_{50} = \frac{0.692 \times (V_{des})^2}{(Sg - 1) \times 2g} \qquad V_{des} = K_1 \times K_2 \times V_{ave}$$

TOWER: **6S41**

	Output
	Input

d_{50}=	0.58	Particle size for which 50% is finer by weight (ft)
V_{ave}=	6.31	Average velocity (See hydraulic calculations)
V_{des}=	9.46	Design velocity at the pier (ft/s)
Sg=	2.65	Specific gravity of riprap (taken as 2.65)
g=	32.2	Acceleration of gravity (32.2 ft/s^2)
K1=	1.5	Shape factor equal to 1.5 for round nosed pier
K2=	1.0	Velocity adjustment for location in channel (ranges from 0.9 for pier near bank, to 1.7 for pier located in main current of flow around sharp bend)

RIP RAP CLASS= II *

* Upsize to Class **IV** per **Tower Scour Site Visit Memo**, see Appendix F

HEC-23 RIP RAP STONE SIZE EQUATION:

$$d_{50} = \frac{0.692 \times (V_{des})^2}{(Sg - 1) \times 2g} \qquad V_{des} = K_1 \times K_2 \times V_{ave}$$

TOWER: **6X42**

	Output
	Input

d_{50}=	0.58	Particle size for which 50% is finer by weight (ft)
V_{ave}=	6.31	Average velocity (See hydraulic calculations)
V_{des}=	9.46	Design velocity at the pier (ft/s)
Sg=	2.65	Specific gravity of riprap (taken as 2.65)
g=	32.2	Acceleration of gravity (32.2 ft/s^2)
K1=	1.5	Shape factor equal to 1.5 for round nosed pier
K2=	1.0	Velocity adjustment for location in channel (ranges from 0.9 for pier near bank, to 1.7 for pier located in main current of flow around sharp bend)

RIP RAP CLASS= II *

* Upsize to Class **IV** per **Tower Scour Site Visit Memo**, see Appendix F

HEC-23 RIP RAP STONE SIZE EQUATION:

$$d_{50} = \frac{0.692 \times (V_{des})^2}{(Sg - 1) \times 2g} \qquad V_{des} = K_1 \times K_2 \times V_{ave}$$

TOWER: **6X43**

	Output
	Input

d_{50}=	0.58	Particle size for which 50% is finer by weight (ft)
V_{ave}=	6.31	Average velocity (See hydraulic calculations)
V_{des}=	9.46	Design velocity at the pier (ft/s)
Sg=	2.65	Specific gravity of riprap (taken as 2.65)
g=	32.2	Acceleration of gravity (32.2 ft/s^2)
K1=	1.5	Shape factor equal to 1.5 for round nosed pier
K2=	1.0	Velocity adjustment for location in channel (ranges from 0.9 for pier near bank, to 1.7 for pier located in main current of flow around sharp bend)

RIP RAP CLASS= II

HEC-23 RIP RAP STONE SIZE EQUATION:

$$d_{50} = \frac{0.692 \times (V_{des})^2}{(Sg - 1) \times 2g} \qquad V_{des} = K_1 \times K_2 \times V_{ave}$$

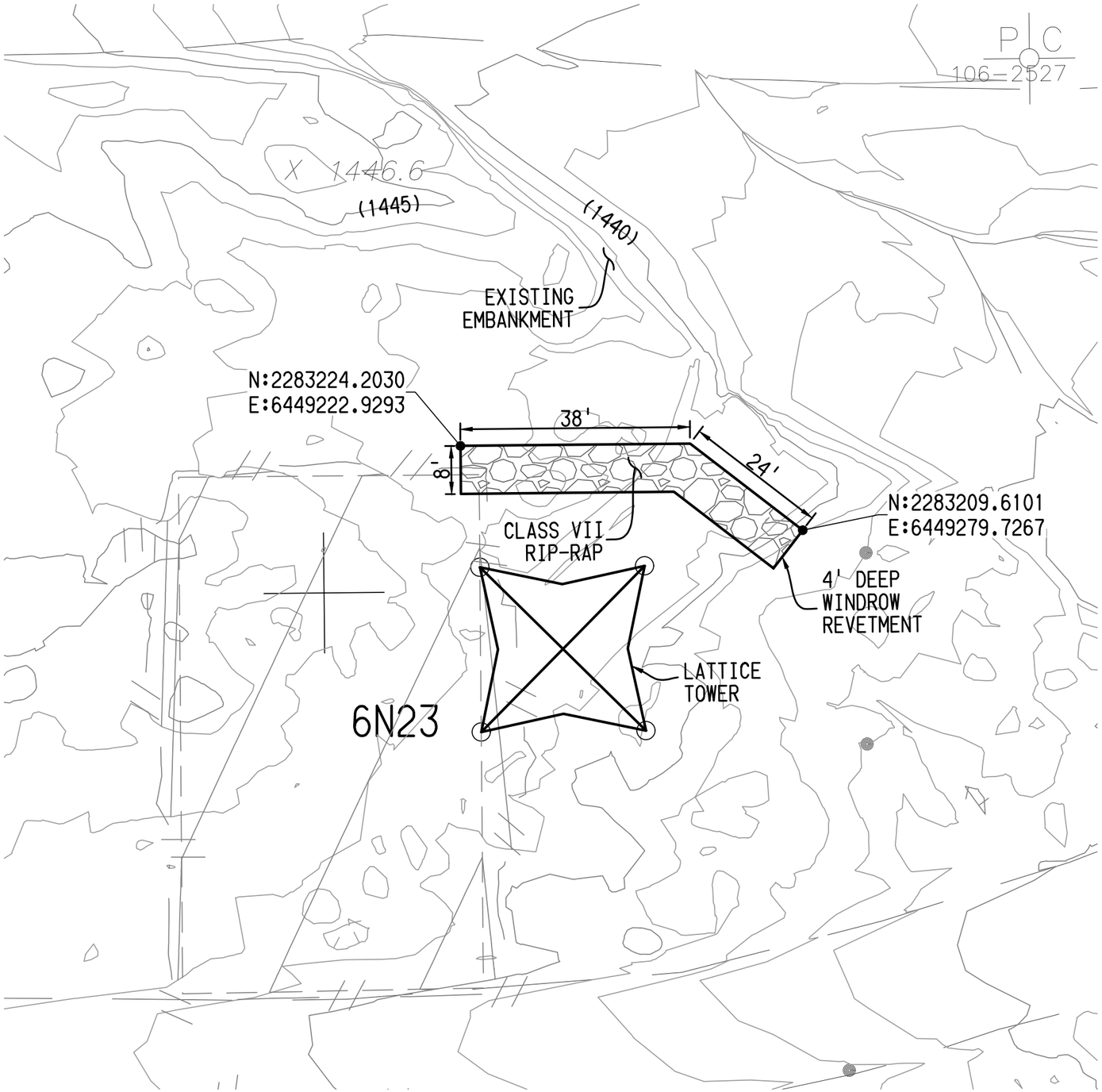
TOWER: **6X44**

	Output
	Input

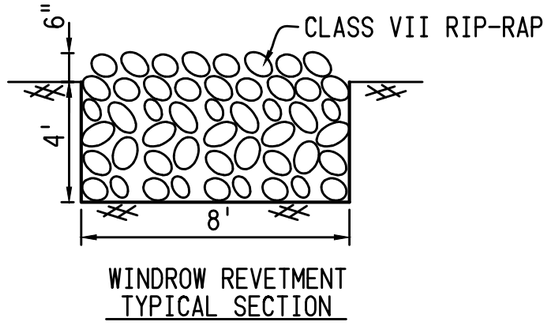
d_{50}=	0.58	Particle size for which 50% is finer by weight (ft)
V_{ave}=	6.31	Average velocity (See hydraulic calculations)
V_{des}=	9.46	Design velocity at the pier (ft/s)
Sg=	2.65	Specific gravity of riprap (taken as 2.65)
g=	32.2	Acceleration of gravity (32.2 ft/s^2)
K1=	1.5	Shape factor equal to 1.5 for round nosed pier
K2=	1.0	Velocity adjustment for location in channel (ranges from 0.9 for pier near bank, to 1.7 for pier located in main current of flow around sharp bend)

RIP RAP CLASS= II

APPENDIX B
Rip-Rap Countermeasure Site Exhibits



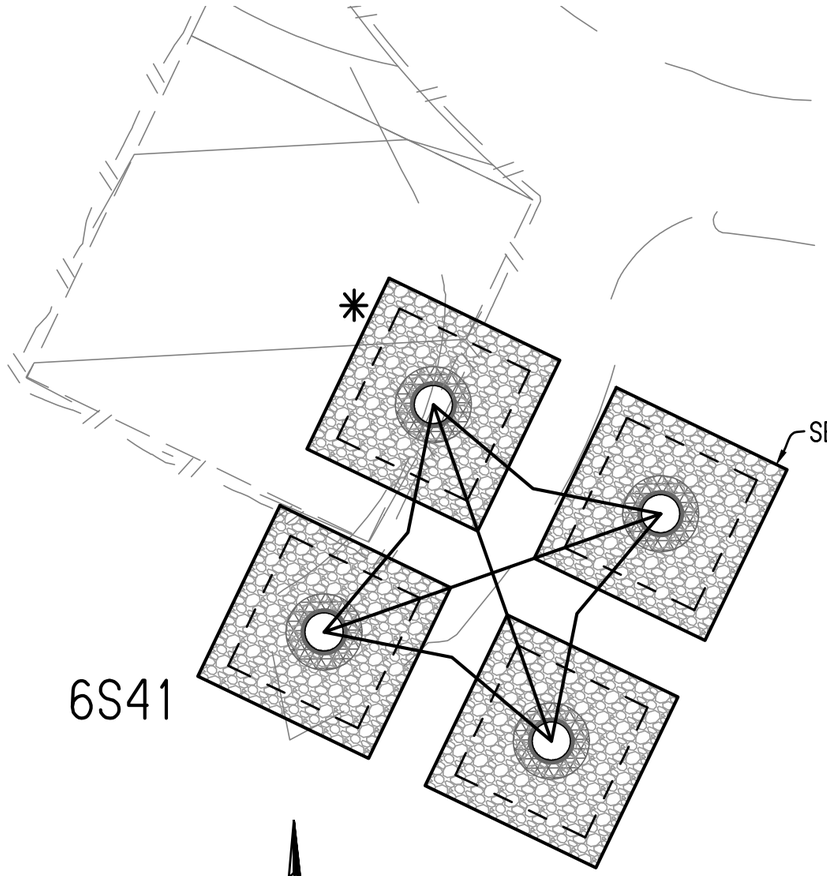
SITE PLAN
SCALE 1"=20'



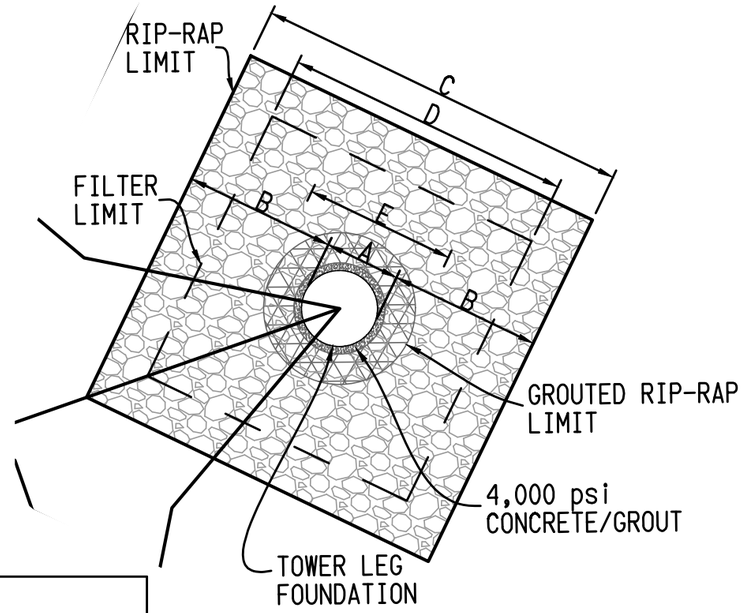
WINDROW REVETMENT
TYPICAL SECTION

6N23

WILSON MIKAMI CORPORATION
9 CORPORATE PARK
SUITE 100
IRVINE, CA 92606
T: 949-679-0090



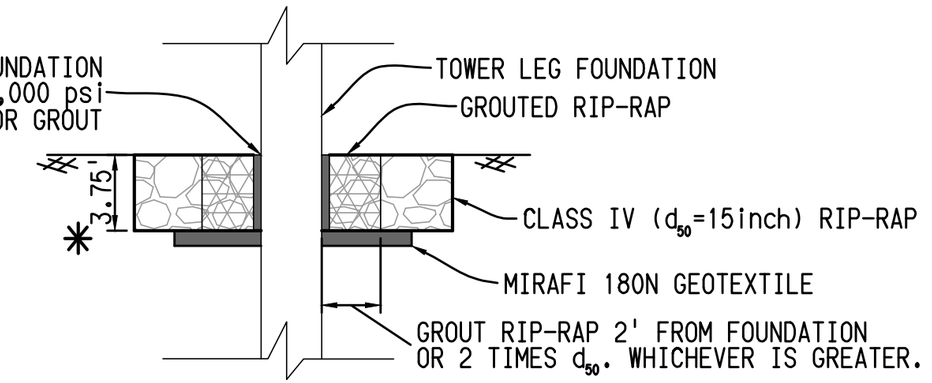
SITE PLAN
SCALE 1"=20'



TYPICAL TOWER LEG
SCALE 1"=10'

DIMENSION TABLE

TOWER #	A	B	C	D	E
6S41	5'	10'	25'	18'	10'

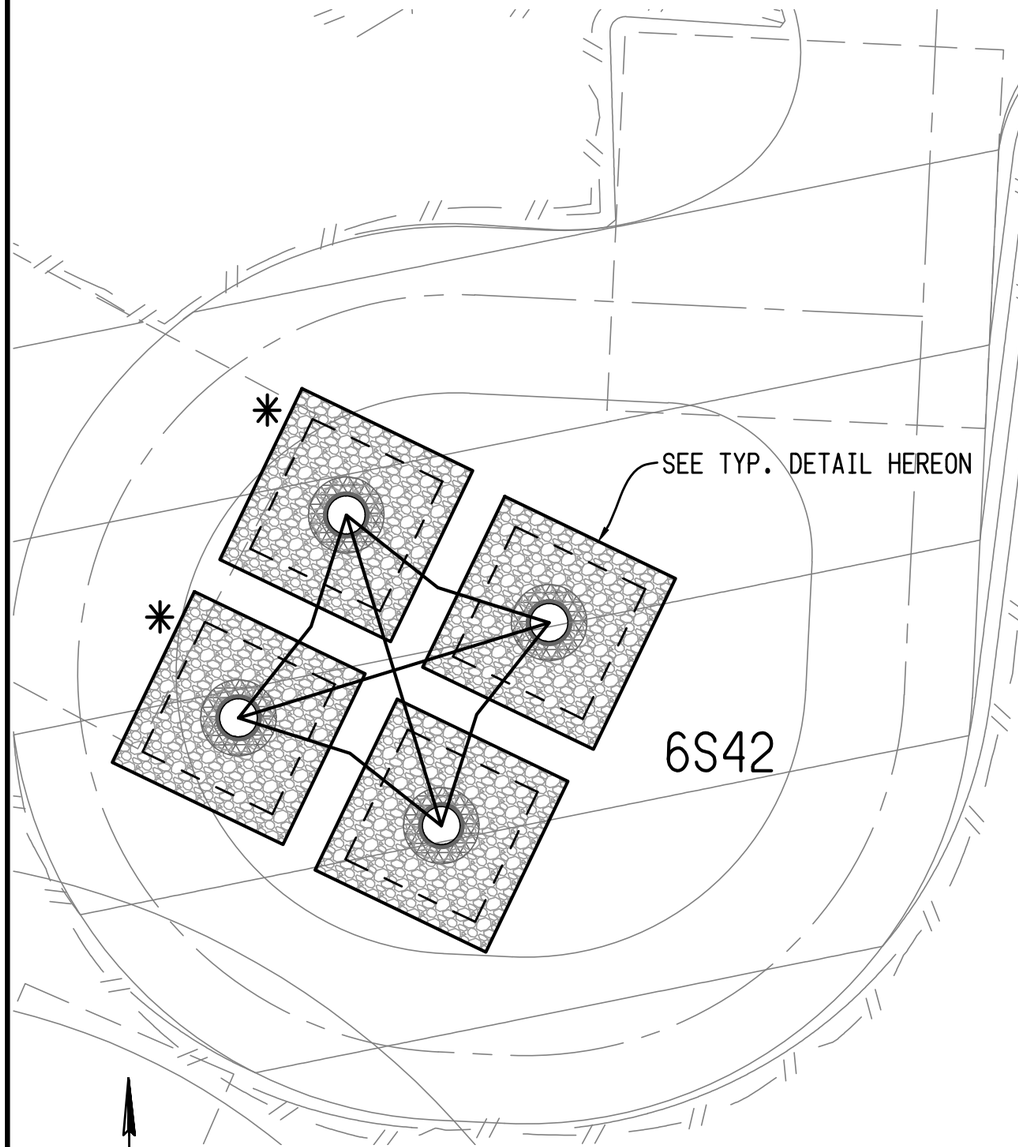


TYPICAL SECTION

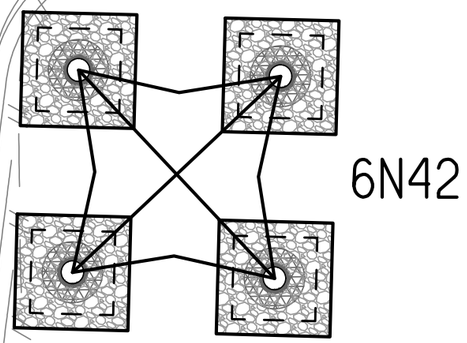
* FOR 6S41 NORTH-WEST TOWER LEG, BURY RIP-RAP WITH 2-FOOT OF COVER TO MAINTAIN ACCESS ACROSS PAD. DEPTH TO BOTTOM OF RIP-RAP EQUAL TO 5.75'.

6S41

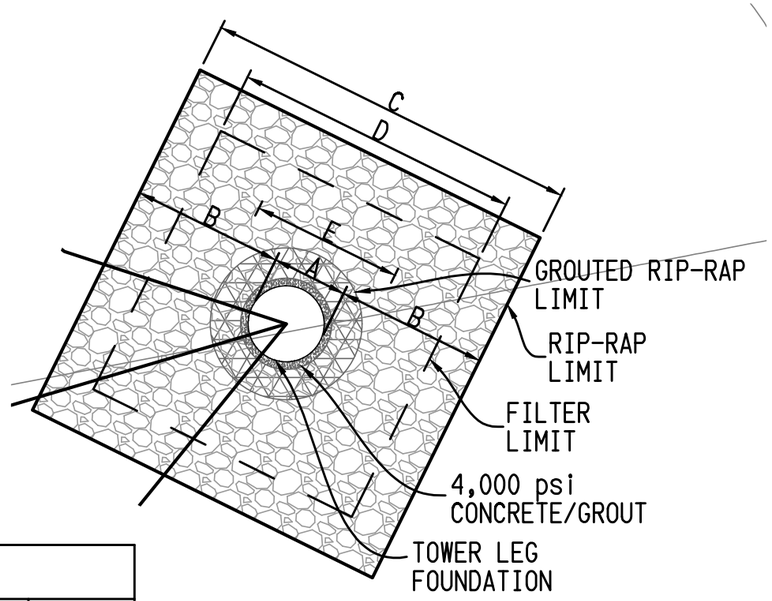
WILSON MIKAMI CORPORATION
9 CORPORATE PARK
SUITE 100
IRVINE, CA 92606
T: 949-679-0090



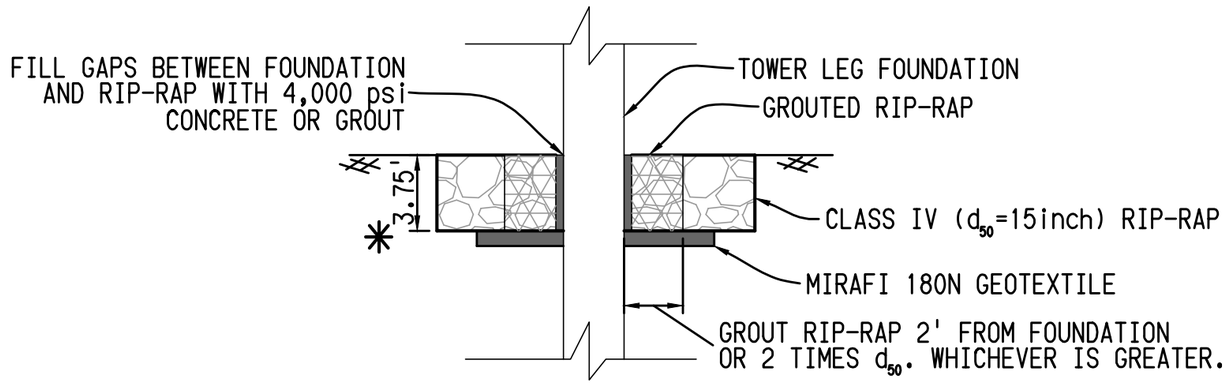
SITE PLAN
SCALE 1"=20'



DIMENSION TABLE					
TOWER #	A	B	C	D	E
6N42	3'	6'	15'	11'	8'
6S42	5'	10'	25'	18'	10'



TYPICAL TOWER LEG
SCALE 1"=10'

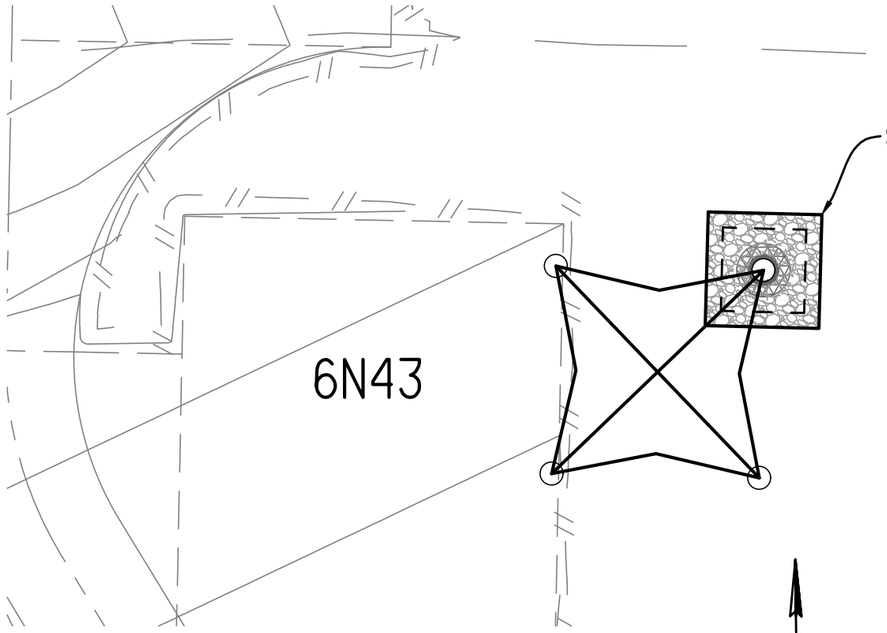


TYPICAL SECTION

* FOR 6S42 NORTH-WEST AND SOUTH-WEST TOWER LEGS, BURY RIP-RAP WITH 2-FOOT OF COVER TO MAINTAIN MOVEMENT ALONG ACCESS ROAD. DEPTH TO BOTTOM OF RIP-RAP EQUAL TO 5.75'.

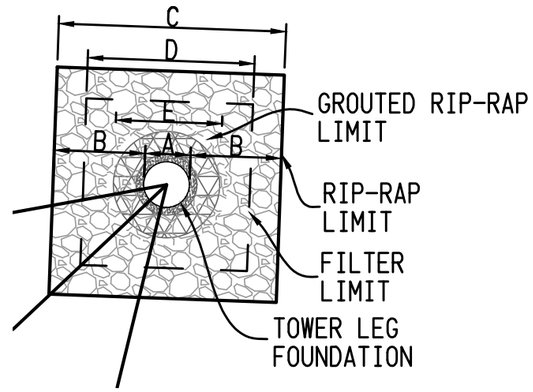
6N42 & 6S42

WILSON MIKAMI CORPORATION
9 CORPORATE PARK
SUITE 100
IRVINE, CA 92606
T: 949-679-0090

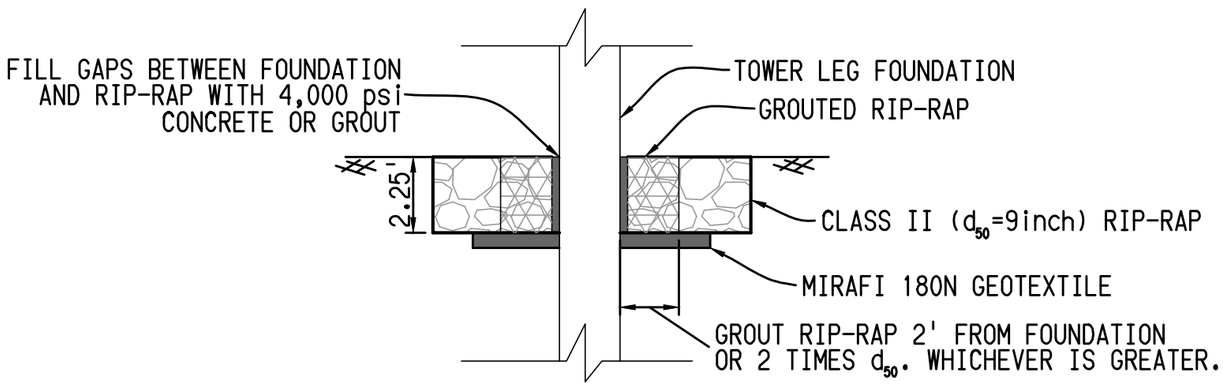


SITE PLAN
SCALE 1"=20'

DIMENSION TABLE					
TOWER #	A	B	C	D	E
6N43	3'	6'	15'	11'	7'



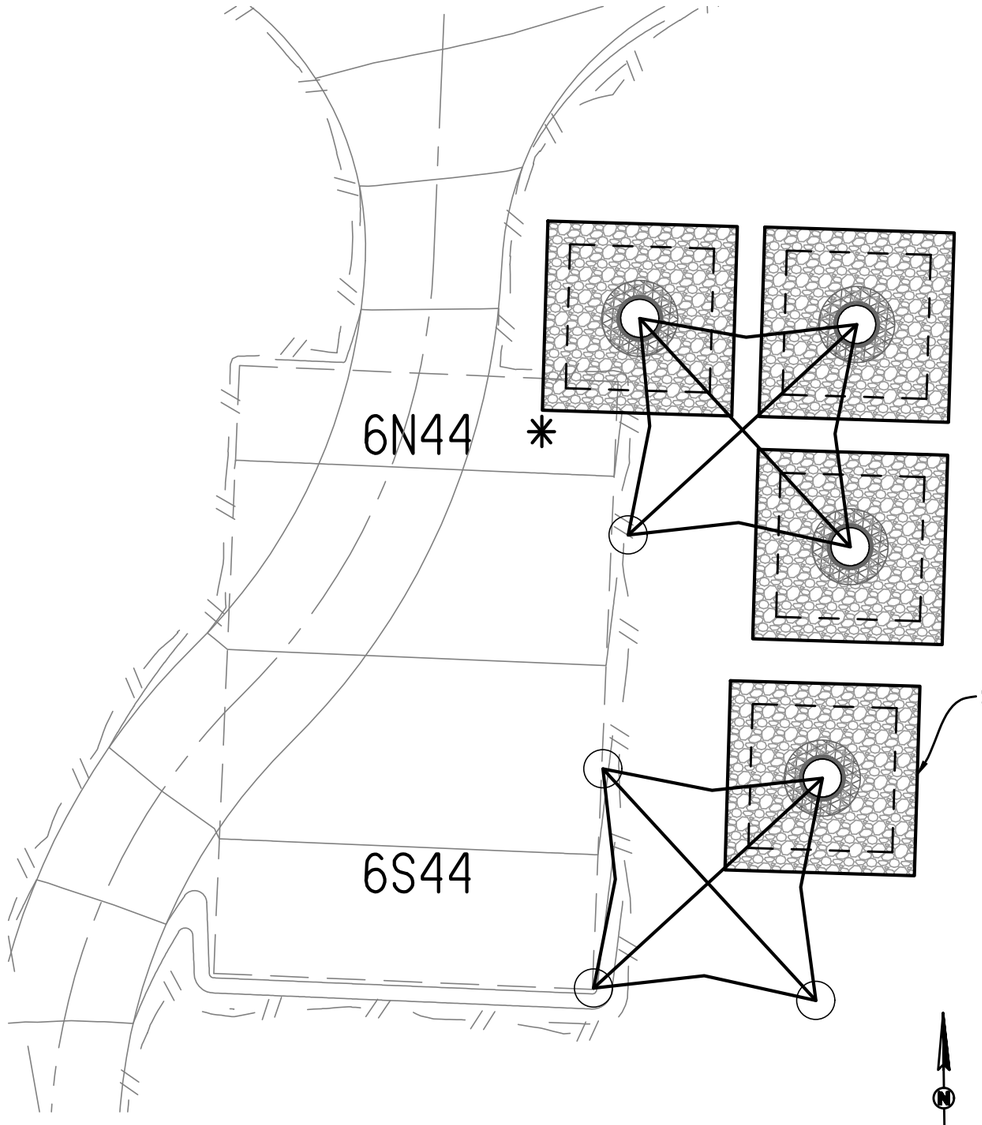
NORTHEASTERLY TOWER LEG
SCALE 1"=10'



TYPICAL SECTION

6N43

WILSON MIKAMI CORPORATION
9 CORPORATE PARK
SUITE 100
IRVINE, CA 92606
T: 949-679-0090



SITE PLAN
SCALE 1"=20'

DIMENSION TABLE					
TOWER #	A	B	C	D	E
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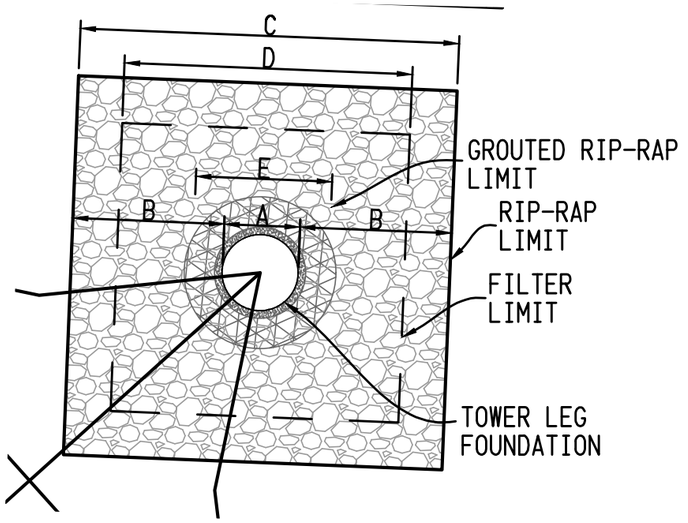
6S44	5'	10'	25'	18'	9'



TYPICAL TOWER LEG
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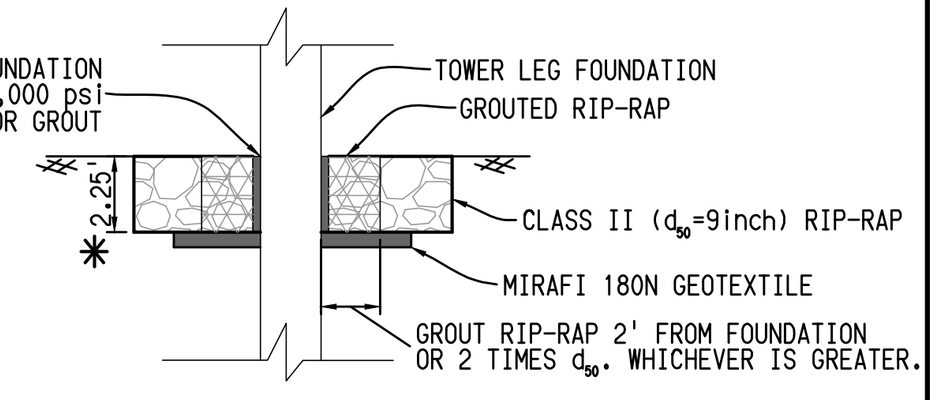

TYPICAL SECTION

* FOR 6N44 NORTH-WEST TOWER LEG, BURY RIP-RAP WITH 2-FOOT OF COVER TO MAINTAIN ACCESS ACROSS PAD. DEPTH TO BOTTOM OF RIP-RAP EQUAL TO 4.25'.

6N44 & 6S44

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4.2.4 Riprap Shape and Gradation

Riprap design methods typically yield a required size of stone that will result in stable performance under the design loadings. Because stone is produced and delivered in a range of sizes and shapes, the required size of stone is often stated in terms of a minimum allowable representative size. For example, the designer may specify a minimum d_{50} or d_{30} for the rock comprising the riprap, thus indicating the size for which 50 or 30% (by weight) of the particles are smaller. Stone sizes can also be specified in terms of weight (e.g., W_{50} or W_{30}) using an accepted relationship between size and volume, and the known (or assumed) density of the particle.

Shape: The shape of a stone can be generally described by designating three axes of measurement: Major, intermediate, and minor, also known as the "A, B, and C" axes, as shown in Figure 4.1.

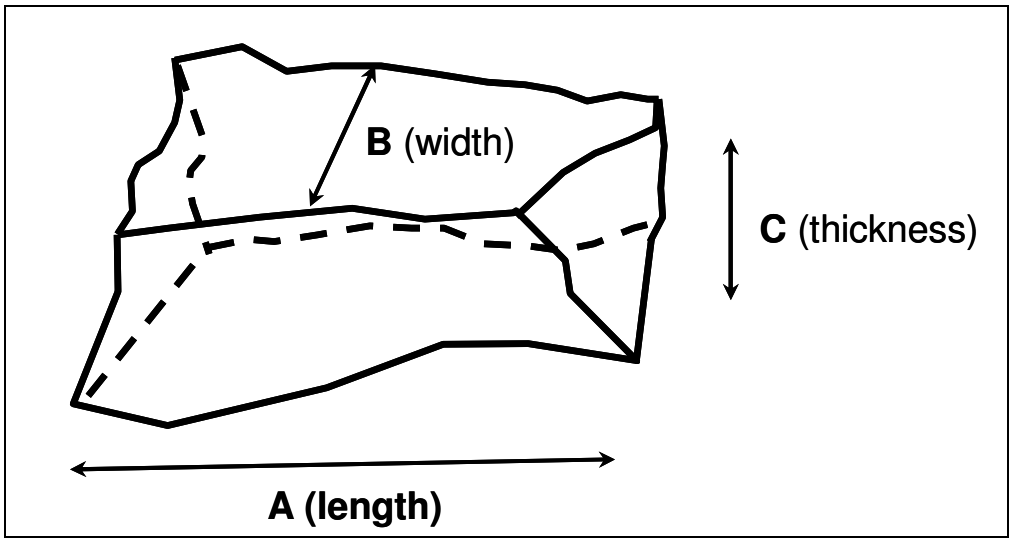

Figure 4.1. Riprap shape described by three axes.

Riprap stones should not be thin and platy, nor should they be long and needle-like. Therefore, specifying a maximum allowable value for the ratio A/C, also known as the shape factor, provides a suitable measure of particle shape, since the B axis is intermediate between the two extremes of length A and thickness C. A maximum allowable value of 3.0 is recommended:

$$\frac{A}{C} \leq 3.0 \qquad (4.3)$$

For riprap applications, stones tending toward subangular to angular are preferred, due to the higher degree of interlocking, hence greater stability, compared to rounded particles of the same weight.

Density: A measure of density of natural rock is the specific gravity S_g, which is the ratio of the density of a single (solid) rock particle γ_s to the density of water γ_w:

$$S_g = \frac{\gamma_s}{\gamma_w} \tag{4.4}$$

Typically, a minimum allowable specific gravity of 2.5 is required for riprap applications. Where quarry sources uniformly produce rock with a specific gravity significantly greater than 2.5 (such as dolomite, S_g = 2.7 to 2.8), the equivalent stone size can be substantially reduced and still achieve the same particle weight gradation.

Size and weight: Based on field studies, the recommended relationship between size and weight is given by:

$$W = 0.85(\gamma_s d^3) \tag{4.5}$$

where:

W = Weight of stone, lb (kg)
γ_s = Density of stone, lb/ft^3 (kg/m^3)
d = Size of intermediate ("B") axis, ft (m)

Table 4.1 provides recommended gradations for ten standard classes of riprap based on the median particle diameter d_{50} as determined by the dimension of the intermediate ("B") axis. These gradations conform to those recommended in NCHRP Report 568 (Lagasse et al. 2006). The proposed gradation criteria are based on a nominal or "target" d_{50} and a uniformity ratio d_{85}/d_{15} that results in riprap that is well graded. The target uniformity ratio d_{85}/d_{15} is 2.0 and the allowable range is from 1.5 to 2.5.

Table 4.1. Minimum and Maximum Allowable Particle Size in Inches.

Nominal Riprap Class by Median Particle Diameter		d_{15}		d_{50}		d_{85}		d_{100}
Class	Size	Min	Max	Min	Max	Min	Max	Max
I	6 in	3.7	5.2	5.7	6.9	7.8	9.2	12.0
II	9 in	5.5	7.8	8.5	10.5	11.5	14.0	18.0
III	12 in	7.3	10.5	11.5	14.0	15.5	18.5	24.0
IV	15 in	9.2	13.0	14.5	17.5	19.5	23.0	30.0
V	18 in	11.0	15.5	17.0	20.5	23.5	27.5	36.0
VI	21 in	13.0	18.5	20.0	24.0	27.5	32.5	42.0
VII	24 in	14.5	21.0	23.0	27.5	31.0	37.0	48.0
VIII	30 in	18.5	26.0	28.5	34.5	39.0	46.0	60.0
IX	36 in	22.0	31.5	34.0	41.5	47.0	55.5	72.0
X	42 in	25.5	36.5	40.0	48.5	54.5	64.5	84.0

Note: Particle size d corresponds to the intermediate ("B") axis of the particle.

Based on Equation 4.5, which assumes the volume of the stone is 85% of a cube, Table 4.2 provides the equivalent particle weights for the same ten classes, using a specific gravity of 2.65 for the particle density.

Table 4.2. Minimum and Maximum Allowable Particle Weight in Pounds.								
Nominal Riprap Class by Median Particle Weight		W_{15}		W_{50}		W_{85}		W_{100}
Class	Weight	Min	Max	Min	Max	Min	Max	Max
I	20 lb	4	12	15	27	39	64	140
II	60 lb	13	39	51	90	130	220	470
III	150 lb	32	93	120	210	310	510	1100
IV	300 lb	62	180	240	420	600	1,000	2,200
V	1/4 ton	110	310	410	720	1,050	1,750	3,800
VI	3/8 ton	170	500	650	1,150	1,650	2,800	6,000
VII	1/2 ton	260	740	950	1,700	2,500	4,100	9,000
VIII	1 ton	500	1,450	1,900	3,300	4,800	8,000	1,7600
IX	2 ton	860	2,500	3,300	5,800	8,300	13,900	30,400
X	3 ton	1,350	4,000	5,200	9,200	13,200	22,000	48,200
Note: Weight limits for each class are estimated from particle size by: $W = 0.85(\gamma_s d^3)$ where d corresponds to the intermediate ("B") axis of the particle, and particle specific gravity is taken as 2.65.								

4.2.5 Recommended Tests for Rock Quality

Standard test methods relating to material type, characteristics, and testing of rock and aggregates typically associated with riprap installations (e.g., filter stone and bedding layers) are provided in this section and are recommended for specifying the quality of the riprap stone. In general, the test methods recommended in this section are intended to ensure that the stone is dense and durable, and will not degrade significantly over time.

Rocks used for riprap should only break with difficulty, have no earthy odor, no closely spaced discontinuities (joints or bedding planes), and should not absorb water easily. Rocks comprised of appreciable amounts of clay, such as shales, mudstones, and claystones, are ***never*** acceptable for use as fill for gabion mattresses. Table 4.3 summarizes the recommended tests and allowable values for rock and aggregate.

4.2.6 Filter Requirements

The importance of the filter component of revetment riprap installation should not be underestimated. Geotextile filters and granular filters may be used in conjunction with riprap bank protection. When using a granular stone filter, the layer should have a minimum thickness of 4 times the d_{50} of the filter stone or 6 inches, whichever is greater. When placing a granular filter under water, its thickness should be increased by 50%.

The filter must retain the coarser particles of the subgrade while remaining permeable enough to allow infiltration and exfiltration to occur freely. It is not necessary to retain all the particle sizes in the subgrade; in fact, it is beneficial to allow the smaller particles to pass through the filter, leaving a coarser substrate behind. Detailed aspects of filter design are presented in Design Guideline 16 of this document.

Some situations call for a composite filter consisting of both a granular layer and a geotextile. The specific characteristics of the base soil determine the need for, and design considerations of the filter layer. ***In cases where dune-type bedforms may be present at the toe of a bank slope protected with riprap, and where adequate toe down extent cannot be ensured, it is strongly recommended that only a geotextile filter be considered.***

APPENDIX E
Cost Estimate

ENGINEER'S ESTIMATE OF COST

ITEM	UNIT	UNIT PRICE	QUANTITY	PRICE
Grading and Excavation (Cut)	Cubic Yard	$200	500	$100,000
Material and Labor Costs				
Rock Rip Rap Class II	Ton	$39.50	460	$18,170
Rock Rip Rap Class IV	Ton	$49.50	1,900	$94,050
Rock Rip Rap Class VII	Ton	$70.00	405	$28,350
Mirafi 180N Geotextile	Square Foot	$2.25	9,000	$20,250
				$260,820
			Contingency 25%	$90,205
			Total	$351,025

APPENDIX F
Tower Scour Site Visit Memo

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Date of Field Visit: April 23, 2019

PROJECT: West of Devers 220 kV Upgrade Project

RE: **Tower Scour Site Visits**
Locations visited: 5X05, 5X19, 5X54, 6X23, 6S32, 6S41, 6X42, 6X43, 6X44, & 6X45

In attendance: Javier Izaguirre, SCE
Scott Richtmyer, SCE
Mark Mikami, WMC

Prepared by: Mark Mikami, WMC

OBSERVATIONS/RECOMMENDATIONS:

Tower Site 5X05: Smaller gullies and washes were noted to be existing, the main gully that is near the 5N05 tower location is being intercepted on the proposed grading plans and directed west of the tower sites. It is recommended that the recommendations in the Scour Countermeasures Report not be implemented; it is recommended that a soil cement berm be added along the southerly edge of the proposed access road and north of the 5N05 tower to prevent a gullying at the tower location.

Tower Site 5X19: Concentrated flows (gullies and washes) are apparent easterly of the tower locations. It did not appear that there was a potential for these concentrated flows to move westerly and to impact the towers. Additionally, the proposed access road on the approved grading plans shows a high point in the road north of the towers that would prevent concentrated flows from impacting the towers. It is recommended that the countermeasures proposed in the Scour Countermeasures Report not be implemented.

Tower Site 5X54: No gullies or washes were observed at the anticipated tower locations. Gullies were observed east and west of the tower site but no incising was observed. Scott Richtmyer did want to confirm that the southerly existing slope to the San Gorgonio River was reviewed for slope stability. It is recommended that the countermeasures proposed in the Scour Countermeasures Report not be implemented.

Tower Site 6X23: A wash was observed easterly of the site and in relatively close proximity to Tower 6N23, Tower 6S23 is a large distance away from the wash. It is recommended that the countermeasures proposed or similar countermeasures (buried

riprap(?)) in the Scour Countermeasure Report be implemented for Tower 6N23 only. Countermeasures for Tower 6S23 are not recommended.

Tower Site 6S32: A gully was observed easterly of the Tower site; existing ground grades fall considerably form the west to the east. It is not anticipated that the gully would move to the west (uphill). It is recommended that the countermeasures proposed in the Scour Countermeasures Report not be implemented.

Tower Site 6S41: Indicators of concentrated runoff (gullies and/or wash) was observed at the tower location, loose cobbles and vegetation debris from upstream were observed. The tower appears to be within a large flow area with numerous flow lines. It is recommended that the countermeasures proposed in the Scour Countermeasure Report be upsized 1 or 2 rip rap classes since loose cobbles approximately 6”-10” in size were observed in the vicinity of the proposed tower location.

Tower Site 6X42: Indicators of concentrated runoff (gullies and/or wash) was observed at the tower location, loose cobbles and vegetation debris from upstream were observed. The tower appears to be within a large flow area with numerous flow lines. It is recommended that the countermeasures proposed in the Scour Countermeasure Report be upsized 1 or 2 rip rap classes since loose cobbles approximately 6”-10” in size were observed in the vicinity of the proposed tower location. Additionally, a washout of the existing access road (not shown on the existing topo or observed in earlier field walks) was observed northerly of the tower site and an additional wet crossing is recommended.

Tower Site 6X43: A wash was observed easterly of the tower site; due to the proximity of the existing wash it is recommended that the northeasterly tower foundation of Tower 6N43 implement the countermeasures proposed in the Scour Countermeasures Report. It is recommended that the countermeasures proposed in the Scour Countermeasures Report not be implemented for the northwesterly, southwesterly, and southeasterly foundations. Additionally, it is recommended that the countermeasures proposed in the Scour Countermeasures Report not be implemented for Tower 6S43.

Tower Site 6X44: A gully was observed bisecting the proposed location for Tower 6N44, additionally a gully was observed to the east of the tower site. It is recommended that the northwesterly, northeasterly, and southeasterly tower foundation of Tower 6N44 implement the countermeasures proposed in the Scour Countermeasures Report. Additionally, it is recommended that the countermeasures recommended be implemented for the northeasterly foundation of Tower 6S44. It is recommended that the countermeasures proposed in the Scour Countermeasures Report not be implemented for the southwesterly foundation of Tower 6N44 and the northwesterly, southwesterly and southeasterly foundation of Tower 6S44.

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Tower Sire 6X45: A gully was observed westerly of the tower site but no tributary was observed upstream. It appears that the headwater of the gully is adjacent to Tower 6N45, just south of the existing access road. It is recommended that the countermeasures proposed in the Scour Countermeasures Report not be implemented.